Applied Demography Series 2

Nazrul Hoque
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Opportunities and Challenges for Applied Demography in the 21st Century

Springer

Opportunities and Challenges for Applied Demography in the 21st Century

Applied Demography Series

Volume 2

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ISBN 978-94-007-2296-5 e-ISBN 978-94-007-2297-2
DOI 10.1007/978-94-007-2297-2
Springer Dordrecht Heidelberg London New York

Library of Congress Control Number: 2011944023

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Acknowledgements

This work is the product of the 2nd Applied Demography Conference which was held in San Antonio, Texas from January 10-12, 2010. We would like to express our appreciation to a number of organizations and persons who made this work possible.

We would like thank Dr. Lloyd Potter, Director of the Institute for Demographic and Socioeconomic Research and former chair of the Department of Demography and Organization Studies at The University of Texas at San Antonio for sponsoring the conference and also for providing financial support for this book. We would like to thank all those who agreed to organize and/or chair a session and those who participated and or attended the conference. We would also like thank those who provided peer reviews and comments for the authors in regard to the chapters in this volume.

We sincerely appreciate the support of McKibben Demographics for sponsoring the welcoming reception for the conference. We also appreciate the contributions of Patricia Bramwell, Lisa Espinoza, Beverly Pecottee, Jeffrey Jordan and Eric Quiroz who helped with conference and also with the book. We owe special thanks to Karen White who helped us as a technical editor for the book. We especially appreciate the support of Evelien Bakker, the senior editor of the Springer publications, and her staff, as well as the staff at production office, particularly Ms. Juno Martina George.

Contents

Chapter 1
Introduction

Nazrul Hoque and David A. Swanson

As was documented in the proceedings from the 2007 applied demography conference (Murdock and Swanson 2008), we see in this current edition that the field of applied demography continues to evolve as its stakeholders become involved in the emerging trends of the twenty-first century. One of the obvious areas of evolution is the extension of applied demography beyond the United States. In this volume, there are papers that deal with applied demography in Australia, Canada, Estonia, and Mexico.

This volume contains selected papers from the second post-2000 national conference on Applied Demography, which was held in San Antonio, Texas, on January 10–12, 2010, under the sponsorship of the Institute for Demographic and Socioeconomic Research at The University of Texas at San Antonio. The conference was attended by more than 120 people, representing a broad range of interests. In addition to a plenary luncheon address by Tom Messenbourg, the Acting Director of the U.S. Census Bureau, the conference featured 20 regular sessions, a poster session, and several panels, with more than 75 presentations.

After the conference was completed, the editors of this volume sent an invitation to authors to submit their works for possible publication. The submissions resulting from this invitation were then sent out for peer-review, and those found to be acceptable are included in this volume.

This volume serves as an important update to the one published in 2008 and, like it, should be of interest to practitioners of applied demography, students, and private

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_1,

and public-sector stakeholders wondering what answers demography can offer in addressing important public and private sector issues.

Following this introduction (Chap. 1), the volume contains 20 additional chapters, spread across five numbered parts. Part I deals with the assembly of data by government agencies, with a focus on issues facing the United States. Part II looks at demographic issues associated with globalization, while Part III is focused on business demography and Part IV on health demography. Part V examines methodological advances in the areas of estimation and projection.

In Part I, there are four papers that deal with the collection and distribution of data by governmental agencies. The first, by Ed Spar (Chap. 2) outlines major challenges he sees facing the collection and distribution of data by federal agencies in the United States. Spar's paper is followed by an overview of the "alternative questionnaire experiment" conducted by the U.S. Census Bureau in preparation for the 2010 census. In this paper (Chap. 3), Sonya Rastogi and Nicholas Jones provide an excellent example of the challenges facing a statistical data collection agency as it attempts to retain data continuity in the face of demographic change. Next, Peter Lobo and Joe Salvo offer us an evaluation of the quality of age data in data found in the American Community Survey's 3 year aggregated estimates (Chap. 4). In closing this part, Karen Woodrow-Lafield gives us many insights in her paper on the development of estimates of the "unauthorized population" in the United States (Chap. 5). Her comments describe some of the challenges facing statistics outlined by Spar in the opening chapter of this part.

Part II is composed of four papers that examine demographic and statistical aspects of globalization. The first is by Richard Verdugo, who adeptly brings together issues of language acquisition, immigration, and social class (Chap. 6). The second is by four doctoral students at the University of North Texas, Kittiwan Junrith, Erika Symonette, Hsiang Hsing Kung, and Sompron Khunwishit (Chap. 7). They consider the social and policy implications of elderly Asian immigrants in the United States. Turning south of the U.S. border, Komanduri Murty and Jehad Yasin use survey data to look at the characteristics of people in Mexico who have African heritage (Chap. 8). Part II concludes with a paper by an international team consisting of Miguel Flores, Mary Zey, Cinthya Caamal, and Nazrul Hoque that looks at the North American Free Trade Agreement, industrial concentration, employment, wages, and international Mexican migration (Chap. 9).

Business demography is the central topic of Part III. Here, there are three papers. The first is an examination of alcohol buying behavior in Australian households by Farhat Yusuf and Julian deMeyrick (Chap. 10), while the second is by Alison Yacyshyn of the University of Alberta, who considers the relationship between demographic cohorts and marketing strategies (Chap. 11). The part concludes with a paper by Don Warren, Mary Zey, and John Garcia on corporate reform and executive backdating of stock options (Chap. 12).

Part IV consists of three papers on health demography. The first is by Luule Sakkeus and Kati Karelson, who examine the health transition in Estonia following its successful separation from the former Soviet Union (Chap. 13). Nazrul Hoque, David Swanson, and Jeff Jordan look at the rural-urban gradient in relation to life expectancy in the United States (Chap. 14), while Somporn Khunwishit and Sudha Arlikatti look at the demographic challenges facing successful disaster management strategies in the United States (Chap. 15). The final paper in Part IV is by Augustine Kposowa and Aikaterini Glyniadaki, who provide an ecological hierarchical analysis of mental health and suicide in the United States (Chap. 16).

Methodological advances are the focus of Part V, which consists of five papers.

The first paper (Chap. 17) is by Eric Larson and Judith Droitcour. It continues themes found in the papers by Spar and Woodrow-Lafield and extends them with a description of a new methodology for estimating the status of immigrants in the United States and an example of its application.

The second paper is by Miguel Flores, Ben Bradshaw, and Nazrul Hoque, who use a regression-based technique to estimate life expectancy at birth in Mexican municipalities (Chap. 18). This paper represents the first time this technique has been used for small areas in Mexico. The next two papers both deal with what is likely to be the future of estimation and projection techniques: microsimulation. The first is by Cameron Griffith, Bryon Long, David Swanson, and Mike Knight (Chap. 19). It details "DOMICILE 1.0," an agent-based simulation model for developing population estimates at the household level. The second is by researchers from Statistics Canada, ric Caron Malenfant, André Lebel, and Laurent Martel, who discuss "Demosim," a microsimulation model now moving to regular use by Statistics Canada for generating population projections (Chap. 20). The fifth and final chapter in Part V is by Joachim Singelmann, Dudley Poston, and Rogelio Saenz, who demonstrate the value of qualitative research and incorporating expert and local knowledge in an applied analysis of poverty (Chap. 21).

Overall, this volume provides a good update of the development of applied demography as the twenty-first century continues to reveal its demographic dimensions. Together with its 2008 companion, this volume adds to the picture of applied demography that is emerging as the field seeks opportunities offered by methodological and substantive advances while it grapples with a range of challenges, including known and pending data collection cutbacks by various national governments. It is clear from many of the papers in this volume that applied demographers are prepared to deal with this looming lacuna. In so doing, they will enhance our understanding of the demographic world that the twenty-first century is serving up.

Reference

Murdock, S., & Swanson, D. A. (2008). *Applied demography in the 21st century*. Dordrecht: Springer.

Part I
The Collection and Distribution of Demographic Data

Chapter 2
Some Challenges Facing Federal Statistics in the United States

Edward J. Spar

On the Positive Side

Are the federal statistical agencies in the United States meeting the needs of their many users? Surveys that are required for policy purposes in health, education, labor, and other areas are being conducted with well tested statistical designs that so far have reasonable margins of error. The decennial census, even with an under and over count meets the needs of the Constitution and thousands of federal, state, and local data users. Measures, including labor force data, gross domestic product, the system of national accounts, health, education, and income estimates are excellently covered by the federal statistical agencies. Estimates of the population are reasonable even in situations where high immigration and/or internal migration, which have disproportionate influence, take place. The agencies are very sensitive of the need to maintain the confidentiality of respondents. Based on the above, it sounds as if the federal statistical system in the United States is healthy and on track; yet what about the future?

The Need for Innovation

Many new problems are facing the statistical agencies in the United States, and it will take an enormous effort to solve them. Indeed, the agencies are fully aware and understand that there is a need for innovative thinking. An example of the type of innovation that has already taken place is the U.S. Census Bureau's American Community Survey. This is a replacement for the decennial census long form, and as an ongoing annual survey of about three million housing units, is unique. The ability

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_2,

to have data available every year for national, state, and local geographies is an important step for a dynamic country such as the United States. Another innovative set of data is the U.S. Census Bureau's Longitudinal Employer-Household Dynamic (LEHD). Using a mathematical model to insure non-disclosure, data are available at local geographic levels. One issue that will have to be resolved is measuring the accuracy of the modeled data when compared to the original records while at the same time maintaining confidentiality. In other words, although we know the model does protect individuals, we don't know how well it portrays real data.

Response Rates

A critical issue that is being closely monitored is the declining response rates in key federal surveys that measure, for example, employment, income, consumer expenditures, health, and education. Surveys that were achieving rates in the middle to high 90-percent range are now attaining response rates well below that. Clearly, the continuing decline in response will have serious effects on the usefulness of data collected. Either the statistical error will become so high so as to make the estimates of limited value, or, perhaps even worse, with biases due to non-response, the data may lose most of its value. Clearly the statistical agencies are aware of the problem and much research is being conducted to determine, for example, if address-listing techniques can be of use in conjunction with telephone interviewing. Some work has been accomplished in the areas of non-response bias, yet much more is required. The issue of conducting telephone surveys, given the elimination of "land-lines" due primarily to the increasing use of cell phones, must be addressed. A combination of telephone, address lists, and administrative records data will have to be found that will enable agencies to maintain the response rates that the Office of Management and Budget has requested.

To perhaps overstate the case, the days of taking censuses and surveys may soon be coming to an end. We may be at the crossroads of relying on administrative records. Using administrative records data brings up issues of confidentiality on the part of agencies and the sensitivity to the privacy needs of the public. Yet these data may have to become the basis for measuring health, education, employment, expenditure, transportation, and energy use, and to meet many more statistical needs on the part of the federal government. Using administrative data will call for public/private sector coordinated analyses and the allocation of talent and research dollars. If the use of administrative data becomes the norm, it is not too outré to see a time when no data will be real – put another way, to protect identities, the data will be modeled-based estimates.

Data Integration

The data retrieval world has been transformed by the world-wide-web. The concept of charging for governmental data is no longer realistic given the data user's assumption that all data on-line should be free. Also, search engines such as Google have enabled users to retrieve diverse information as an integrated "package." However, data integration across federal statistical agencies is for the most part limited. For example, there is no way to analyze and reconcile the many different measures of income between and sometimes even within an agency. Each agency creates its own web site and its own data dissemination system with little or no regard for the fact that the user has to go to over a dozen sites and learn a dozen approaches to data retrieval to get a complete review of the socio-economic data of the United States. Indeed, if the user wants to integrate the data, it's much easier, but more expensive, to go to a private sector vendor to do the work for you. At a time when the web is there for the specific purpose to retrieve information easily, freely, and comprehensively, this approach is outdated. The time has come for an integration of data processing and retrieval systems. This should be accomplished even though the structure of the federal statistical system in the United States is highly decentralized.

Centralization of the Federal Statistical System

The concept of a single system in the case of the United States, and probably most countries, is misleading. In reality what you have is a confederation of agencies reporting to different jurisdictions that are quite independent of each other. In the United States, there is very limited administrative record data sharing, and with separate Internet sites as mentioned above, little integration of tabulated data sets. Each agency has its own budget, and except for the purchasing of surveys from the U.S. Census Bureau, little in the way of financial interaction. This lack of centralization impacts the agencies' influence with Congress and the funding for their programs. (The lack of centralization is not the case during the decennial census cycle where the apportionment of Congressional seats can impact a Member of the House of Representatives. Other data series such as employment and inflation are also closely reviewed.) Would a centralized single agency help solve this problem? Put another way, would an agency large enough to be noticed by Congress and the Administration as being critical to the overall health of the nation have a better opportunity of receiving the needed resources to implement innovative statistical techniques?

Local Area Data

Assuming that the statistical accuracy of the American Community Survey is reasonable for small areas of geography for data such as income, education, and employment, these data will significantly enhance the ability to measure the affects of policies and social change. Yet there are many data series where much more local information is needed. For example, users of the National Criminal Victimization Survey conducted by the Bureau of Justice Statistics have overwhelmingly stated the need for state and even county information. Similar requests for local education and health data have also been voiced. Most surveys from statistical agencies such as the National Center for Health Statistics and the National Center for Education Statistics produce data at the national level, which makes sense for national policy needs. To serve the needs of states and local communities however, national data does little good. The statistical agencies surely understand local needs, and this lack of local information is not based upon any lack of desire on the part of the agencies to produce it. Rather, we are back to the issue of influence and the need for resources.

Staffing the Agencies

Over the next few years, much of the senior staffs of statistical agencies will be of retirement age. At the same time, it is difficult for agencies to hire new personnel and hold on to talented statisticians and economists who have entered the federal statistical system. The private sector offers both higher salaries and the opportunity to diversify. Indeed, the problem of "stove-piping" within statistical agencies, where talented people are expected to stay in one place for an overly extended period of time, is counter-productive. There is a need to develop a system whereby people can move not only within an agency, but also across agencies. Such a system of diverse training will be required so that personnel can develop the skills needed to address the concerns that have been mentioned in this review.

Conclusion

The challenges reviewed above are only the beginning. To properly measure the effects of the current and probably future economic crises in the United States, timely and relevant data are needed for those who have to make informed decisions affecting all Americans. Data from statistical agencies will have to be more timely, and in more detail at local levels of geography. The agencies will need the support of Congress to affect these changes. A big question looms: where are those in Congress who truly understand the needs of the federal statistical system? Do they still exist?

Chapter 3
Overview of the 2010 Census Alternative Questionnaire Experiment: Race and Hispanic Origin Research

Sonya Rastogi and Nicholas A. Jones

Introduction

The U.S. Census Bureau is committed to improving the accuracy and reliability of census results by expanding our understanding of how people self-identify their race and Hispanic origin. This commitment is reflected in numerous past Census Bureau studies that have been conducted on race and Hispanic origin reporting. The 2010 Census Race and Hispanic Origin Alternative Questionnaire Experiment (AQE) continues this long tradition.

The AQE focuses on improving the race and Hispanic origin questions by testing a number of different questionnaire design strategies in a decennial environment. The primary research objectives are to design and test questionnaire strategies that will increase reporting in the U.S. Office of Management and Budget (OMB) race and ethnic categories, elicit reporting of detailed race and ethnic groups, lower item non-response, and increase accuracy and reliability.[1]

The first and primary component of the AQE is mailout/mailback questionnaires focusing on three areas of research. The first research area includes several features: (1) testing the use of modified examples in the race and Hispanic origin questions; (2) testing the removal of the term "Negro" from the "Black, African Am., or Negro" checkbox response category; and (3) testing the use of a modified Hispanic origin question instruction that permits multiple responses. The second research area focuses on several exploratory approaches to combining the race and Hispanic

[1] U.S. federal government agencies must adhere to the 1997 Standards for the Classification of Federal Data on Race and Ethnicity, issued by the U.S. Office of Management and Budget. The standards are available online at <www.whitehouse.gov/omb/fedreg/1997standards.html>.

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_3, © Springer Science+Business Media B.V. 2012

origin questions into one item. The third research area focuses on (1) ways to clarify that the detailed Asian checkbox categories and the detailed Native Hawaiian and Other Pacific Islander checkbox categories are part of the two broader OMB race groups; and (2) ways to limit the use of the term "race" in the race question. Additionally, two features from the first research area, testing the removal of the term "Negro" and testing modified examples in the race question, are also tested in this research area.

The second component of the AQE is a telephone reinterview study conducted with a sample of AQE mail respondents. This research assesses the accuracy and the reliability of both the control and the alternative race and Hispanic origin questionnaires by exploring responses to a number of probing questions.

The third component of the AQE is a series of focus groups conducted to complement the quantitative analyses. The focus groups seek to identify the source of response issues that emerged from the AQE questionnaires, as well as to identify trends in race and Hispanic origin reporting, giving us a better understanding of response patterns. The results from the paper treatments, the reinterview, and the focus groups will be assessed to determine successful strategies to move forward with during the 2020 Census research program.

Paper Questionnaire Design Strategies[2]

Research Area 1

The first research area has three elements: testing the use of modified examples for the race and Hispanic origin questions, testing the removal of the term "Negro" from the "Black, African Am., or Negro" checkbox response category, and testing the use of an instruction allowing for multiple responses to the Hispanic origin question (see Appendix, Research Area 1).

Modified Examples

One goal of the first research area is to evaluate whether the addition of examples for 'White' and 'Black, African Am., or Negro' help clarify these response categories, thereby increasing reporting in OMB categories and reducing misreporting in the 'Some Other Race' category (Humes 2009). OMB defines 'White' as a person having origins in any of the original peoples of Europe, the Middle East, or North Africa (OMB 1997). Evidence from Census 2000 suggests that the inclusion of Middle Eastern and North African groups in the 'White' category may not be obvious to many

[2] For a detailed discussion regarding the development and rationale of the mailout/mailback questionnaires, please see Karen Humes' paper entitled "2010 Census Alternative Questionnaire Experiment: Race and Hispanic Origin Treatments."

respondents, resulting in increased reporting in the ‘Some Other Race’ category (Humes 2009). Therefore, this research area tests the strategy of adding the examples ‘German, Irish, Lebanese, Egyptian’ to ‘White’ to elucidate the response category.

Examples are also added to the ‘Black, African Am., and Negro’ response category, which OMB defines as a person having origins in any of the Black racial groups of Africa. OMB also states that terms such as ‘Haitian’ or ‘Negro’ can be used in addition to ‘Black or African American.’ The example “African American” is being evaluated due to the unique experience of American Blacks in the United States. The majority of Blacks in the United States have ancestors who experienced forced migration mainly from West African countries and the institution of slavery, a historical legacy that makes it difficult to specify a country of origin, relative to other groups who have come to the United States voluntarily (Jones and Rastogi 2008). Furthermore, the inclusion of the example “African American” with Caribbean and North African examples is expected to help clarify that the “Black, African Am., or Negro” category is meant for both native and foreign-born respondents. There is a segment of the Afro-Caribbean and African population who do not identify with the term “African American,” and therefore, may not report in the “Black, African Am., or Negro” category. Evidence from Census 2000 suggests that many respondents from Black ethnic groups such as Haitian and Kenyan responded by writing their ethnicity in the ‘Some Other Race’ write-in area (Humes 2009). Therefore, the examples ‘African American, Haitian, and Nigerian’ are being evaluated to see if these examples help orient those of Afro-Caribbean and African heritage to the ‘Black, African Am., or Negro’ response category.

This research area also evaluates the use of examples for the ‘American Indian and Alaska Native’ (AIAN) response category. The purpose of adding examples to the AIAN category is two-fold. First, the examples ‘Navajo, Mayan, and Tlingit’ are added to help elicit detailed responses in the AIAN write-in line. Another important purpose of adding AIAN examples is to clarify this response category for indigenous groups from Central and South America. OMB defines an ‘American Indian or Alaska Native’ as a person having origins in any of the original peoples of North and South America (including Central America); and who maintain tribal affiliation or community attachment (OMB 1997). Census 2000 results suggest it may not be clear to respondents that the AIAN category encompasses indigenous Central and South American groups. Therefore, the example ‘Mayan’ has been added to help orient Central and South American indigenous groups to the AIAN category.

The use of modified examples for the ‘Other Asian’ and ‘Other Pacific Islander’ categories is also tested in this research area. The modified examples for the ‘Other Asian’ category are ‘Cambodian, Pakistani, and Mongolian.’ These groups represent the three geographic areas defined in the OMB definition of Asian; the Far East, Southeast Asia, and the Indian subcontinent and are the largest groups from these geographic areas residing in the United States. The modified examples for the ‘Other Pacific Islander’ category are ‘Tongan, Fijian, and Marshallese.’ The addition of ‘Marshallese’ brings balance to the list of examples by representing all three cultural groups, which represent the OMB definition of Native Hawaiian or Other Pacific Islander – Polynesian (Tongan), Melanesian (Fijian), and Micronesian (Marshallese).

This research area also uses modified examples for the “Yes, another Hispanic, Latino, or Spanish origin” category. The examples on the 2010 Census questionnaire for this category are “Argentinean, Colombian, Dominican, Nicaraguan, Salvadoran, and Spaniard.” Using the same selection criteria as for the examples for the race categories, geographic area defined by OMB and population size within the United States, we are evaluating the following modified examples for Hispanic origin: ‘Dominican, Salvadoran, Colombian, and Spaniard.’

Removal of the Term “Negro”

The 1900 Census was the first time the term “Negro” was included in the Census (Bennett 2000). It has been used in many subsequent Censuses, including the 2010 Census questionnaire. However, ethno-racial labels and terminology for the Black community have changed over time and many people no longer identify with the term “Negro” (Sigelman et al. 2005; Lavrakas et al. 1994). Moreover, many Black and non-Black respondents find the term offensive (Fernández et al. 2010). Although, it is believed that some respondents, such as older black southern respondents, still identify with the term. Additionally, in Census 2000, some respondents wrote in the term “Negro” even with the presence of the term in the “Black, African Am. or Negro” checkbox response category. Nevertheless, it is expected that the removal of the term will not have an impact on the level of responses for the “Black or African American” category.

Hispanic Origin Instruction

During the development of the 1997 revised OMB standards, discussions arose regarding the addition of a Hispanic origin instruction allowing multiple responses (Humes 2009). However, the focus of these discussions primarily centered on the race question, where the “Mark one or more races” instruction was added to the 2000 Census. The AQE is the first time we will be testing the allowance of multiple responses for the Hispanic origin question.

Without the instruction to mark multiple responses in the Hispanic origin question, census and survey data indicate that respondents provide two types of multiple responses (Humes 2009). One pattern is that respondents provide mixed responses, checking the “No, not of Hispanic, Latino, or Spanish origin” category and indicating they are of a Hispanic origin such as Mexican. This was the most prevalent multiple Hispanic response type in Census 2000, comprising 70.6% of all multiple Hispanic origin responses (Ramirez 2005). Another type of multiple response is when respondents provide more than one Hispanic origin, for example, Mexican and Salvadoran. The AQE will evaluate mixed and multiple Hispanic origin reporting in the presence of an instruction to “Mark one or more boxes.”

Research Area 2

The second research area primarily focuses on two elements: limiting the use of the term “race” and the use of spanners to help clarify the “Asian” and “Native Hawaiian and Other Pacific Islander” categories (see Appendix, Research Area 2). Additionally, two elements from the first research area are tested in the second research area: the removal of the term “Negro” from the “Black, African Am., or Negro” checkbox response category and testing modified examples for the “Other Asian” category.

Limiting the Use of the Term Race

The term “race” can be a highly politicized word, sometimes evoking strong reactions (Humes 2009). The AQE tests limiting the use of the term by evaluating whether response levels are affected by its removal from the race question stem and the “Other Asian,” “Other Pacific Islander,” and “Some Other Race” example sentences (i.e., Print race). The term “race” is retained in the “Some Other Race” response category due to a mandate from Congress.

“Asian” and “Native Hawaiian and Other Pacific Islander” Spanners

The presence of “Asian” and “Native Hawaiian and Other Pacific Islander” national origin and ethnic checkbox response categories often confuses respondents (Humes 2009). Additionally, there has been concern that categories such as “Chinese” and “Samoan” are presented as if they are separate race groups (Humes 2009). To clarify that the “Asian” and “Native Hawaiian and Other Pacific Islander” checkbox response categories are part of two broader OMB categories, we are testing the use of spanners “Asian” and “Native Hawaiian and Other Pacific Islander” above the checkbox response categories.

Research Area 3

The third research area tests approaches to combining the race and Hispanic origin questions into one item (see Appendix, Research Area 3). While the OMB race classification works well for many respondents, there are other respondents who do not identify with the OMB race categories (Humes 2009). This is particularly true for Hispanic respondents, as illustrated by Census 2000 results. In 2000, 42% of Hispanic respondents were classified as “Some Other Race” alone. Of all respondents who were classified as “Some Other Race” alone, 97% reported being Hispanic to the Hispanic origin question. Moreover, in Census 2000, “Some Other Race” alone was the third largest race group, behind “White” alone and “Black or African American” alone (Humes 2009). As a result of a large and potentially growing

"Some Other Race" alone population, the Census Bureau is testing new approaches to combining the race and Hispanic origin questions into one item.

The AQE tests four different versions of the combined race and Hispanic origin question: the detailed approach, streamlined approach, very streamlined approach, and alternative control approach.

The detailed approach combines the race and Hispanic origin questions into one item, has examples and write-in areas for each OMB group and "Some other race or origin," and retains all of the checkbox groups on the 2010 census form. This version treats all OMB race and ethnic groups similarly by providing examples and write-in areas for each major response category, for which many groups are currently lobbying the Census Bureau and Congress.

The streamlined approach also treats all OMB race and ethnic groups similarly by providing examples and write-in areas for each major response category. This approach removes all national origin checkboxes, which streamlines the combined question. All groups that are national origin checkboxes on the 2010 census form have been added as examples. The expectation is that this will offset any decrease in the reporting of these particular groups.

The very streamlined approach removes all national origin checkboxes. A two question approach is used, with the first question displaying the OMB groups and "Some other race or origin" and the second question eliciting detailed race or ethnic group(s). This design also treats all OMB race and ethnic groups similarly by providing one shared area for all detailed race and ethnic responses.

Our combined question experimental panels represent a huge departure from the 2010 census form. Therefore, a panel is needed to serve as a bridge between the control and the combined question approach. Thus, the alternative control basically combines the Hispanic origin and race questions, leaving the formatting similar to 2010 census control.

Methodology and Sampling for Mailout/Mailback

There are 15 race and Hispanic origin experimental questionnaires that test the research areas discussed above.[3] Additionally, there are two control questionnaires that will be used to evaluate the alternative questionnaire design strategies.[4] The experimental and control questionnaires will be mailed to a national sample

[3] The first and second research areas evaluate potential interaction effects between design strategies by combining different design strategies within form designs. The first research area includes seven form designs and the second research area has four form designs, where strategies are tested separately and in combination with other strategies within each research area.

[4] Many of the experimental designs could not incorporate one of the questions that is on the 2010 census, "Does Person 1 sometimes live or stay somewhere else." Therefore, there are two control questionnaires in this study, one control questionnaire is the exact design of the 2010 census questionnaire, the other control questionnaire is the same as the 2010 census questionnaire except that question mentioned above has been removed.

of housing units of about 30,000 households per questionnaire, for a total of about 500,000 housing units. Information from housing units that respond to the AQE will serve as their official responses for the 2010 census. Initial questionnaire non-respondents will receive a replacement questionnaire that mimics the initial contact questionnaire that they received. Housing units that do not respond to the replacement experimental forms will be dropped from the sample and receive the standard 2010 census questionnaire during the Non-Response Follow-Up operation (NRFU).

Since most of the design changes to the race and Hispanic origin questions are most likely to directly impact various groups within the general population, the sample design for these questionnaires focuses on an oversampling of areas expected to have high proportions of these groups. The sample design is based on an oversampling of census tracts with relatively high proportions of specific race and origin groups. The sample selection includes an oversampling of housing units in three strata: Asian, Native Hawaiian and Other Pacific Islander; Black or African American; and Hispanic or Latino. The remaining tracts represent the "All other" strata, including White, American Indian and Alaska Native, Some Other Race, and multiracial groups (Compton et al. 2010).

Numerous measures will be used to evaluate the mailout/mailback questionnaire results. Among the measures are mail response rates, item-nonresponse rates for the separate Hispanic origin and race questions and the combined question, percent Hispanic, Hispanic checkbox distributions, race distributions, general versus specific reporting for race and Hispanic origin, and results corresponding to treatment specific hypotheses.

Telephone Reinterview

There is also a reinterview component for the AQE, which will be conducted over the telephone with a sample of 2010 AQE mail respondents. This is the first time in the Census Bureau's history that the AQE will incorporate a corresponding reinterview. The reinterview will contact a pre-selected sample of about one-in-five AQE households and will ask a combined race and Hispanic origin question as well as probing questions regarding the racial and ethnic background of respondents. Questions will be asked of the person who filled out the mailout/mailback questionnaire[5] and of one randomly selected person in the household, if there are two or more people in the household. The person who filled out the mailout/mailback form will provide answers for himself/herself and for the randomly selected person in the household.

[5] Several attempts will be made to speak to the person who filled out the mailout/mailback questionnaire. In the event this person cannot be reached, another household member will be interviewed.

The main goal of the reinterview is to compare the distributional findings from the mailout/mailback questionnaires to the reinterview findings to assess reliability and bias of the mailout/mailback questionnaires. Reliability is measured by simple response variance using gross difference rates. Response bias is measured using net difference rates.

There are three primary sections from the AQE reinterview questionnaire that will be used as the standard for assessing reliability and bias. The first section contains two open-ended questions, which ask the respondent "What is your race or origin?" and "Are you any other race or origin?" The second section is a combined race and Hispanic origin question, which asks a series of yes/no questions based on OMB race and ethnic groups and checkbox response categories that are on the 2010 census questionnaire. For example, the second section asks, "Are you White…Are you Black or African American? etc.…" If respondents identify as "Hispanic," "Asian," or "Native Hawaiian and Other Pacific Islander," then they are asked a series of questions to obtain their specific national origin or ethnicity based on the checkbox response categories on the 2010 census questionnaire. Finally, the third section asks what the respondents usually say when asked about their race or origin. Extensive iterative cognitive interviewing and analysis using additional probing questions within the AQE reinterview indicate that responses to these three sections are stable, reliable, and internally consistent. Additional rigorous evaluation will be conducted with the AQE reinterview results prior to making comparisons to the mailout/mailback questionnaires.

Focus Groups

In addition to the mailout/mailback and reinterview components of the 2010 AQE, focus groups will be conducted in 2011 to complement the quantitative analyses. Focus groups will be conducted with various racial and ethnic groups, focusing primarily on OMB racial and ethnic categories. Census Bureau staff will conduct preliminary analyses of the mailout/mailback questionnaires and reinterviews in late 2010. These analyses will help refine focus group moderator guides and probes for each racial and ethnic group. The focus groups will in turn help refine questionnaire design strategies for the 2020 research program.

The primary objectives of the focus groups are to obtain feedback on race and Hispanic origin questionnaire designs and to gain a better understanding of participant racial and ethnic self-identification. Focus group participants will fill out one of the AQE mailout/mailback questionnaires at the beginning of the focus group session. The questionnaire will vary across racial and ethnic groups, depending on which questionnaire is most salient for a particular group. For example, to better understand how American Indians and Alaska Natives react to the addition of American Indian and Alaska Native examples, "Navajo, Mayan, Tlingit," they would fill out a questionnaire that has these examples. When relevant to particular groups, participants will be shown additional AQE questionnaires to discuss and provide feedback. During the remainder of the focus group session, moderator probes will include issues that focus group participants have with the mailout/mailback questionnaires, response issues observed in the AQE mailout/mailback and reinterview components, participant self-identification, and racial and ethnic identification within OMB categories.

One important aspect of the focus group project is that it allows the Census Bureau to conduct important research on groups that may not be well represented in the AQE mailout/mailback and reinterview phases. For example, many American Indian respondents are in the update/enumerate universe, not in mailout/mailback. The focus groups allow us to target these populations to get critical feedback about the AQE questionnaires and racial and ethnic self-identification.

Conclusion

The goal of the 2010 AQE is to assess design strategies for improving race and Hispanic origin reporting as we move forward into the 2020 census content testing. The main objective of the AQE quantitative research is to identify response patterns and measurement error associated with the treatments and, in doing so, identify promising questionnaire strategies. The focus groups, an integral component to this research program, help us identify the source of response issues that emerged from the AQE survey and give us a better understanding of response patterns. This mixed method approach gives us a comprehensive, meaningful, and integrated assessment to help the Census Bureau move forward with during mid-decade testing for the 2020 research program.

Acknowledgments This paper reports the results of research and analysis undertaken by U.S. Census Bureau staff. It has undergone a Census Bureau review more limited in scope than that given to official Census Bureau publications. This report is released to inform interested parties of ongoing research and to encourage discussion of work in progress. We appreciate the assistance and the insightful comments of Karen Humes, Frank Hobbs, and Enrique Lamas.

Appendix: 2010 Census Questionnaire

Research Area 1

Please note: There are seven form designs in this research area. The form design below is an interacted panel representing the design strategies that are being tested in this research area.

➜ NOTE: Please answer Both Question 8 about Hispanic origin and Question 9 about race. For this census, Hispanic origins are not races.

8. Is Person 1 of Hispanic, Latino, or Spanish origin?

☐ **No,** not of Hispanic, Latino, or Spanish origin
☐ Yes, Mexican, Mexican Am., Chicano
☐ Yes, Puerto Rican
☐ Yes, Cuban
☐ Yes, another Hispanic, Latino, or Spanish origin — *Print origin, for example Argentinean, Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on.*

9. What is Person 1's race? *Mark* ☒ *one or more boxes.*

☐ White
☐ Black, African Am., or Negro
☐ American Indian or Alaska Native — *Print name of enrolled or principal tribe*

☐ Asian Indian
☐ Chinese
☐ Filipino
☐ Other Asian — *Print race, for example, Hmong, Laotian, Thai, Pakistani, Cambodian, and so on.*
☐ Japanese
☐ Korean
☐ Vietnamese
☐ Native Hawaiian
☐ Guamanian or Chamorro
☐ Samoan
☐ Other Pacific Islander — *Print, race, for example, Fijian, Tongan, and so on.*

☐ Some other race — *Print below.*

Research Area 2

Please note: There are four form designs in this research area. The form design below is an interacted panel representing the design strategies that are being tested in this research area.

➜ **NOTE: Please answer Both Question 8 about Hispanic origin and Question 9 about race. For this census, Hispanic origins are not races.**

8. Is Person 1 of Hispanic, Latino, or Spanish origin? *Mark ✗ one or more boxes.*

- ☐ **No,** not of Hispanic, Latino, or Spanish origin
- ☐ Yes, Mexican, Mexican Am., Chicano
- ☐ Yes, Puerto Rican
- ☐ Yes, Cuban
- ☐ Yes, another Hispanic, Latino, or Spanish origin — *Print one or more origins, for example Dominican, Salvadoran, Colombian Spaniard, and so on.*

9. What is Person 1's race? *Mark ✗ one or more boxes.*

- ☐ White — *For example, German, Irish, Lebanese, Egyptian, and so on.*
- ☐ Black or African Am. — *For example, African American, Haitian, Nigerian, and so on.*
- ☐ American Indian or Alaska Native — *Print name of enrolled or principal tribe, for example, Navajo, Mayan, Tongit and so on.*

- ☐ Asian Indian
- ☐ Chinese
- ☐ Filipino
- ☐ Other Asian — *Print race, for example, Cambodian, Pakistani, Mongolian, and so on.*
- ☐ Japanese
- ☐ Korean
- ☐ Vietnamese
- ☐ Native Hawaiian
- ☐ Guamanian or Chamorro
- ☐ Samoan
- ☐ Other Pacific Islander — *Print, race, for example, Tongan, Fijian, Marshallese, and so on.*

- ☐ Some other race — *Print race.*

Research Area 3: Detailed Approach

➜ **NOTE: Please answer Both Question 8 and Question 9.**

8. Is Person 1 of Hispanic, Latino, or Spanish origin?

- ☐ **No,** not of Hispanic, Latino, or Spanish origin
- ☐ Yes, Mexican, Mexican Am., Chicano
- ☐ Yes, Puerto Rican
- ☐ Yes, Cuban
- ☐ Yes, another Hispanic, Latino, or Spanish origin — *Print origin, for example Argentinean, Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on.*

9. Is **Person 1...** *Mark ✗ one or more boxes.*

- ☐ White
- ☐ Black or African Am.
- ☐ American Indian or Alaska Native — *Print name of enrolled or principal tribe*

Asian

- ☐ Asian Indian
- ☐ Chinese
- ☐ Filipino
- ☐ Japanese
- ☐ Korean
- ☐ Vietnamese
- ☐ Other Asian — *Print, for example, Cambodian, Hmong, Laotian, Pakistani, Thai, and so on.*

Native Hawaiian and Other Pacific Islander

- ☐ Native Hawaiian
- ☐ Guamanian or Chamorro
- ☐ Samoan
- ☐ Other Pacific Islander — *Print, for example, Fijian, Tongan, and so on.*

- ☐ Some other race — *Print below.*

Research Area 3: Streamlined Approach

8. What is Person 1's race or origin? *Mark ☒ one or more boxes* **AND** *write in the specific race(s) or origin(s).*

☐ White — *Print origin(s), for example, German, Irish, Lebanese, Egyptian, and so on.*

☐ Black, African Am., or Negro — *Print origin(s), for example, African American, Haitian, Nigerian, and so on.*

☐ Mexican, Mexican Am., Chicano ☐ Puerto Rican ☐ Cuban

☐ Other Hispanic, Latino, or Spanish origin — *Print origin(s), for example, Argentinean, Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on.*

☐ American Indian or Alaska Native — *Print name of enrolled or principal tribe(s), for example, Navajo, Mayan, Tlingit, and so on.*

☐ Asian Indian ☐ Chinese ☐ Filipino

☐ Japanese ☐ Korean ☐ Vietnamese

☐ Other Asian — *Print origin(s), for example, Hmong, Laotian, Thai, Pakistani, Cambodian, and so on.*

☐ Native Hawaiian ☐ Guamanian or Chamorro ☐ Samoan

☐ Other Pacific Islander — *Print origin(s), for example, Fijian, Tongan, and so on.*

☐ Some other race or origin — *Print race(s) or origin(s).*

Research Area 3: Very Streamlined Approach

8. What is Person 1's race or origin? *Mark ✗ one or more boxes* **AND** *write in the specific race(s) or origin(s).*

☐ White — *Print origin(s), for example, German, Irish, Lebanese, Egyptian, and so on.*

☐ Black, African Am., or Negro — *Print origin(s), for example, African American, Haitian, Nigerian, and so on.*

☐ Hispanic, Latino, or Spanish origin — *Print origin(s), for example, Mexican, Mexican Am., Puerto Rican, Cuban, Argentinean, Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on.*

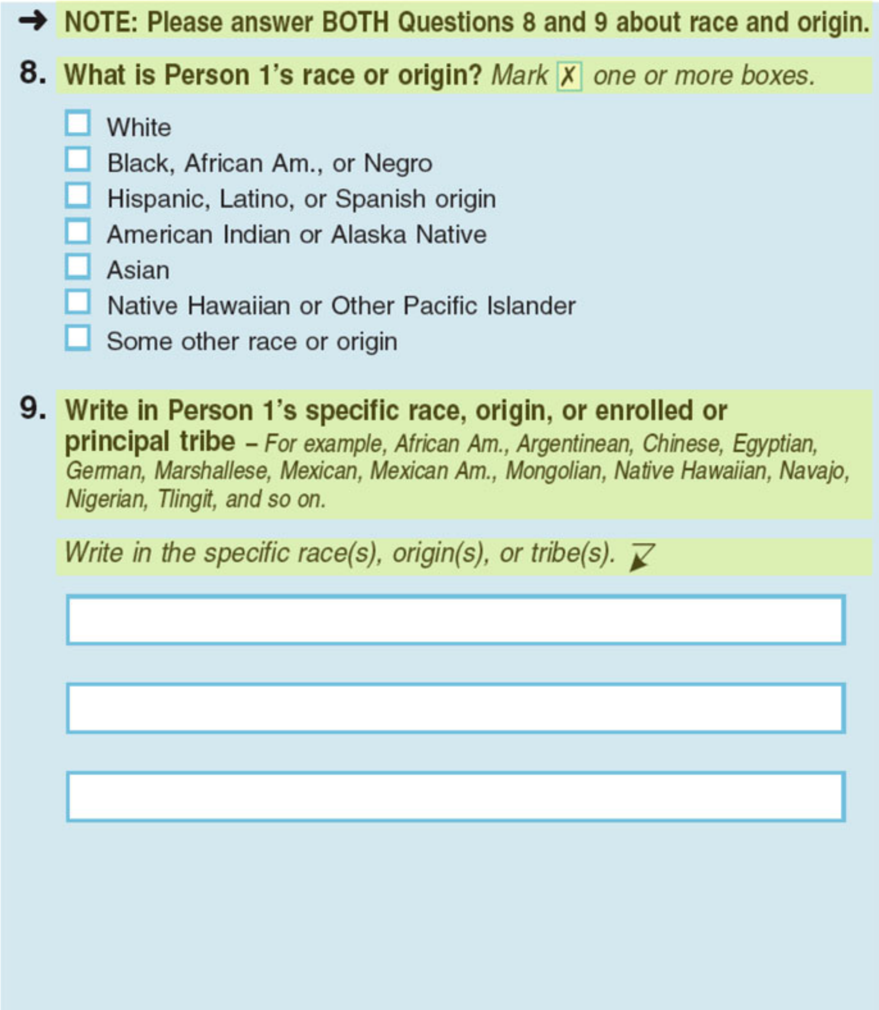
☐ American Indian or Alaska Native — *Print name of enrolled or principal tribe(s), for example, Navajo, Mayan, Tlingit, and so on.*

☐ Asian — *Print origin(s), for example, Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Hmong, Laotian, Thai, Pakistani, Cambodian, and so on.*

☐ Native Hawaiian or Other Pacific Islander — *Print origin(s), for example, Native Hawaiian, Guamanian or Chamorro, Samoan, Fijian, Tongan, and so on.*

☐ Some other race or origin — *Print race(s) or origin(s).*

Research Area 3: Alternative Control Approach


→ NOTE: Please answer BOTH Questions 8 and 9 about race and origin.

8. **What is Person 1's race or origin?** *Mark ☒ one or more boxes.*

- ☐ White
- ☐ Black, African Am., or Negro
- ☐ Hispanic, Latino, or Spanish origin
- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ Some other race or origin

9. **Write in Person 1's specific race, origin, or enrolled or principal tribe** – *For example, African Am., Argentinean, Chinese, Egyptian, German, Marshallese, Mexican, Mexican Am., Mongolian, Native Hawaiian, Navajo, Nigerian, Tlingit, and so on.*

Write in the specific race(s), origin(s), or tribe(s).

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Chapter 4
Quality of Age Data at the PUMA Level in the 3-Year Estimates from the American Community Survey

Arun Peter Lobo and Joseph J. Salvo

Introduction

This paper evaluates the utility of 2005–2007 American Community Survey (ACS) age/sex distributions below the county level, focusing on Bronx, New York. For large counties that comprise multiple Public Use Microdata Areas (PUMAs) – areas with at least 100,000 people – PUMA-level estimates are derived using controls by age/sex, race, and Hispanic origin that are determined at the county level but that are used uniformly across all PUMAs within a county. This process improves sampling variance and helps compensate for nonresponse. An important issue in a county like the Bronx, which is heterogeneous racially, ethnically, and socioeconomically, is whether county controls reflect nonresponse among individual PUMAs and whether the age/sex distributions that are a product of this process are useful at the PUMA level.

Across PUMAs, we find significant differences between ACS age/sex estimates and those derived using a cohort component model. This finding is of concern because ACS age/sex estimates affect analyses of key socioeconomic attributes like income by source, education, and migration, since they are better understood when stratified by age/sex. However, data for various socioeconomic characteristics by broad age groups at the PUMA level proved, for the most part, reliable. But given the significant PUMA differences in age/sex estimates, we conclude that controls below the county level would be helpful in heterogeneous counties, as weighting for nonresponse and other issues would reflect the PUMA itself and not the overall county totals. This formidable challenge needs to be met if the ACS is to be a true replacement for the decennial census long form.

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_4, © Springer Science+Business Media B.V. 2012

Objectives and Data Sources

Much research has focused on the viability of the ACS as the new source of socioeconomic data for the nation (http://www.census.gov/acs/www/AdvMeth/Papers/Papers1.htm). A more limited number of studies have focused on the validity, reliability, and overall usefulness of small area estimates based on data from ACS test counties for small governments, neighborhoods, and census tracts (Salvo et al. 2003, 2004, 2007; Gage 2007; Hough and Swanson 2004; Van Auken et al. 2004). Discussions on age and sex (age/sex) have focused on the Census Bureau's population estimates, which are used as controls for the ACS at the county level, with little attention, thus far, paid to sub-county ACS results. This paper delves deeper into the quality of age/sex data in the ACS by examining the 2005–2007 ACS age/sex estimates for the Bronx and its 10 Public Use Microdata Areas (PUMAs), sub-county areas with a population of at least 100,000.

For large counties, ACS data by PUMA have been a gold mine of information at the sub-county level. PUMA-level estimates are derived using controls by age/sex, race, and Hispanic origin that are determined at the county level but that are used uniformly across all PUMAs within a county. This process improves sampling variance and helps compensate for nonresponse. An important issue in a heterogeneous county is whether county controls reflect nonresponse among individual PUMAs and whether the age/sex distributions that are a product of this process are useful at the PUMA level. This paper's primary objectives are to evaluate the age/sex distribution by PUMA, and examine the reliability of selected socioeconomic variables, again focusing on their age/sex dimension.

Data for these analyses come from three sources: the 2005–2007 ACS, the 2000 decennial census, and local administrative data on births and deaths. In addition, data from the New York City Department of City Planning's ongoing population projections program are used as points of comparison with the 2005–2007 ACS age/sex distributions.

Evaluating Age/Sex Distributions at the PUMA Level

Deriving an Independent Estimate Using a Cohort-Component Model

ACS age/sex estimates by PUMA were first compared to age/sex estimates that were obtained using a cohort-component model. The cohort-component model used fertility and mortality rates from 1999–2001, and the 1990–2000 migration experience, to move the population forward by age/sex from 2000 to 2006, the mid-year comparison point for the 2005–2007 ACS.

There were three distinct stages in the creation of these 2006 cohort-component estimates:

A. Adjusting for population undercount and removing the group quarters population;
B. Creating the baseline – fertility, mortality, and migration rates by age/sex;
C. Calibrating the baseline estimates to the 2005–2007 ACS PUMA population by sex.

Adjusting for Population Undercount and Removing the Group Quarters Population

Reasonable estimates of population change can only be obtained when errors in census coverage are relatively constant from one census time point to the next. Therefore, before assessing change from 1990 to 2000, we had to evaluate census undercount for both time points. Indeed, since the Bronx undercount for 1990 was high (58,000 persons or 4.8%), compared to a negligible number for 2000, reported growth over the period related to migration was likely to be overstated. In order to determine the real contribution of migration, it was necessary to adjust the 1990 population upward to correct for the undercount.[1]

We also followed the common practice of initially removing those in group quarters from the general population and placing them back in after the estimation procedure was completed. Thus, the group quarters population remained the same from 2000 to 2006.

Creating the Baseline

Fertility

So as not to subject births to any 1-year anomaly, we averaged births in 1999, 2000, and 2001 and calculated age-specific rates based on the 2000 population. Birth data were obtained from the New York City Department of Health and Mental Hygiene, while population data by age were from the decennial census.

Mortality

In order to project deaths into the future, we averaged deaths occurring in 1999, 2000, and 2001 to calculate age-specific death rates based on the 2000 population.[2] Data on deaths were obtained from the New York City Department of Health and

[1] The age/sex distribution of the undercounted population in the Bronx was not available. At the national level, undercount rates by age/sex were available through demographic analysis, so we employed this distribution to make adjustments to the Bronx population.

[2] The calculation of age-specific death rates excluded deaths that were a result of the terrorist attacks of September 11, 2001.

Mental Hygiene, while population data by age were from the decennial census. These age-specific death rates were then used as the foundation for a life table that was used to calculate survival rates by age. These rates represent the percentage of persons who are likely to survive over the next 5 years. The cohort-component model used in this analysis actually uses rates that are age- *and* sex-specific. This permitted us to derive estimates by age/sex.

Migration

Age-specific migration rates were calculated by applying survival rates to the 1990 adjusted decennial census household population for 5 year intervals, then subtracting that result from the mid-year estimate (the average population of 1990 and 2000). The difference between the two is the total number of net migrants by age for that 5 year interval. Assume, for example, a 1990 population of 20–24 year olds totaling 5,000 and a mid-decade estimate of 25–29 year olds totaling 5,500. If the population of 20–24 year olds was survived 5 years resulting in a population of 4,900 25–29 year olds in 1995, this would imply a net inflow of 600 from 1990 to 1995. Net migrants were divided by the initial population to create age-specific migration rates for 1990–1995 and 1995–2000, and then averaged to arrive at the rate for the entire decade.

Calibrating Results to the ACS PUMA Population by Sex

Using the baseline rates and the 2000 Census as a launch point, 2005 age/sex estimates were created by PUMA and then extrapolated to 2006[3] (baseline estimates). For 5 out of the 20 *total* PUMA male and female estimates, the ACS and baseline estimates were significantly different. Since our focus was on age/sex groups and not on the total PUMA population, we adjusted PUMA crude migration rates by sex to have the 2006 *total* baseline population for males and females in each PUMA match the 2005–2007 ACS estimates. For example, the baseline male population for PUMA 3701 was 49,623 (Table 4.1), while the ACS estimate was 51,082. After adjusting the crude migration rate, the revised estimates for males by age aggregate to 51,081, close to the ACS total. We chose to adjust migration, as opposed to fertility or mortality, since the latter components are reasonably accurate, and thus migration accounts for most of the difference between the ACS and DCP estimates. By adjusting the crude migration rate, and not selected age-specific migration rates, the baseline pattern of migration is maintained though the level is adjusted. For most PUMAs, the adjusted PUMA age/sex estimates (labeled Department of City Planning or DCP estimates) aggregate almost exactly to the ACS total for the PUMA.

[3] Given that it is extrapolated from 2005, the 2006 projection is identical to an extrapolated projection averaged for 2005–2007, the exact ACS period to which it is being compared.

Table 4.1 Age/sex distributions for Bronx PUMAs: 2000 census, 2005–2007 ACS, and 2006 DCP baseline and DCP estimates

		2000 census		2005–2007 ACS		2006 DCP baseline		2006 DCP estimates	
		Male	Female	Male	Female	Male	Female	Male	Female
BRONX, Total	Total	620,171	712,479	640,981	728,878	624,298	729,483	640,959	728,887
	0–4	55,807	53,925	55,038	53,043	51,667	49,579	51,623*	49,543*
	5–19	167,541	161,250	165,180	159,101	175,849	169,134	181,003*	168,940*
	20–44	236,690	272,441	238,650	266,843	232,057	274,853	238,501	274,463*
	45–64	111,321	139,727	129,007	160,234	117,637	152,796	121,101*	152,715*
	65+	48,812	85,136	53,106	89,657	47,089	83,121	48,732*	83,227*
PUMA 3701	Total	49,357	59,135	51,082	59,128	49,623	60,387	51,081	59,125
	0–4	3,635	3,510	3,567	4,083	3,525	3,384	3,487	3,350*
	5–19	10,452	10,022	11,030	9,881	11,156	10,574	11,495	10,348
	20–44	18,281	21,002	17,966	19,649	17,844	20,962	18,389	20,541
	45–64	10,469	12,876	11,790	14,358	11,127	14,056	11,497	13,740
	65+	6,520	11,725	6,729	11,157	5,972	11,411	6,213	11,145
PUMA 3702	Total	61,420	75,074	67,530	81,975	62,972	79,088	67,529	81,975
	0–4	5,170	4,946	6,906	5,344	4,569	4,329	4,653*	4,408*
	5–19	16,033	15,620	17,468	15,757	18,354	17,816	19,549*	18,403*
	20–44	22,361	28,439	23,389	30,659	21,846	29,185	23,526	30,233
	45–64	12,228	16,374	13,853	20,130	12,776	18,245	13,820	18,956
	65+	5,628	9,695	5,914	10,085	5,426	9,513	5,981	9,975
PUMA 3703	Total	50,632	61,029	51,332	63,289	52,320	63,023	51,330	63,286
	0–4	3,119	3,054	3,106	2,356	2,928	2,816	2,934	2,822
	5–19	10,160	9,446	9,940	10,141	11,536	10,777	11,337*	10,816
	20–44	18,146	20,447	17,227	19,608	17,731	20,016	17,388	20,097
	45–64	11,671	14,914	12,850	16,597	12,984	16,708	12,722	16,778
	65+	7,536	13,168	8,209	14,587	7,141	12,706	6,949*	12,773*
PUMA 3704	Total	56,151	63,809	59,449	66,807	58,907	66,411	59,447	66,805
	0–4	4,147	4,027	4,107	4,017	4,049	3,921	4,061	3,933
	5–19	12,170	11,608	12,875	12,944	13,894	13,286	14,018	13,360
	20–44	21,977	24,021	21,928	23,906	22,639	24,728	22,845	24,869
	45–64	11,015	12,961	13,798	14,659	12,364	14,642	12,485*	14,733
	65+	6,842	11,192	6,741	11,281	5,961	9,834	6,039	9,909*
PUMA 3705	Total	64,948	76,737	70,864	80,615	66,068	79,983	70,862	80,619
	0–4	6,813	6,642	7,425	6,577	6,494	6,346	6,519*	6,372
	5–19	21,334	20,775	23,138	21,789	21,912	21,605	23,548	21,773
	20–44	23,456	29,800	24,812	30,080	23,647	30,998	25,498	31,240
	45–64	9,686	13,099	11,233	15,389	10,204	14,313	11,083	14,441
	65+	3,659	6,421	4,256	6,780	3,810	6,721	4,213	6,793
PUMA 3706	Total	60,965	68,398	59,892	66,025	60,901	70,205	59,884	66,022
	0–4	6,025	5,827	5,112	4,799	5,731	5,475	5,569	5,318
	5–19	16,338	16,058	15,342	15,613	17,131	16,870	16,879*	15,840
	20–44	25,002	28,298	23,706	25,657	24,161	28,755	23,801	27,069
	45–64	10,046	11,839	11,608	13,654	10,557	13,220	10,378*	12,336*
	65+	3,554	6,376	4,124	6,302	3,321	5,884	3,256*	5,459*

(continued)

Table 4.1 (continued)

		2000 census		2005–2007 ACS		2006 DCP baseline		2006 DCP estimates	
		Male	Female	Male	Female	Male	Female	Male	Female
PUMA 3707	Total	62,543	71,347	62,701	69,602	60,507	70,411	62,698	69,603
	0–4	6,952	6,534	6,156	6,006	5,777	5,311	5,744	5,281
	5–19	19,491	19,311	18,673	17,746	19,261	18,979	20,009*	18,758
	20–44	23,911	29,062	22,678	27,308	22,704	28,257	23,600	27,936
	45–64	9,771	12,173	12,141	14,205	10,221	13,411	10,661*	13,243*
	65+	2,418	4,267	3,053	4,337	2,544	4,453	2,683	4,385
PUMA 3708	Total	61,571	70,874	62,993	72,263	62,512	73,358	62,987	72,267
	0–4	6,626	6,396	6,417	6,911	6,175	5,940	6,130	5,897
	5–19	17,912	17,853	17,670	16,208	18,506	18,375	18,672	18,093*
	20–44	23,507	28,206	23,618	28,690	23,320	29,041	23,525	28,618
	45–64	10,271	12,531	11,613	14,159	10,998	13,739	11,106	13,513
	65+	3,255	5,888	3,675	6,295	3,513	6,262	3,554	6,147
PUMA 3709	Total	80,689	94,743	82,903	94,914	80,587	95,387	82,907	94,917
	0–4	7,348	7,013	6,580	7,051	6,899	6,557	6,884	6,541
	5–19	22,611	21,483	20,251	18,861	23,875	22,239	24,549*	22,135*
	20–44	29,835	36,001	33,287	34,616	28,871	35,811	29,774*	35,637
	45–64	15,158	20,007	16,362	22,149	15,308	21,027	15,826	20,915
	65+	5,737	10,239	6,423	12,237	5,634	9,753	5,874	9,688*
PUMA 3710	Total	71,895	71,333	72,235	74,260	69,901	71,230	72,233	74,266
	0–4	5,972	5,976	5,662	5,899	5,521	5,498	5,642	5,618
	5–19	21,040	19,074	18,793	20,161	20,223	18,613	20,946*	19,414
	20–44	30,214	27,165	30,039	26,670	29,294	27,099	30,155	28,222*
	45–64	11,006	12,953	13,759	14,934	11,097	13,434	11,521*	14,059
	65+	3,663	6,165	3,982	6,596	3,766	6,585	3,969	6,952

*Significantly different from the 2005–2007 ACS estimate at the .10 level

Comparing ACS Age/Sex Estimates with Cohort-Component Estimates

The number of persons in the ACS survey is controlled to estimates by age/sex and race/Hispanic origin at the county level. At the PUMA level, however, estimates vary as a function of the survey sample itself and the weighting that is employed to adjust for the limitations of the sample, especially with respect to nonresponse. To evaluate overall ACS population estimates by age/sex at the PUMA level, we compare them to the independently derived DCP estimates. Special attention is given to two age/sex groups: males and females 0–4 and those 65 years of age and over.

Overall

We divided up the population into five age groups for males and females in each of the 10 Bronx PUMAs: 0–4, 5–19, 20–44, 45–64, and 65 and over. Of the 100 age sex

Table 4.2 Comparing 2005–2007 ACS age/sex estimates for Bronx PUMAs to DCP estimates

	Males			Females		
	Mean absolute difference	Mean absolute % difference	PUMAs with a significant difference	Mean absolute difference	Mean absolute % difference	PUMAs with a significant difference
Under 5 years	494	7.9%	2	547	11.0%	2
5–19	1,582	9.6%	6	1,136	7.1%	3
20–44	706	2.7%	1	862	3.3%	1
45–64	791	6.1%	4	803	5.0%	2
65 and over	451	8.1%	2	726	6.9%	4

estimates across the 10 PUMAs, there were 27 significant differences (Table 4.1) between the ACS and DCP estimates.

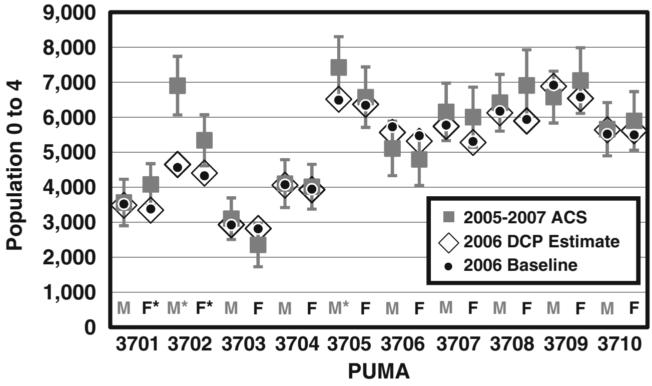
Table 4.2 presents summary statistics – mean absolute differences and mean absolute percent differences – for each age/sex subgroup in the ACS vis-à-vis DCP estimates. For females, the percent difference for 20–44 year olds was smallest, while the differences in estimates for those 0–4 years (11%), and for those 5–19 and 65 and over were the largest (7%). Among males, the smallest percent difference was also among 20–44 year olds, and the highest percent difference (10%) was among those 5–19 years of age. In fact, among males 5–19, 6 out of the 10 PUMAs in the Bronx showed statistically significant differences.

Persons 0 to 4 Years of Age

Figure 4.1 shows the population ages 0–4 by sex from the 2005–2007 ACS estimates, the 2006 baseline estimates, and the 2006 DCP estimates. The baseline and DCP estimates for the 0–4 populations were very similar, so we focus on just the DCP and ACS estimates.

For the 10 PUMAs, there were 20 ACS estimates of the 0–4 population by sex, and 4 estimates were significantly different from the DCP estimates. We focus on these differences and explain why we think the DCP estimates are more accurate. Even when differences between the ACS and DCP estimates were not statistically significant, the ACS sex ratios were substantially different from three other points of comparison: the 2000 Census full count data, sex ratios based purely on births over the 2001–2006 period, and the 2006 DCP estimates. The skewed ACS sex ratios lend greater credence to the DCP age/sex estimates.

In PUMA 3701, the ACS estimate of males 0–4 was virtually identical to the DCP estimate. The ACS estimate for females 0–4, however, was significantly higher, a difference of 18%. This results in an abnormally low sex ratio of 87 for this age group in the ACS. It is likely that females in this PUMA are overestimated in the ACS, since the ACS and DCP estimates for males are nearly identical. The reverse was true in PUMA 3705, where the ACS male estimate was significantly higher (14%) than the DCP estimate, while there was no significant difference among females. Thanks to the higher estimate of males, the sex ratio stood at 113 in the ACS, compared to DCP and census sex ratios of 102.



*Difference between the ACS and DCP estimates is significant at the .10 level.

Sex Ratio	3701	3702	3703	3704	3705	3706	3707	3708	3709	3710
2000 Census	103.6	104.5	102.1	103.0	102.6	103.4	106.4	103.6	104.8	99.9
Jul 01-Jul 06 Births	104.7	103.6	107.0	104.4	104.1	104.1	103.3	103.2	102.3	104.5
2006 DCP	104.1	105.5	104.0	103.2	102.3	104.7	108.8	104.0	105.2	100.4
2005-2007 ACS	87.4	129.2	131.8	102.2	112.9	106.5	102.5	92.9	93.3	96.0

Fig. 4.1 Population 0–4 by sex for Bronx PUMAs: comparing 2005–2007 ACS estimates to DCP estimates

In PUMA 3702, the ACS population 0–4 for both sexes is significantly different from the DCP estimates, the only PUMA where this occurs. The ACS estimate for females was 21% higher than the DCP estimate (5,344 vs. 4,408), while it was 48% higher for males (6,906 vs. 4,653). The exceedingly high ACS estimate for males results in an implausible sex ratio of 129, compared to 106 using DCP estimates, and 105 in 2000. (The DCP estimate for males shows a decline in this population from 2000 – primarily a result of net out-migration of this group – while the ACS shows net inflows,[4] which results in a dramatic one-third increase in this age group, the highest of any PUMA.)

In PUMA 3703, the ACS estimate for males is unchanged from 2000, but the estimate for females is 23% lower; DCP estimates are 6% and 8% lower, respectively. The dramatic decline in females in the ACS leads to a sex ratio of 132, compared to 104 using the DCP estimates, and 102 in 2000. The CV for females in the ACS is a relatively high 16, compared to 12 for males. However, differences between the ACS and DCP estimates were not statistically significant. On the other hand, in PUMAs 3708 and 3709, sex ratios in the ACS were over 11 points lower vis-à-vis DCP, but again there were no significant differences in the population estimates.

[4]We applied our own 5-year survival rates to the 2000 population, then compared the "expected" outcome to the 2005–2007 ACS estimate, interpolated to 2005 (5/6 of change of 2005–2007 value). This gives us net migrants by age and sex for each PUMA.

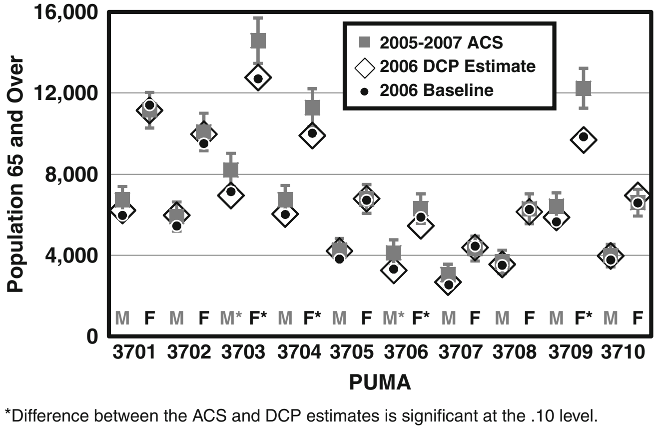


Fig. 4.2 Population 65 and over by sex for Bronx PUMAs: comparing 2005–2007 ACS estimates to DCP estimates

Persons 65 Years and Over

Population projections to 2030 performed by the Population Division of the New York City Department of City Planning show that the aging of large baby boom cohorts, a decline in fertility, and improvements in life expectancy will all contribute to a general aging of the population in the Bronx. However, in the first decade of this century, these projections show that the elderly population in the Bronx will decline slightly, from 133,900 in 2000 to 132,700 in 2010, but then rise to 172,700 in 2030. For Bronx elderly males, the population ages 65 and over stood at over 48,800 in 2000 and the 2005–2007 ACS estimate indicates that this population is increasing 9%, to 53,000, while the DCP projection shows this population virtually unchanged from 2000 (Table 4.1). Among females as well, ACS estimates show a post-2000 increase of 5%, while DCP projections show a 4% decline. Thus the elderly population for the Bronx as a whole in the ACS is significantly different from DCP projections. This is a result of DCP estimates using a net out-migration for this group (−68 per 1,000 for males, −82 per 1,000 for females), which is consistent with the experience of the 1990s, while the ACS estimates a net in-migration for this age group (12.3 for males and 47.8 for females). The overestimation of this age group (along with those 45–64) is partly why the median age in the ACS is 1.5 years higher than the DCP median age of 30.9 years.

Of the 20 PUMA level age/sex ACS estimates for the population 65 and over, 6 were significantly different from DCP estimates (Table 4.2 and Fig. 4.2). The overall Bronx pattern, with DCP estimates projecting a post-2000 decline, and ACS estimates reflecting growth, can be seen in PUMA 3703. As a result, the ACS estimates are significantly higher than DCP projections – by 15% for males and 12% for females. A similar pattern for males is seen in PUMA 3706 – the ACS estimate is 16% higher than the census, compared to an 8% post-2000 decline in the DCP estimate. Among females in PUMA 3706, the ACS is 1% lower than the census, compared to a post-2000 DCP decline of 14%. As a result, the ACS estimates in PUMA 3706 are significantly higher than DCP, for both males and females 65 and over.

In PUMAs 3704 and 3709, the ACS estimates for females 65 and over are also significantly higher than the DCP estimate. In PUMA 3704, the ACS indicates post-2000 growth of less than 1%, compared to a DCP decline of 20%; in PUMA 3709, the ACS shows post-2000 growth of 20%, while DCP shows a decline of 13%.

Assuming that vital statistics data are accurate for these PUMAs, it is instructive to take a look at the migration scenario posited by the ACS and DCP in PUMAs where these estimates differ. With just one exception, DCP has net out-migration in every PUMA for both males and females ages 65 and over (the exception is males in PUMA 3705, who have a minimally positive migration rate). However, the ACS has net gains in this cohort in PUMAs 3701, 3703, 3704, and 3705 for males, and PUMAs 3701, 3703, 3704, 3706, and 3709 for females. Moreover, as noted earlier, when all these values are aggregated, the Bronx net migration patterns for those 65 and over trend positive for the ACS, in direct contrast to the negative DCP rates.

Percent Distributions by Age/Sex

While differences in absolute terms are important, it is equally essential to examine the *relative* share of age/sex groups at the PUMA level. Indeed, the Census Bureau encourages users to focus on percent distributions, as opposed to absolute numbers. In terms of the age structure, it is important to note that the Bronx has, by far, the youngest population of any borough in New York City, which is heavily a function of an influx of young Hispanic immigrants who are replacing the older European and now aging Puerto Rican populations. About 28% of the population of the Bronx is under 18 years of age, compared with 23% for the city overall.

Table 4.3 examines the share by sex for the five broad age groups used in this analysis. For the Bronx overall, the ACS numbers have a small degree of sampling variability, but the comparison with DCP estimates is essentially between controls from the population estimates program at the Census Bureau and the DCP population estimates. For the most part, differences are in the range of one percentage point. Once again, the 5–19 year old males stand out, with a difference of 2.5 percentage points. Thus, the large absolute difference between the estimates, cited earlier, manifests itself in the form of a sizable difference in the percentage in this age group.

In addition to the overall age/sex percent distributions in the Bronx for the ACS and DCP estimates, Table 4.3 also shows the 100 age/sex distributions for its 10 PUMAs. There were significant differences in every PUMA and significant

Table 4.3 Age/sex percent distributions for Bronx PUMAs: 2005–2007 ACS compared to DCP estimates

	Percent 0–4				Percent 5–19				Percent 20–44				Percent 45–64				Percent 65+			
	ACS	DCP	Diff.	Sig.	ACS	DCP	Diff.	Sig.	ACS	DCP	Diff.	Sig.	ACS	DCP	Diff.	Sig.	ACS	DCP	Diff.	Sig.
Males, Total	8.6	8.1	0.5		25.8	28.3	−2.5		37.2	37.3	0.0		20.1	18.9	1.2		8.3	7.5	0.8	
PUMA 3701	7.0	6.8	0.2		21.6	22.5	−0.9		35.2	36.0	−0.8		23.1	22.5	0.6		13.2	12.2	1.0	
PUMA 3702	10.2	6.9	3.3	*	25.9	29.0	−3.2	*	34.6	35.0	−0.3		20.5	20.5	0.0		8.8	8.5	0.2	
PUMA 3703	6.1	5.7	0.3		19.4	22.1	−2.7	*	33.6	33.9	−0.3		25.0	24.8	0.2		16.0	13.5	2.5	*
PUMA 3704	6.9	6.9	0.0		21.7	23.7	−2.1	*	36.9	38.7	−1.8	*	23.2	21.2	2.0	*	11.3	9.5	1.8	*
PUMA 3705	10.5	9.2	1.3	*	32.7	33.3	−0.6		35.0	36.0	−1.0		15.9	15.7	0.2		6.0	5.8	0.2	
PUMA 3706	8.5	9.3	−0.8		25.6	28.2	−2.6	*	39.6	39.7	−0.2		19.4	17.3	2.1	*	6.9	5.4	1.4	*
PUMA 3707	9.8	9.2	0.7		29.8	31.9	−2.1	*	36.2	37.6	−1.5		19.4	17.0	2.4	*	4.9	4.3	0.6	
PUMA 3708	10.2	9.7	0.5		28.1	29.6	−1.6	*	37.5	37.3	0.1		18.4	17.6	0.8		5.8	5.6	0.2	
PUMA 3709	7.9	8.3	−0.4		24.4	29.7	−5.2	*	40.2	36.0	4.2	*	19.7	19.1	0.6		7.7	6.8	0.9	*
PUMA 3710	7.8	7.8	0.0		26.0	29.0	−3.0	*	41.6	41.8	−0.2		19.0	16.0	3.1	*	5.5	5.4	0.1	
Females, Total	7.3	6.8	0.5		21.8	23.2	−1.4		36.6	37.8	−1.1		22.0	21.0	1.0		12.3	11.2	1.1	
PUMA 3701	6.9	5.7	1.2	*	16.7	17.5	−0.8		33.2	34.7	−1.5		24.3	23.2	1.0		18.9	18.9	0.0	
PUMA 3702	6.5	5.4	1.1	*	19.2	22.4	−3.2	*	37.4	36.9	0.5		24.6	23.1	1.4	*	12.3	12.2	0.1	
PUMA 3703	3.7	4.5	−0.7	*	16.0	17.1	−1.1		31.0	31.8	−0.8		26.2	26.5	−0.3		23.0	20.2	2.9	*
PUMA 3704	6.0	5.9	0.1		19.4	20.3	−1.0		35.8	37.9	−2.1	*	21.9	22.5	−0.5		16.9	13.4	3.5	*
PUMA 3705	8.2	7.9	0.3		27.0	27.0	0.0		37.3	38.8	−1.4	*	19.1	17.9	1.2		8.4	8.4	0.0	
PUMA 3706	7.3	8.1	−0.8		23.6	24.0	−0.3		38.9	41.0	−2.1	*	20.7	18.7	2.0	*	9.5	8.3	1.3	*
PUMA 3707	8.6	7.6	1.0	*	25.5	26.9	−1.5	*	39.2	40.1	−0.9		20.4	19.0	1.4	*	6.2	6.3	−0.1	
PUMA 3708	9.6	8.2	1.4	*	22.4	25.0	−2.6	*	39.7	39.6	0.1		19.6	18.7	0.9		8.7	8.5	0.2	
PUMA 3709	7.4	6.9	0.5		19.9	23.5	−3.7	*	36.5	37.9	−1.4	*	23.3	22.3	1.1		12.9	9.4	3.5	*
PUMA 3710	7.9	7.6	0.4		27.1	26.1	1.0		35.9	38.0	−2.1	*	20.1	18.9	1.2		8.9	9.4	−0.5	

*Significant at a .10 level

differences in 41 of the 100 age/sex groups.[5] How meaningful are these differences? Of the 41 significant age/sex differences between the ACS and DCP, 24 were 2 percentage points or greater, including 10 that were 3 percentage points or greater. Considering the size of these PUMAs, a difference of just a few percentage points in an age group represents a potential shift of several thousand people. And, once again, it is the 5–19 year old males who stand out the most, where 12 of the PUMA differences were statistically significant, including 5 that were 3 percentage points or more. Even when the focus is on age/sex percent distributions as opposed to absolute values, there are significant differences between the ACS and DCP.

Assessing the Reliability of Selected ACS Variables by Age at the PUMA Level

Given that PUMAs have a minimum population of 100,000 and that we are dealing with 3 years of aggregated ACS data, we expect ACS estimates to be reliable at the PUMA level. However, the primary focus in this section is to examine how reliable these PUMA estimates are for selected age/sex groups. Data from both the full 2005–2007 ACS sample and Public Use Microdata Sample (PUMS) are explored. The 2005–2007 full sample is substantially less than the 9% the ACS hoped to start out with (Citro and Kalton 2007), further reduced by the high level of nonresponse in the Bronx (Salvo and Lobo 2006) and follow-up of only a subset of nonrespondents. Similarly, the 2005–2007 ACS PUMS for the Bronx is less than the best case scenario of a 3% sample. To measure the reliability of estimates that differ in size, we use the coefficient of variation (CV) as a standardized measure of reliability. The CV is the standard error of an estimate percentage on the estimate. In general, we consider CVs of 15% to signal problems with reliability, though a higher CV may be considered acceptable depending on how the estimates are being applied. We begin with a survey of selected socioeconomic variables from the 2005–2007 full sample.

Seven detailed tables from American FactFinder were selected, showing socioeconomic characteristics subdivided by age/sex dimensions (Table 4.4):

B05003. Sex by Age by Citizenship Status
B15001. Sex by Age by Educational Attainment for the Population 18+
B17001. Poverty Status by Sex by Age
B08101. Means of Transportation to Work by Age
B17001I. Latino Poverty Status by Sex by Age
B13001. Marital Status by Age for Women 15–50 years
B19049. Median Household Income by Age of Householder

[5] Generalized standard errors for age percent distributions had to be calculated; for absolute values, these standard errors were published. If standard errors had been calculated for absolute values of age/sex, there would have been 35 statistically significant PUMA differences, instead of the 27 reported in Table 4.2.

Table 4.4 Average Bronx PUMA estimates and coefficients of variations for selected characteristics from the full ACS sample, 2005–2007

	PUMA avg.			PUMA avg.			PUMA avg.	
B05003. Sex by age by citizenship status – Universe: total population	Estimate	CV	B15001. Sex by age by educational attainment for the population 18 years and over – Universe: population 18 years and over	Estimate	CV	B17001. Poverty status in the past 12 months by sex by age – Universe: population for whom poverty status is determined	Estimate	CV
Total:	161,326	2.1	Total:	134,141	1.9	Total:	156,916	2.2
Female:	84,293	2.5	Female:	70,974	2.3	Income in the past 12 months below poverty level:	28,277	6.4
Under 18 years:	13,319	7.2	18–24 years:	7,658	7.1	Female:	15,891	7.5
Native	12,276	7.6	Less than 9th grade	184	62.9	Under 5 years	1,009	36.5
Foreign born:	1,044	24.2	9th to 12th grade, no diploma	910	27.2	5 years	226	56.7
Naturalized U.S. citizen	307	40.3	High school graduate (includes equivalency)	1,869	16.9	6–11 years	1,141	31.9
Not a U.S. citizen	737	30.1	Some college, no degree	2,520	13.9	12–14 years	607	45.4
18 years and over:	70,974	2.3	Associate's degree	280	43.0	15 years	195	45.4
Native	47,779	2.9	Bachelor's degree	1,748	16.5	16 and 17 years	479	47.4
Foreign born:	23,195	4.9	Graduate or professional degree	147	48.6	18–24 years	1,902	17.0
Naturalized U.S. citizen	11,230	6.9	25–34 years:	16,233	5.5	25–34 years	2,110	17.0
Not a U.S. citizen	11,965	7.0	Less than 9th grade	329	48.5	35–44 years	2,302	16.7

(continued)

Table 4.4 (continued)

B05003. Sex by age by citizenship status – Universe: total population	PUMA avg. Estimate	CV	B15001. Sex by age by educational attainment for the population 18 years and over – Universe: population 18 years and over	PUMA avg. Estimate	CV	B17001. Poverty status in the past 12 months by sex by age – Universe: population for whom poverty status is determined	PUMA avg. Estimate	CV
			9th to 12th grade, no diploma	682	37.4	45–54 years	1,743	16.6
			High school graduate (includes equivalency)	1,292	23.8	55–64 years	1,588	16.8
			Some college, no degree	1,272	21.4	65–74 years	1,162	20.1
			Associate's degree	657	32.4	75 years and over	1,425	17.7
			Bachelor's degree	7,394	9.1			
B08101. Means of transportation to work by age – Universe: workers 16 years and over			Graduate or professional degree	4,609	11.2	B17001I. Poverty status in the past 12 months by sex by age (hispanic or latino) – Universe: hispanic or latino population for whom poverty status is determined		
Total:	82,670	2.6	35–44 years:	14,814	5.4	Total:	47,524	6.0
Car, truck, or van – drove alone:	5,844	10.1	Less than 9th grade	616	37.9	Income in the past 12 months below poverty level:	14,932	11.8
16–19 years	20	100.0	9th to 12th grade, no diploma	940	28.2	Female:	8,842	12.3
20–24 years	188	50.3	High school graduate (includes equivalency)	1,888	21.2	Under 5 years	659	44.0

25–44 years	3,256	14.4	Some college, no degree	1,399	20.0	5 years	105	62.6
45–54 years	1,231	20.2	Associate's degree	702	28.2	6–11 years	766	31.9
55–59 years	458	29.0	Bachelor's degree	4,864	11.7	12–14 years	460	45.4
60–64 years	338	39.7	Graduate or professional degree	4,404	13.0	15 years	134	52.3
65 years and over	352	35.0	45–64 years:	20,232	4.0	16 and 17 years	390	48.6
Public transportation (excluding taxicab):	47,475	3.5	Less than 9th grade	2,121	23.2	18–24 years	951	30.1
16–19 years	628	27.1	9th to 12th grade, no diploma	1,584	19.8	25–34 years	1,009	31.3
20–24 years	3,914	11.4	High school graduate (includes equivalency)	2,998	13.2	35–44 years	1,218	32.3
25–44 years	28,396	4.7	Some college, no degree	2,273	12.8	45–54 years	992	25.4
45–54 years	8,108	7.4	Associate's degree	955	22.3	55–64 years	838	33.6
55–59 years	2,984	12.6	Bachelor's degree	5,007	10.7	65–74 years	616	36.0
60–64 years	1,857	16.3	Graduate or professional degree	5,293	8.8	75 years and over	705	32.4
65 years and over	1,588	17.0	65 years and over:	12,037	5.1			
B13001. Marital status by age for women 15–50 years – Universe: women 15–50 years			Less than 9th grade	2,778	14.9	B19049. Median household income in the past 12 months (in 2007 inflation-adjusted dollars) by age of householder – Universe: households		
Total:	47,812	3.1	9th to 12th grade, no diploma	1,210	18.6	Median household income in the past 12 months (in 2007 inflation-adjusted dollars)		

(continued)

Table 4.4 (continued)

	PUMA avg.			PUMA avg.			PUMA avg.	
B05003. Sex by age by citizenship status – Universe: total population	Estimate	CV	B15001. Sex by age by educational attainment for the population 18 years and over – Universe: population 18 years and over	Estimate	CV	B17001. Poverty status in the past 12 months by sex by age – Universe: population for whom poverty status is determined	Estimate	CV
Now married (including spouse absent):	16,072	5.3	High school graduate (includes equivalency)	2,598	12.4	Total:	61,593	3.5
15–19 years	44	74.5	Some college, no degree	1,435	16.6	Householder under 25 years	33,135	17.1
20–34 years	5,313	9.2	Associate's degree	322	34.4	Householder 25–44 years	75,108	3.9
35–50 years	10,715	6.6	Bachelor's degree	1,813	18.0	Householder 45–64 years	64,427	5.1
Unmarried (never married, widowed, and divorced):	31,739	3.8	Graduate or professional degree	1,881	18.1	Householder 65 years and over	30,504	6.4
15–19 years	4,060	9.5						
20–34 years	16,471	5.6						
35–50 years	11,209	6.3						

Table 4.5 Average Bronx PUMA estimates and coefficients of variation for females by age, nativity, and citizenship status: comparing the ACS full sample to the ACS PUMS, 2005–2007

	PUMA average			
	Full sample – 18 years and over		PUMS – 25–44 years	
	Estimate	CV	Estimate	CV
Females	70,974	2.3	21,478	5.8
Native-born	47,779	2.9	11,823	11.2
Foreign-born	23,195	4.9	9,655	13.0
Naturalized US citizen	11,230	6.9	3,561	22.5
Not a US citizen	11,965	7.0	6,094	16.6

The data are examined for Bronx PUMAs and estimates, and CVs presented are an average of the 10 Bronx PUMAs. The results show that PUMA level estimates by age/sex from the 2005–2007 ACS full sample are generally reliable. For example, the average PUMA CV for native-born females 18 and over was 2.9, workers 20–24 years old that used public transportation for their commute had a CV of 11.4, while 35–44 year old females that had a bachelor's degree had a CV of 11.7. Only when the frequency of an attribute measured was low did CVs become large enough to make the estimates unreliable. These small populations included foreign-born females under the age 18 (average PUMA CV of 24.2), 15–19 year old married women (74.5), 5 year old females living below poverty (56.7), and median household income for householders under 25 (17.1).

Although the tables provided through the full sample in American FactFinder usually have low CVs, these tables may not include the age breaks or other detail that may be required. In these cases the PUMS dataset can be employed. Unfortunately, since the PUMS sample is roughly one-third the size of the full sample, the general precision seen in full sample estimates drops when switching to the ACS PUMS. This can be seen in Table 4.5, which examines females by nativity and citizenship status for two different age groups and data sources: for those 18 years and over, we use full sample data, while data for those 25–44 come from the PUMS. The PUMS data, for a narrower age band, produced CVs that were much higher than those from the full sample. Still, estimates produced from the ACS PUMS are often reliable, as seen in Table 4.5, where only two CVs exceed our 15% threshold.

While 2005–2007 data from the full sample and PUMS are usually reliable enough to explore age/sex dimensions, changes in the phrasing of survey questions can produce smaller samples that make ACS data much less reliable, especially compared with census data. One such example is the migration question. The ACS questionnaire asks where the respondent lived "1 year ago," as opposed to the 2000 Census questionnaire which asked where respondents lived "5 years ago." The 1 year question results in smaller in-migrant populations in the ACS, larger CVs, and decreased data reliability. Table 4.6 compares ACS and Census CVs for in-migrant populations subdivided by age, race, and education. While the PUMS file from the ACS is smaller than that from the

Table 4.6 Average PUMA estimates and coefficients of variation for selected characteristics of in-migrants: comparing the 2000 census PUMS to the 2005–2007 ACS PUMS

	PUMA average			
	Census 2000 5% PUMS		ACS 2005–2007 PUMS	
	Estimate	CV	Estimate	CV
Mutually exclusive race				
Total, in-migrants, 5 and over	13,481	7.3	3,122	33.5
White, nonhispanic	2,130	28.0	579	107.2
Black, nonhispanic	3,538	18.3	799	77.0
Hispanic	6,185	13.7	1,475	58.9
Total, in-migrants 25–44 years	5,943	11.5	1,228	53.4
White, nonhispanic	914	41.6	212	184.8
Black, nonhispanic	1,736	26.1	338	123.8
Hispanic	2,539	21.3	585	93.9
Educational attainment				
Total, in-migrants, 25 and over	8,131	9.6	1,790	44.4
High school graduate or higher	4,978	12.4	1,244	53.5
College graduate	1,687	24.8	395	101.8
Total, in-migrants 25–44 years	5,943	11.5	1,228	53.4
High school graduate or higher	3,898	14.0	953	60.3
College graduate	1,329	27.6	298	115.4

census (roughly 3% vs. 5%), CVs in the ACS are over four times larger for in-migrant subgroups. The impact on data utility is dramatic. Whereas half of the Census estimates have CVs below the 15% threshold, not one of the ACS estimates can be considered reliable. Even the overall ACS estimate for in-migrants has an average PUMA CV of 34, while the estimates for every subset of in-migrants are even less reliable.

Discussion and Conclusion

The ACS has been advertised as the new source of socioeconomic information on the nation's population, replacing the census long form. While the ACS does contain the same short-form subjects, there is no argument that the decennial census will still be the gold standard for data on age/sex of the population since these are from the full census count. On the other hand, age/sex in the ACS are estimates that are derived at the county level and used as controls, making them a cornerstone of the survey. These age/sex estimates affect analyses of key socioeconomic attributes in the ACS, like income by source, education, and migration, since they are better understood when stratified by age/sex. Indeed, life-cycle changes in income and migration propensities are defined by age/sex qualifiers.

Given the pivotal role of age/sex data, imprecise ACS age/sex estimates can affect the representativeness of the whole socioeconomic package of variables in the survey. The full accounting of the universe by age/sex is so basic that inaccuracies can affect every aspect of the survey. Since we already know that differences in response vary by age/sex, race and Hispanic origin, the role of independent controls is critical in the formation of weighting adjustments to compensate for nonresponse. While never perfect, the use of controls not only enhances the reliability of estimates, but it also compensates for differences in response that would likely render the data unrepresentative in many counties of the nation.

Of course, the degree to which the controls act to curb problems with response is a function of how well the independent estimates used in the ACS actually represent the survey universe. The litmus test will come when the 2010 Census results are issued and compared with the independent estimates. Given the fact that evaluations of the ACS are ongoing, we did not have the luxury of waiting. Therefore, we turn to an alternate "standard" that permits some level of evaluation to occur. The standard we have chosen here consists of population estimates using a cohort-component method that used the 1990–2000 migration experience, and fertility and mortality schedules from the 1999–2001 period, to move the population forward by age/sex from 2000–2006 for the 10 PUMAs in the Bronx.

We have confidence in the use of a short-term cohort-component methodology as a standard in this analysis. With the exception of catastrophic events that may cause a sudden displacement of population, changes in the number and distribution of persons by age/sex are usually gradual over time. This is especially the case here, given the fact that the population estimates that serve as our standard are just 6 years out from the 2000 Census. An exception to this reasoning would be with small geographic areas like census tracts, where even small changes in migration can have a big effect on their small base populations. Such is not likely the case in the PUMAs examined in this analysis, where the average population is well in excess of 100,000 persons.

It is reasonable to argue that differences are to be expected and that some of these differences may represent the relative advantage that the ACS has of actually surveying the "current" population of Bronx PUMAs. It may be that the ACS is measuring change that the cohort-component model cannot detect because the projection is based on a set of obsolete assumptions. So how do these ACS estimates compare with the DCP estimates?

Since we combined the estimates of males and females each into five age groups (0–4, 5–19, 20–44, 45–64, and 65 and over), there were 100 age/sex estimates across 10 PUMAs – for 27 of these age/sex estimates, there were significant differences between the ACS and DCP. Differences among males 5–19 years of age are especially a cause for concern because the results are so consistent, with the ACS understating males in this age group in 6 of the 10 PUMAs; among females, the ACS significantly understated this age group in three PUMAs. Even when PUMA differences were not widespread, as in the case of 0–4 year olds, the skewed ACS sex ratios do not inspire confidence. Among those ages 65 and over, ACS PUMA estimates often imply a migration scenario at odds with patterns of the very recent past. When age/sex percent distributions were examined, there were significant differences in 41 of the 100 age/sex groups, including 10 PUMA differences that were 3% or greater.

Are the age/sex data in the ACS for 2005–2007 acceptable at the PUMA level, based on a comparison with the DCP estimates? The answer varies depending on the application at hand. For example, in terms of differences across PUMAs, ACS age/sex data are more than adequate to compare populations in the north and south Bronx. Or if the focus is an age/sex percent distribution within a PUMA, most percent differences between the ACS and DCP were 2% or less, a difference that may still deliver a useful portrait of the area. On the other hand, if one is in charge of a program that serves the population of young people in a neighborhood where absolute numbers matter, the differences between ACS and the DCP estimates can have a serious impact. While the ACS program emphasizes that users focus on percent distributions, most users are likely to use absolute values.

With respect to the reliability of the ACS data by age at the PUMA level, the 3-year averages provide a generally strong basis for examining characteristics of the population. In the absence of any administrative data to check the veracity of the data, we confined our analysis to an examination of CVs for data items. The key question concerns whether the 3-year averages provided a large enough sample to examine key characteristics by broad age group at the PUMA level to inform local decision making. The answer is generally "yes." Estimates for educational attainment, migration and poverty by age generally had acceptable CVs that permitted meaningful distinctions by broad age group.

From the standpoint of reliability and representativeness, the litmus test for controls is not whether they make the data perfect, but whether they make the estimates better. It is likely that the use of appropriate controls at the county level reduces the volatility of estimates and helps compensate for differences in response by age/sex, race, and Hispanic origin. At the PUMA level, however, the capacity of county controls to reduce sampling variance and the bias associated with differential nonresponse may be more limited, at least from this examination of the ACS data. Counterintuitive changes in the age groups and sex ratios at the PUMA level when compared with data from the 2000 Census enumeration suggest that weighting adjustments that occur as a result of the implementation of county controls may fail to compensate adequately for differences between PUMAs. This is especially true in the Bronx, where PUMAs differ markedly in their age/sex distributions and in their socioeconomic characteristics. It would be extremely difficult for any weighting adjustments that are county-based to compensate fully for biases that result from nonresponse in specific PUMAS. Bronx PUMAs have big differences in race, ethnic, nativity, economic, and housing characteristics that cannot be captured in a single set of county controls.

Thus, this analysis leads to the conclusion that sub-county controls are required in the ACS, especially in counties with high levels of heterogeneity. From a theoretical standpoint, using PUMA-specific information from the most recent decennial census enumeration would enhance age directly because the enumeration itself is the best gauge of an age distribution. More indirectly, the weighting for nonresponse and other issues would more closely reflect the PUMA itself and not the overall county totals. Understanding the improvements that would result from such actions needs to be high on the Bureau's research agenda for the ACS, as we move forward.

Producing sub-county estimates by age/sex, race, and Hispanic origin would be a major undertaking, especially in light of the recent past, when *county* estimates were sometimes questionable. But this formidable challenge needs to be met if the ACS is to be a true replacement for the decennial census long form.

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Chapter 5
A Sociology of Official Unauthorized Statistics: Estimation or Guesstimation?

Karen A. Woodrow-Lafield

Introduction

Immigration issues are in the mainstream of public interest as rarely before in the United States. National, state, and local level knowledge about immigrants, by composition on legality, country of origin, and economic well-being, is at a premium for political debates. After long neglect, federal statistics systems have made some advances in monitoring immigration and describing demographic, social, and economic characteristics of immigrants, but informational demands still outweigh statistical assets. In 2009 there were approximately 200 million migrants living away from their countries of birth, and within countries there is considerable migration, so migration is the primary shaper of the contours of populations. Just as the increase in numbers has been dramatic, there has been an increase in research and attention to managing migration, with several U.N. meetings and workshops, including eight Coordination Meetings on International Migration involving governments, non-governmental organizations, experts, and others. Immigration statistics for the U.S. situation may be worse than statistics for assessing immigration impacts among European state-nations for which there have been efforts toward producing consistent immigration statistics for more than two decades (Kelly 1987).

The topic of unauthorized migration is relevant for both domestic policy and national security. The operations of the U.S. federal statistical system as a whole are governed by major legislation and agency regulations (Citro et al. 2009) from the 1980 Paperwork Reduction Act to recent legislation and OMB statistical policy directives. The current time series of estimates for unauthorized immigrants from the Office of Immigration Statistics of the Department of

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_5,

Homeland Security (OIS-DHS) seems regarded as official unauthorized statistics, appearing in recent *Statistical Abstracts of the United States*. These estimates and the Pew Hispanic Center estimates are used for policy discussions of immigration reform. Indeed, the actual numbers of persons likely to benefit from another regularization program has been very important in the debates over comprehensive immigration reform (Bean et al. 2001). The control and abatement of unauthorized immigration may be perceived as “an intractable social policy issue” (Newton 2008, p. 39), but an alternative viewpoint is that blended policies on trade, migration, and border enforcement can usefully address the specific and unique relationships of the U.S. with other nations, especially Mexico. Many experts explicitly attribute unauthorized migration from Mexico to U.S. failure to even consider structural adjustment subsidies, social harmonization policies, and provisions for labor mobility and to immigration reform in shaping the 1994 NAFTA agreements (Massey 2009; Massey et al. 2002). With this U.S. strategy of emphasizing border enforcement with only partial economic integration, both legal and illegal immigration from Mexico accelerated after NAFTA; as predicted, a disadvantaged population resulted, and the Mexican economy had not grown enough to reduce outmigration (Martin 1993; Massey 2004). Migration is beneficial in facilitating economic development.

Tracking geographic impacts of U.S. immigration is exacerbated by the absence of local population registers, considerable internal migration, and sizable undocumented migration from non-bordering and bordering countries. The U.S. censuses over 1980–2000 served to benchmark geographic impacts of immigration, and observations of demographic, social, and economic impacts for states and communities have multiplied. Rothman and Espenshade (1992) reviewed studies of fiscal impacts of immigrants, usually without specificity for legality, at national, state, and local levels as to coverage of all possible costs and contributions. In the anti-immigrant climate of the early 1990s, California passed Proposition 187 to deny basic public services to illegal immigrants and their children (that was stayed), there were lawsuits for federal reimbursement for local and state services for undocumented aliens in several states, and the Office of Management and Budget sponsored an Urban Institute (UI) study (Clark et al. 1994b) to estimate the fiscal impact of undocumented immigrants in seven states—Arizona, California, Florida, Illinois, New Jersey, New York, and Texas. Following this and other studies that endeavored to address fiscal impacts of undocumented residents for geographic locales (Huddle 1993, 1994; LA County Internal Services Division 1992; Parker and Rea 1993; Romero and Chang 1994), an expert workshop convened for discussion of improving data sources, expanding the range of analytical methods, and examining the need for better research frameworks (Edmonston and Lee 1996). The UI researchers relied on INS estimates of the undocumented populations in each state (Warren 1993, 1994) as detailed and defensible, and the INS unauthorized estimate was consistent with GAO (1993) and Woodrow (1991). A National Academy of Sciences workshop in October 1994 reiterated that data improvements were needed for immigration research (Edmonston 1996) and, consequently, for addressing fiscal impacts of immigration (Edmonston and Lee 1996). GAO (1995b) gave similar conclusions (Also, see Smith and Edmonston 1997).

Any interpretation of numbers and arguments is necessarily complicated by differing conceptions or data capture of undocumented migrants, and debates can be muddied with use of alternative analytic dates, varying degrees of scientific rigor, and serious hidden methodological limitations. Analysis of impacts of undocumented workers at the state level involves addressing questions about their numbers as well as questions about various demographic, economic, cultural, and social impacts. The pertinent questions include:

> How many undocumented and legally resident immigrants are in the nation or in specific states such as California, New York, Texas, Florida, Illinois, or New Jersey? What is the relative magnitude of undocumented residents to legally resident immigrants and natives? In what types of living arrangements are undocumented residents found? To what extent do immigration and unauthorized migration contribute to population change or growth?
>
> How many of these undocumented residents work in a selected state? How many additional undocumented workers in the state's labor force are living in other nearby states or are temporarily living in the state? Are undocumented workers displacing native-born workers in the state labor market or are undocumented workers simply taking jobs which are unattractive to native-born workers in the state? What would be the effects for the state economy of making these types of jobs attractive to native-born workers?
>
> Are contributions of undocumented workers through state and local taxes sufficient to offset costs for the selected state, cities, and local areas? Are their federal taxes sufficient to more than offset their costs to federal programs? What is the long-term value of a future worker, future citizen, future resident?

The key questions about fiscal impacts of unauthorized immigration involve comparing the current situation with what situation can be imagined with only lawful immigration. Two questions are, to quote from Edmonston and Lee (1996, p. 24), "What would the population of a particular local area be if there had been *no* illegal immigration in recent years?" and "What would the current account balance for cities and states look like if there had been *no* illegal immigration?"

Obviously, these questions pose challenges to demographic and social science researchers, and even greater challenges to policymakers faced with decisions and questions for which answers may be vague, misleading, inaccurate, or just missing. This review examines the sociology of official statistics on undocumented or unauthorized immigrants using the framework of Starr (1987) and evaluates research on net undocumented migration, nationally and subnationally. In the larger context of economic and environmental issues for political entities, making estimates of net undocumented migration may be as much "a politically charged craft of great interest to policymakers and the public," as Ahlburg and Vaupel (1990, p. 649) described making population projections as not merely a "bloodless technical task."

Sociological Questions: Undocumented Immigrants

> System origins and development: "What causes statistical systems to be established? Why do governments or other actors make a decision to count or to allow themselves to be counted?" (Starr 1987, p. 9).

Research to estimate the unauthorized resident population developed because the 1980 census count was more than expected, which is a familiar tale following the 2000 census. In the 1970s and 1980s, measuring unauthorized migration was a developing field, and the work to quantify undocumented migration was part of the system of statistical production in Population Estimates and Projections and Population Analysis and Evaluation at the U.S. Census Bureau, with a complementary role of the Statistics Office, U.S. Immigration and Naturalization Service. Accuracy of census data and postcensal estimates was paramount, with increasing demand for racial and Hispanic detail (Petersen 1987; Choldin 1994). In the 1970s, undocumented immigration clearly increased, with markedly rising numbers of border and interior apprehensions of persons who usually had entered without inspection. Speculative and unrealistic estimates of the numbers of illegally resident immigrants stemmed from "got-away" ratios based on these apprehensions statistics. As requested by the Select Commission on Immigration and Refugee Policy, Census Bureau demographers critically reviewed studies on undocumented migration as of 1978 (Siegel et al. 1980). Their scrutiny led them to postulate that there were likely to be three to six million undocumented residents and possibly no more than five million. There was pre-1980 litigation (*FAIR et al. vs. Klutznick*) to require that the Census Bureau exclude undocumented residents from apportionment counts.

In this systematic effort, individual researchers suspected that net undocumented migrants might be mensurable in the 1980 census despite the absence of a measured undocumented population in the 1970 census. There had been some mention of an amnesty program for which proof of 1980 census enumeration might have seemed evidence of long-term residence. About 2.1 million unauthorized residents, including one million Mexican-born persons, were demonstrated as included in the 1980 census (Warren and Passel 1987), with one million in California (Passel and Woodrow 1984a). With census coverage promotions, immigrant and ethnic advocacy groups were likely to succeed in encouraging participation by undocumented residents. A range of 2.5–3.5 or 4.0 million was postulated (Passel and Robinson 1988). To evaluate completeness of the 1980 census, an upper limit for the number of undocumented residents was devised on the basis of limited research for California (Heer and Passel 1987) and the Mexican census (Bean et al. 1983), with an underlying assumption that undocumented residents were undercounted at higher rates than legal residents. Consistent coverage estimates were developed for the 1940, 1950, 1960, 1970, and 1980 censuses by age, sex, and race (Fay et al. 1988), and the preferred unauthorized population figure in discussion of 1980 census coverage was three million, allowing for higher undercoverage with figures of four million and five million. State-level figures were not published.

In the Immigration Reform and Control Act (IRCA) and the Immigration Act of 1990 (IA1990), there was language mandating major reporting requirements on impacts of the legislation. In the late 1980s, the Census Bureau dealt with unsuccessful legislation and additional litigation on excluding undocumented aliens from the apportionment counts (*Ridge v. Verity* filed in Pennsylvania, 715F. Supp. 1308, 1321 (W.D. Pa. 1989)). After 1990, there was a shift to increased research on unauthorized residents at the INS due, at least in part, to IRCA and IA1990 legislation and possibly due to the reality that availability of measures for unauthorized residents promoted various efforts toward exclusion of unauthorized residents that conflicted with the institutional mission of conducting an accurate and complete census. Certainly severe data limitations were a consideration for stating, in regard to research to estimate unauthorized residents in the 1990 census, "There will be research only at the national level; data sources that were essential for state-level estimates of undocumented residents included in the 1980 census do not exist for 1990" (Woodrow 1992b). For the 1990 census coverage evaluation, there were both findings about net unauthorized migration for 1975–1980 based on the 1980 census and findings about net unauthorized migration in the 1980s. For the 2000 census coverage evaluation and population estimates, assumptions about net unauthorized migration for the 1990s relied upon research studies of the Statistics Office, U.S. Immigration and Naturalization Service. As spelled out in post-2000 strategic planning of the U.S. Census Bureau, measuring net international migration is part of established census demographic programs within the ongoing activity of census economic statistics programs, specifically in that accurate population estimates are needed for federal funding allocation.

Currently, certain actors initiated efforts to discourage foreign-born persons from being counted as a Census 2010 a boycott to push for comprehensive immigration reform. This could directly affect research to derive unauthorized estimates and possibly lead to estimates that are lower than expected. The organizers' political message could become part of a more broad-based fear of cooperating with governmental officials and programs.

> Social organization of statistical systems: "What are the sources and consequences of different designs or patterns in the social organization of statistical systems?" (Starr 1987, p. 9).

The system that has become most established for measuring net undocumented migration from all sources is basically comparative of aggregate data sources for all foreign-born residents and estimated legally resident foreign-born persons. The residual approach originated as a Census Bureau effort to analyze net undocumented migration as of the 1980 census (Warren and Passel 1987). In Congressional testimony after the 1980 census, INS commissioners' discussions of undocumented migration converged with Census Bureau publications and sources.

As a centralized statistical agency, the Census Bureau is functionally autonomous over production of population estimates and projections, and significant advances have been made in sophistication and utility. The federal statistical system began to produce more regular and geographically detailed population statistics between censuses for administration of federal revenue-sharing programs beginning in 1972 (Nathan 1987) and community development block grants beginning in 1974 (de Neufville 1987). The Federal-State Cooperative Programs for Estimates and Projections (FSCPE and FSCPP) were established to promote information exchange, but many states continue to produce their own estimates and projections, especially at smaller area levels. Informational requirements for population characteristics multiplied as well from media, business, government, and private groups and several population information providers became well-established.

Undocumented estimation has been subject to the constraints of this highly structured area. Changes to immigration assumptions in the population estimates and projections were subjected to expert scrutiny (Passel 1985b) although changes outside the once-in-a-decade cycle might have been unlikely. Certainly, the decennial census design with the short form for core questions and long form for collection of detailed characteristics, including nativity, period of immigration, and citizenship, had the major drawback of limited timeliness. As the foreign-born population was increasing and the legality dimension was more crucial, delaying any research on unauthorized migration until the 1990 census was not feasible. A national survey design emerged with nativity, period of immigration, citizenship, and birthplace of parents on the CPS occasionally over 1979–1991, allowing research to estimate net change due to unauthorized and legal migration (Passel and Woodrow 1987; Woodrow and Passel 1990; Woodrow 1991, 1992a, b, c). Incorporation in 1980 and 1990 census coverage evaluation by demographic analysis was extensively evaluated internally by Bureau statisticians involved with dual systems analyses of census coverage. By 1994, this data collection was on a monthly basis, and research on unauthorized estimation was conducted by Warren at INS, Bean and Woodrow-Lafield in the Binational Migration Study, and Passel at the Urban Institute (2005). The major limitation of the CPS data was greater sampling variability than the census. Similarly, considerable attention was given to demographic analysis of 2000 census coverage evaluation, and immigration components, albeit somewhat after discovery of crucial errors in the Accuracy and Coverage Evaluation Survey.

In the 1980s, Census Bureau researchers on unauthorized migration were highly autonomous in making presentations at professional meetings, publishing research in scholarly journals, and providing information to media. Layers of review were undoubtedly less than for publications in official Bureau series, generally deriving from the innovative nature of the research, situation of key measurement researchers in staff rather than line positions, and individuals' professional standings. There was a similar situation for an INS researcher (Warren 1993, 1994, 1997), perhaps explicable by the nature of the INS Statistics Office as insular within an enforcement-oriented agency, but the INS ceased releasing results of research to estimate unauthorized migration in the late 1990s, prompting a Congressional subpoena. With the DHS, the OIS has a more elevated and central role that necessarily conveys greater structure and oversight over the scope and production of statistics. Although DHS is not a statistical agency, the OIS is listed as a federal statistical website (Citro et al. 2009).

Typically, the statistical processes for measuring undocumented immigration are a conglomeration of census or survey methods and administrative data. A question ascertaining legal status has not been included on any census or national survey. Such a question might not accurately measure prevalence of undocumented status because individuals may not know or may misrepresent their residence status, but questions designed to elicit responses on immigration statuses may provide details as to unauthorized status from special surveys (Larson and Droitcour 2010; Marcelli 2010; Loue and Bunce 1999). Because individuals would not be likely to respond in regular surveys that they were of undocumented status, the most used approach is comparison of aggregate statistics on the foreign-born population and the legally resident foreign-born population to discern characteristics and numbers for the aggregate undocumented population. The first information set is generated by the Census Bureau in conducting national surveys and decennial censuses (until 2000) including nativity and immigration; the second information set has been developed from data sources of the INS and OIS-DHS. Reserving discussion of these administrative data until the next section, certain considerations are necessary as to foreign-born population estimates.

Interactive and interpretative factors may come into play in generation of official data on the foreign-born population. Census guidelines call for enumeration of all persons for whom the U.S. is the usual place of residence, but residence rules, which are somewhat more inclusive, differ for the Current Population Survey (CPS) and the American Community Survey (ACS). Among a transient population, living in Mexico and the U.S. for varying periods, applying the usual residence rules may be more theoretical than practical, and year of entry may not correspond with year of immigration or year of coming to stay. Some individuals may be enumerated who should not have been (and vice versa) according to the criteria, and a cross-sectional survey may be less appropriate than ongoing surveys.

Although statistical information is broadly available in the United States, disclosure avoidance and privacy concerns affect the extent of information dissemination. Access to statistical information may be restricted in practice to those working as federal employees or those with computer skills and resources (de Neufville 1987). Emergence of federally funded research data centers is both facilitating as these serve as depositories for highly detailed datasets and restricting as individual researchers must formally propose their research studies, gain approval, and secure funding to support access to workstations within the centers as well as any travel costs. Proprietary information can be an exceptional case from a statistical standpoint. Judgments of statistical merit may preclude a statistical agency from undertaking certain kinds of research, from releasing certain detailed tabulations, or from explicit interpretations of significance. In the case of official statistics about undocumented or unauthorized migration, state-level foreign-born population estimates from the CPSs are subject to sampling variability, and the Census Bureau only recently began publishing CPS tabulations for first, second, third and higher generations. Another national survey design is now presented in the ACS, affording annual and multiyear estimates of "census-quality" for the foreign-born based on questions on place of birth, period of immigration, citizenship, and year of naturalization (2009).

The OIS-DHS utilizes ACS foreign-born population estimates for evaluating the number of unauthorized residents and change over time. The "census quality" feature of the ACS means that sampling variability is less a concern than with the CPS estimates, although one needs to consider sampling variability associated with ACS population estimates more than figures from Census 2000 and prior censuses.

> Cognitive organization of statistical systems: "What are the sources and consequences of elements in the informational structure?" (Starr 1987, p. 9).

In considering the cognitive organization of statistical systems on undocumented immigration, perceptions abounded in the 1970s that two, three, or four aliens succeeded in entering the United States for each one captured. With visibly growing immigrant communities in urban areas and these perceptions of successfully surreptitious illegally resident individuals, politicians perceived census undercoverage as adversely influenced by undocumented growth. Other politicians from less affected districts were concerned that undocumented immigrants were included in the census and estimates. In *FAIR v. Klutznick*, arguments were made that citizens in these districts were unfairly accorded less valuable voting power than lawful residents in districts with undocumented residents included in apportionment counts. Diminishing federal resources also may have contributed to concerns of smaller states' and smaller districts' constituencies that larger states and larger districts, traditionally immigrant destinations, stood to benefit politically and fiscally from growing undocumented and legally resident immigrant communities.

The INS long required that legally resident aliens register their addresses annually, considered an enforcement resource for location of aliens, but that program was discontinued in 1981 as unreliable due to dependence on voluntary cooperation. However, microdata files created from that now defunct alien address registration system were analyzed and yielded annual information on legally resident aliens by limited characteristics including categories corresponding with lawful permanent residence, to which the majority responded, or somewhat less perfectly, with nonimmigrant admission categories (Warren and Passel 1983, 1987; Jasso and Rosenzweig 1990). As a statistical resource, it was considered poor, but ironically, research after its demise indicated that coverage was as high as 89%. Later studies to estimate the legally resident foreign-born population required assumptions about emigration of lawful permanent residents and about temporary residents for derivation of undocumented estimates.

Advances in technology and management systems led to more timely statistics on immigrants, nonimmigrant arrivals, apprehensions, and other administrative data, usually within 3 or 4 months of the fiscal year end, and place more emphasis on precision across categories. With qualified INS supervisory staff in the late 1970s and early 1980s, greater computerization, and higher funding associated with border enforcement responsibilities, there were improvements in INS statistical capabilities, records systems, and more timely release of publications such as the Statistical Yearbook of the Immigration and Naturalization Service that offered annual descriptions of legal immigrants, i.e., aliens admitted for lawful permanent residence. Public-use microdata files for lawful permanent residents admitted in 1972–2000 were available to researchers and the Census Bureau and were useful in developing the legal immigration component for postcensal population estimates and in estimating population change due to net undocumented migration. Statistical foundations for analyzing immigration were still inadequate (Levine et al. 1985), although several research studies were fostered by these statistical data sources (Greenwood et al. 1991; Jasso et al. 2000).

Internally to the INS, systematic production of statistics on apprehensions of undocumented aliens served to justify budgetary requests for border enforcement, including both staff and technological equipment. INS statistical systems handling enforcement data would not be an adequate resource for addressing the magnitude of the undocumented resident population in the United States because those statistics demonstrate captures rather than those successfully entering without inspection or overstaying nonimmigrant visas. Apprehensions statistics would have been more useful for understanding the magnitude of undocumented migration if apprehensions were not treated as discrete events. There is abundant anecdotal evidence that many apprehended aliens are repeaters (Massey et al. 1987). Although technological aspects of detecting repeaters among apprehensions are great, high numbers of apprehensions and low numbers of individuals attempting illegal entry (or low numbers of undocumented residents) lead to divergent interpretations of undocumented migration as a social problem. Attention to apprehensions statistics emphasizes the role of external factors, e.g., "push" factors in countries of origin rather than the role of internal, domestic factors, e.g., "pull" factors such as low-skilled and low-wage employment. In the policy debates prior to IRCA's passage, the causal story on unauthorized migration was the classic push-pull explanation (Newton 2008).

The Nonimmigrant Information System (NIIS) originated in 1983 for maintenance of arrival and departure records for aliens admitted for temporary residence, with the exception of students for which there was a separate system. With hundreds of millions of arrivals since then, the task of tracking departures is major. With numerous ports and modes of departure, collection of departure forms is not systematically accomplished. Research based on the database of arrivals without known departures involved derivation of estimates for systematic error to develop measures for selected visa overstay cohorts at various durations (Warren 1990). This so-called system error worsened in the late 1990s, diminishing the usefulness of making such adjustment procedures. The NIIS never provided cross-sectional data on legally resident nonimmigrants included in a census as usually resident, although that was possible in principle (Woodrow 1987). Through the proposed US-VISIT program that may become operational in 2012, departing visitors would be identified through fingerprints or eye scans in order to link with similar data collected from foreign nationals arriving by air.

With peer-reviewed publications on residual estimates studies (Passel and Woodrow 1984a, 1987; Warren and Passel 1987), consistent assumptions for demographic analyses of Mexico's 1980 census coverage (Gomez de Leon and Partida 1986), use of residual results for 1980 census evaluation (Fay et al. 1988), and inclusion of residual and overstay studies in a major review (Bean et al. 1990), estimation research on undocumented immigration gained an apparent consensus in terms of single-digit millions (Durand and Massey 1992). The IRCA legalization program for 1.7 million applicants as having lived here since before 1982 offered further corroboration (Gonzalez-Baker 1990).

These advances and personnel facilitated agency-wide responsiveness to challenges from legislation, particularly, the Immigration Reform and Control Act of 1986 programs for legalization of formerly undocumented residents and seasonal agricultural workers, as well as subsequent handling of additional cases pursuant to settlements in class-action lawsuits. Additionally, INS provided extensive statistics and sponsored special surveys on IRCA beneficiaries, and the agency was cooperative with various entities involved in assisting with legalization application. By some measures, the agency's efficiency was good, although there was some fraud. In 2009, DHS was making preparations for mounting another legalization program should it be enacted by Congress.

Following passage of IRCA, assessments of undocumented immigration found continuing additions to the U.S. population (Bean et al. 1990), and based on residual study of a 1988 national survey, visa overstays, apprehensions statistics, and ethnographic study of Mexicans' trips to the United States, the prevailing viewpoint was that IRCA's employer sanctions were not working to curb undocumented migration. Evident increases in the foreign-born population, immigration and apprehension, and IRCA legalization programs contributed to the politics surrounding the 1990 census. Litigation was begun in 1988 to require exclusion of undocumented residents from the 1990 census counts for apportionment, but the effort was shortlived as the Census Bureau's mandate was judicially interpreted as to count all persons resident in the United States for purposes of apportionment as required by the 14th amendment. It has seemed generally recognized that producing state-level figures for undocumented residents was unlikely given that sampling methods may not be used with apportionment counts, the INS no longer registered addresses for legally resident aliens, and there was no other data source for the lawfully present foreign-born population. Some politicians (Vitter in 2009) have made proposals that would alter the requirement to inclusion of citizens in the apportionment counts. Over 1980–2010, the divergence from the census sampling design to the ACS design for data collection on the foreign-born population seems to have occurred in tandem with at least a temporary drifting away from estimating net population change due to unauthorized migration toward measuring changes in unauthorized migration for enforcement evaluation.

Aspects of immigrants' characteristics and behavior became critical elements, as the prevalence of family units in legal immigration brought more attention to familial ties among unauthorized residents and mixed-status families. Knowing about sequencing of unauthorized status and lawfully resident status may create greater acceptance of the unauthorized presence. Statistics about transitions to naturalization contributed another dimension to public understanding about the immigrant life course and impacts of recent immigration for political participation. Perceptions of immigrant characteristics and group behavior may be related to attitudes toward immigration policies.

> System uses and effects and contemporary system change: "What effects do the production and distribution of statistical information have on politics and society? Do statistical systems shape understanding of social and economic reality so that effects are due, not to the phenomena measured, but to the system measuring it? What processes, such as political changes or technological innovations, are now shaping the current and future development of statistical systems? Like the first group, these questions are historical and developmental, but they concern the future rather than the past." (Starr 1987, p. 9)

Has the dissemination of unauthorized statistics had demonstrable effects on politics and society? With greater dissemination of information about immigration and migration, the public has become more knowledgeable and specialists have more capabilities. At the same time, there is a heightened awareness of the unauthorized presence and considerable demand for unauthorized statistics for policy purposes. What does it mean that so many unauthorized are present despite the great risk at which their status places them? Might outcomes of IRCA-legalized immigrants have contributed a foundation for or lessened the chances that another legalization program might occur? Certainly, the transition of formerly undocumented aliens to lawful permanent resident and citizen presents a blueprint, but certain Congressmen seemed clearly against ever having another legalization program (Newton 2008).

Following a review of demographics of immigration and "official" statistics on undocumented immigrants nationally and in states, the argument is made that the social and economic realities of undocumented migration imply greater inherent uncertainties for subnational unauthorized statistics than implied by frequent popular usage of unauthorized statistics. Does the statistical system for measuring unauthorized migration shape our understanding of the social and economic reality of the unauthorized presence? A dramatic aspect is distinguishing census-level referents from population-level referents, more hypothetical than conceptual. Although major national surveys are designed to minimize census undercoverage biases, unauthorized residents would be among the hardest to count. What processes should shape development of statistical systems for quantifying and studying unauthorized migration? Should these statistics be considered in the context of human rights, development, and trade?

National Estimates for Net Unauthorized Migration

The major methodology is the well-known territory of a population accounting model in which the unauthorized estimate is the residual result of statistical aggregates. Methods involve quantifying the foreign-born population and the legally resident foreign-born population by characteristics (age, sex, country of birth, and period of immigration). The data consist of foreign-born population stock estimates, that is, data for aliens and naturalized citizens, from the 1980, 1990, and 2000 census detailed sample surveys, CPS (1979, 1983, 1986, 1988, 1989, and from 1994 on), or the ACS, and various administrative records-based data from which an estimate is developed

Table 5.1 Estimates for undocumented residents based on demographic accounting for legally resident foreign-born (populations in millions)

Date	Empirical counted	Total	Extrapolated counted	Total	Source
1979	1.724	–	–	–	Woodrow et al. (1987), Passel and Woodrow (1987)
1980	2.057		–		Warren and Passel (1983, 1987)
1980		2.5–3.5/4.0			Passel and Robinson (1988)
1980	1.651–2.596				Passel (1991)
1980		3.0–5.0			Fay et al. (1988)
1983	2.093 (14+)	–	–	–	Passel and Woodrow (1987)
1986	3.158	–	–		Woodrow et al. (1987)
1986		–	–	3.0–5.0	Passel and Woodrow (1986)
1988	1.906	–	–	–	Woodrow and Passel (1990)
1989	2.05		–		Woodrow (1990, 1991, 1992a, b, c)
1989					Woodrow (1991)
1990			2.4	3.3	Woodrow (1991)
1990			1.8–3.2	1.9–4.5	Woodrow (1991)
1990	At least 2.1–2.4	2.0–5.0	–	–	Woodrow-Lafield (1995) (extrapolation)
	2.2–3.4	2.0–5.0 (or 1.0–4.5/5.0)			Woodrow-Lafield (1998a)

for the legally resident foreign-born population. The administrative estimate relies on assumptions and judgments in absence of data for certain migration and other events. What is known is that there have been more than 30 million admissions of immigrants or lawful permanent residents, refugees, and asylees over 1970–2009, many already long-time residents. Some studies disaggregate the estimate to state of residence, a process that involves assumptions about place of initial residence and place of settlement, discussed later.

Based on Warren and Passel (1983, 1987) and Passel and Woodrow (1984a), a review panel recommended the census-level incorporation in the postcensal population estimates of 200,000 annually for population change due to net undocumented migration (Passel 1985b). Several sets of estimates for undocumented residents (Table 5.1) were developed to monitor net undocumented migration in the 1980s for purposes of population estimates and projections and 1990 census coverage evaluation (Woodrow 1991; Woodrow-Lafield 1998a; Robinson et al. 1993). These estimates were census or survey level with population accounting methods to partition the foreign-born population estimate into legally resident and undocumented components. The U.S. General Accounting Office (1993) reviewed progress in the study of undocumented immigration for 1980–1990, noting studies such as these for narrowing the range of estimates for total undocumented residents.

This measurement program with limited resources sufficed to show growth of the foreign-born population, continuation of population change due to net undocumented migration, and declines in older, European cohorts. Nevertheless, the history of poorly tracking the Hispanic population and foreign-born populations in national surveys hinted that national surveys in the 1980s series might be underestimating growth of the foreign-born population.

A study that estimated the foreign-born population in November 1989 as to lawful residents and undocumented residents (Woodrow 1991, 1992a, b, c) was a major part of the effort to evaluate 1990 census coverage. Three general conclusions were made about undocumented immigration for the 1980s. First, there was no measurable increase for the 1980–1990 decade in the number of undocumented immigrants residing in the United States. Second, net undocumented migration continued to contribute to U.S. population growth in the 1980s, perhaps by as much as 300,000 annually. Third, the explanation for this contradiction lies in the fact that the Immigration Reform and Control Act of 1986 (IRCA) led to legalization in 1988 of at least 1.7 million residents who had resided here in an unlawful status since before 1982.

This research served as a basis for stating possible numbers for total undocumented residents that were required for demographic analysis of 1990 census coverage evaluation necessary by early 1991 as part of the comprehensive evaluation of the 1990 census and preparation for adjustment. That decision was that the apportionment counts for House representation and published census figures would not incorporate an adjustment for undercoverage (Mosbacher 1991). An estimate of 3.3 million was hypothesized for the 1990 total undocumented residents after amnesty accorded to 1.7 million long-term residents (and possibly to up to 1.0 million agricultural workers) approximately offset continued net undocumented migration of two to three million for the decade. When the 1990 census count of foreign-born persons became available, that count was significantly higher than anticipated from national surveys, thereby yielding the expected higher estimate for individuals of potentially undocumented status in the census than in CPS-based studies as elaborated in Woodrow (1991) and Woodrow-Lafield (1995, 1998a).

Three major difficulties of estimating the numbers of undocumented residents nationally are, first, availability of a census or survey of population by nativity; second, the degree of noninclusion of all foreign-born residents in a census or survey; and, third, poor demographic accounting for legally resident foreign-born persons. The "Estimation or Guesstimation" aspect to unauthorized statistics may not be an exaggeration and is rooted in the data and statistical systems. Measuring unauthorized migration is in the midst of a "thicket of ignorance (very poor data on departures)" and "incoherence (conflicting definitions of temporary and permanent migrants)" across nations (Center for Global Development 2007), and at a National Research Council meeting in 2009, Douglas S. Massey referred to immigration data as "the weakest link in our demographic system." Availability of national surveys by nativity and of resulting foreign-born estimates is much greater than in the 1980s. On a monthly basis, the CPS provides data for the nation and the ACS provides annual estimates plus multi-year estimates for smaller subpopulations. One difficulty is distinguishing residents from sojourners. A crucial issue is degree of noninclusion of foreign-born residents in a census or survey, and there are only assumptions as to noninclusion of foreign-born residents in national surveys. Coverage errors directly affect unauthorized estimates (Woodrow-Lafield 1995, 1998a, b; Bean et al. 2001). Coverage issues are related to residence rules, which differ for the ACS, CPS, and decennial census.

Neither the Census Bureau nor the OIS-DHS provides comprehensive demographic accounting of events relating to the legally resident foreign-born population (Woodrow-Lafield 1998b). The OIS-DHS has records for lawful permanent resident admissions, records for temporary resident admissions, and certain other relevant information. Some improvements have been made in data management, such as incorporating nonimmigrant arrival data for adjustees. Emigration events are not tracked for lawful permanent residents, naturalized citizens, or native-born citizens, and I return to this later. The US-VISIT program might be a breakthrough for tracking temporary residents' departures. Consistency errors are likely in comparing survey responses and administrative data, adding inter-data errors upon any intra-data errors. For example, the Special Agricultural Worker (SAW) IRCA beneficiaries were granted lawful permanent resident status by 1991, but their actual residence was not known, and they may or may not have resided in the U.S. and been included in censuses and surveys. One possibility is to reorganize components of change for estimating the legally resident foreign-born population (Woodrow-Lafield 1995; Clark et al. 1994b). Another possibility is to acknowledge the uncertainty in the undocumented estimate posed by uncertainty in various components relating to legal immigration and the foreign-born population (Passel 1991; Woodrow-Lafield 1998a). To allow for these uncertainties, a range is more useful than a point estimate for undocumented residents. Passel (1991) analyzed levels of uncertainty in various components and illustrated that accumulations of errors supported a range of 1.651–2.596 million for undocumented residents based on the 1980 census, without addressing the total size of the population.

Immigrants entitled to stay here cannot be presumed to have done so permanently. On the other hand, we can neither assume that all nonimmigrants have departed or are self-defined as temporarily resident nor assume that none of them are counted in a census. It is highly likely that large numbers of nonimmigrants may resemble lawful permanent residents on many social and economic characteristics because many eventually adjust their status to lawful permanent resident, with this transition taking place after one nonimmigrant status or after a series of nonimmigrant statuses that may or may not involve departures and reentries. From *Statistical Yearbooks of Immigration Statistics* of the DHS in recent years, about two-thirds of lawful permanent resident admittees were adjustments who had already lived here 3–4 years, on average. It is likely that more than a million of those classified as unauthorized in 2000 adjusted status this decade. Besides nonimmigrants who may reside here for months or years, as students, temporary workers, or other, there are several statuses in which unknown numbers of foreign-born persons may be legally present temporarily. These include extended voluntary departure, deferred enforced departure, temporary protected status, awaiting asylum decisions, or contesting right to apply for amnesty under IRCA.

The LIFE Act of 2000 applied to several categories, including those individuals physically present on December 21, 2000, who qualified for permanent residency but were ineligible to adjust because of an immigration status violation. It also was "a corrective policy response," as described by Newton (2008), to three "late amnesty" lawsuits (*CSS v. Meese*, *LULAC v. Reno*, or *INS v. Zambrano*) in regard to unauthorized aliens who had not been able to apply for IRCA legalization, specifically applicable to persons who had filed for class membership before October 1, 2000. In addition to LIFE, settlements in those lawsuits allowed applications from those individuals who had traveled abroad. Even two decades after IRCA, others were able to apply as IRCA beneficiaries following a December 2008 settlement that opened up amnesty for tens of thousands who entered on valid visas and were without legal status between 1982 and 1988. That class-action lawsuit challenged the rule that applicants had to show their shift to legal status was 'known to the government." For individuals eligible under the LIFE legalization provisions with their approval dependent on demonstrating knowledge of English and civics and continuous residence, their spouses and unmarried children would also be protected against certain categories of removal and given work authorization if they showed having begun unlawful U.S. residence before December 1, 1988. According to the *2008 Yearbook for Immigration Statistics*, there were approximately 700,000 nonimmigrant admissions under LIFE over 1999–2008. These persons would have many years of residence upon becoming legal immigrants and might have been naturalizing after 2005. Considering likely numbers adjusting status under 245 (i) provisions over 1996–1998, the total number benefiting from these various policies is likely to be one million, essentially augmenting the legalization impacts of IRCA. Over many years, these aliens were awaiting a resolution as they were living here in uncertainty. More than a million of those classified as unauthorized in 2000 later adjusted status.

Federal responsibilities for legal and undocumented migration studies have historically been divided between the leading federal statistical agency in demographic and economic statistics, the Census Bureau, and the federal enforcement agency in border and immigration, first the INS and now the DHS. Neither the Census Bureau nor INS conducted regular studies for measuring levels of net undocumented migration during the 1990s, but INS research was more evident than Census Bureau research after 1992. There are several assessments of the INS Warren studies (1994, 1997) (GAO 1995a; Passel 1999; Bean et al. 1998; Woodrow-Lafield 1998a, b; Bean et al. 2001). From a past in which meager resources were devoted to immigration studies, the current climate is one in which staff and data resources are considerably greater. Although immigration and immigrant statistics were often regarded as in the purview of the U.S. Immigration and Naturalization Service with an enforcement and events orientation, legal and undocumented migration can only be assessed with national surveys of the native-born and foreign-born populations. DHS, and previously INS, is a high profile federal agency on illegal immigration largely because the border areas are extensive, apprehensions are high in number and attract public interest, and apprehensions are understood as indicative of successful entries. The INS and OIS-DHS administrative records on lawful permanent resident admissions and temporary resident admissions seem advantageous for developing a demographic profile for the legally resident foreign-born population, although technical issues must be resolved, as evident in each study deriving unauthorized estimates. Following earlier studies on nonimmigrant stays, transitions, and overstays, an INS study (Warren 1994) presented unauthorized estimates partially based on using the NIIS database for estimating the visa overstayer population from millions of nonimmigrant arrivals annually. This set was the first effort to make an estimate of net nonimmigrant overstays cumulative as of a specific date and to combine with residual estimates (Woodrow and Passel 1990) for unauthorized or undocumented migration of Mexican and Central American migrants and residents entering before 1982. One problem was that unknown departures could contribute to overestimating the overstay population and as few as one-quarter of apparent overstays might have been actual overstays (Warren 1990). A second problem is that Warren assumed that for every two residents who received amnesty under general IRCA provisions, there was another undocumented resident who did not apply and was still living here in 1992. There were other problems with assumptions about undercoverage, inclusion of SAWs, and assumed decrease in unauthorized migration after IRCA. In principle, the NIIS data could have served as the basis for estimates of nonimmigrant overstays on an ongoing basis, e.g., every 6 months, and provided timely information about this important source of undocumented immigration for states with overstayers but system problems were too serious. Because the methodology relied on assumptions and research prior to completion of both legalization programs, the INS unauthorized estimates of the mid-1990s may have underrepresented undocumented migration of Mexican and other North American origins and thus underestimated the undocumented population nationally. Those individuals who were legalization beneficiaries under agricultural worker provisions were likely to have become resident in the United States after 1990 and those individuals who were legalization beneficiaries under general provisions were neither long-term residents without question nor entirely representative of those long-term residents in undocumented status for whom eligibility requirements were met (Donato and Carter 1999).

Unauthorized Statistics at the State Level

The first empirical study of the geographic distribution of undocumented residents (Passel and Woodrow 1984a) included in the 1980 census (Warren and Passel 1987) found that undocumented residents were concentrated in California, New York, Texas, Florida, Illinois, and New Jersey, the same areas as immigrants in general. Based on aggregate statistics that included state of residence for legally resident aliens in 1980, the results may be affected by various estimation errors, but there was some consistency on geographic characteristics.

If undocumented aliens were to have been excluded from the 1980 census apportionment counts, as sought in *FAIR et al. v. Klutznick*, using these estimates in column (a) to simulate apportionment, California and New York might have each lost a representative and Georgia and Texas might have gained (Passel and Woodrow 1984b). These results would not be sufficient for purposes of reapportionment of House representation among the states if the Census Bureau were required to exclude undocumented residents from the apportionment counts. First, the Supreme Court ruled in 1999 that sampling methods cannot be used for apportionment purposes (Department of Commerce vs. House of Representatives, 98–404, and Clinton vs. Glavin, 98–564), and, second, the estimation methodology involved several data modifications contributing to interstate variability. As noted by Passel and Woodrow (1984b, p. 5), “Slight differences in the population figures used for the apportionment by the method of equal proportions could result in different priorities of selection and different apportionment of House seats.”

Survey foreign-born estimates at the state level are more available now than in 1989–1990 with the ACS multi-year estimates for smaller subpopulations at the state level. As before, there are only assumptions as to inclusion or noninclusion of foreign-born residents in national surveys, and differential coverage by state is likely, partly because coverage is likely to vary by ethnicity, race, nativity, age, and social characteristics. Because residence rules differ for the ACS, CPS, and decennial census, there could be different implications within geographic areas by these data sources. Emigration events and nonimmigrant departures might affect certain state estimates more than others (Kraly 1995). Consistency errors are likely in comparing survey responses and administrative data, in addition to errors within data sources. The state estimates of undocumented aliens in the 1980 census were explained as unofficial, and likely errors were well noted (Passel and Woodrow 1984a). The deviation from this consensus occurred when INS researchers ventured forth with state-level unauthorized estimates after the 1993 release of foreign-born population data from the 1990 census (Warren 1993). Legal immigrants may take up residence elsewhere within the United States, although address of record may be highly consistent for those nonimmigrant adjustees with established residence.

Without any annual registration, administrative records are incomplete as to current residence and residence history, primarily continuing the immigrants’ initial addresses for receipt of their permanent residence cards. The majority of legal immigrants initially indicate residence in the six states with established foreign-born populations—California, New York, Illinois, Texas, Florida, or New Jersey. Additional states are known now as destinations for the foreign-born, e.g., Arizona, North Carolina, Georgia, Colorado, and New Mexico. Secondary migration may be pervasive with differing patterns to be found among place-of-birth, occupation, education, age, and family variables (Neuman and Tienda 1994). Net international migration for post-2000 is allocated based on information from the ACS. In litigation and legislative hearings, representatives of the Census Bureau cited the lack of capability for producing subnational estimates of undocumented migration (Passel 1986a, b), underlining the distinction between production estimates and estimates for research purposes (GAO 1993; Passel 1985a). Regarding INS unauthorized estimates, state-level distributions have uses for allocating personnel and other resources for enforcement purposes or agency mobilization for legalization programs, as in the case of IRCA (INS 1986) or comprehensive immigration reform legislation (Preston 2009) (See Passel and Woodrow 1986, 1987). After the 2000 census, the Census Bureau planned to produce annual estimates of the unauthorized migrant population by age and state of residence (Kincannon 2003).

In lieu of appropriate data or methodology for allocating the total of 3.0 million undocumented residents to state of residence, the subnational distribution for the one million assumed as uncounted undocumented residents for 1980 can be sketched by imposing an assumed distribution, such as in Passel and Woodrow (1984a), to derive illustrative estimates of total undocumented residents for selected states for 1980 (column (b)). If the true distribution of undocumented residents were known, its accuracy would have to be judged on the bases of both absolute levels for states and levels relative among the states. As with any synthetic estimates, accuracy may be associated with accuracy in initial measures, accounting for heterogeneity and temporal or characteristics variation from measured patterns.

Even if the Passel-Woodrow distribution for counted undocumented residents were accurate and an undercount of undocumented residents by 50% nationally were accurate, the risk of being counted in the 1980 census would likely vary from state to state for undocumented residents because census undercount stems from whole household omission and within household omission, and the risks of omission vary by household living arrangement, renter/owner status, community, race, age, sex, and ethnicity. Immigrant communities are highly heterogeneous across states. Consequently, these state-level figures for 1980 are crude and adequate only for addressing the question with explicitly stated qualifications.

In columns (d) and (e) are higher and lower range figures broadly based on Woodrow's (1991) analysis for 1990 undocumented residents and allocation to states by the Passel-Woodrow (1984a) composition. Interpreting the hypothetical 1980 distribution as indicative for 1990 state-level undocumented populations for states is risky but the post-1980 studies on undocumented residents by census demographers did not provide state-by-state detail. First, there was inadequate basis for deriving the state-by-state distribution for legally resident immigrants; and second, survey estimates for the state-by-state distribution of the foreign-born population were subject to high nonresponse errors, chiefly sampling variability and undercoverage. Among possible distributions that could be selected for allocating these national figures to states are those for all foreign-born persons from a census, all noncitizens from a census, amnestied aliens from administrative records, or some combination. None is an optimal choice for representing how this national population estimate might be distributed across states. Each choice is biased by a universe other than undocumented residents and temporal displacement in measurement. Fernandez and Robinson (1994) responded to Warren (1993), drawing on Woodrow's (1991) estimate. For 1992, Robinson and Fernandez stated the figure 3.8 million. For 1994, they stated a range of 3.5–4.0 million, and the working paper showed illustrative estimates at the state level based on Passel and Woodrow, IRCA applications distribution, and 1990 census noncitizens by state. In columns (f) and (g) are the lower and higher figures. Obviously, these distributions have a very low degree of statistical rigor, euphemistically speaking. The essential flaw for using these figures for policy formulation is that these distributions are not based on any calculations involving actual foreign-born immigration, whether legal or undocumented, to states. The accuracy of this distribution depends on a labyrinth of assumptions with the overarching principle that geographic distributional patterns of initial U.S. settlement and internal migration persisted over time.

GAO (1993) noted several data limitations for the 1980s and 1990s, especially that there is a lack of information on the geographic distribution of illegal and legal aliens despite its value for “policy and program evaluation, estimation of local economic impacts, and assessment of cultural assimilation barriers” (U.S. General Accounting Office 1993, p. 68). The OIS-DHS published state-by-state estimates of illegal immigrant residents were based, in part, on comparing legal immigrants’ statements about their intended destinations, as reflected in administrative records when they were admitted to the United States, to decennial census or survey geographic distributions for the total population of foreign-born residents. These state-level estimates were uncertain to the extent that legal immigrants moved to different states from the states of their intended destinations, at any time before the survey date—and some did move to a different state (GAO 2004). As of the 2008 estimates, the OIS-DHS modified procedures to use a post-immigration residence when known, e.g., residence at naturalization. As Woodrow-Lafield’s analyses of naturalization residence (2008b) suggested, earlier studies overestimated unauthorized residents in California and Florida, which gained new citizens, and underestimated unauthorized residents in Illinois and New York, which lost new citizens. Briefly, there was some consideration after 9/11 to reinstating the Alien Address Report Program or mandating an annual registration for nonimmigrants, but the program is unlikely to be reinstated given its reliance on voluntary participation (GAO 2005).

As preparations for the 1990 census neared completion, the issue of undocumented residents by state again emerged in litigation and proposed legislation. This matter was dwarfed by the broader issue of census adjustment for underenumeration. In part, this was attributable to the courts’ support of the Census Bureau’s position that the constitution mandated enumeration of all residents and that representation should be apportioned on the basis of that count. Also, statistical modeling was more definitive as to California’s and New York’s potential loss of a seat than as to which particular state might suffer injury. Interestingly, those states that would have lost statistically on the undocumented issue were also the states standing to gain on the adjustment issue since immigrants, in general, and undocumented immigrants, in particular, tend to be concentrated in the most populous states.

To review the history of census adjustment for undercount, the controversy arose subsequent to the 1970 census. The U.S. Bureau of the Census conducted postenumeration surveys of the 1980 and 1990 censuses as well as demographic evaluations (Fay et al. 1988; Robinson et al. 1993; Choldin 1994). Following comprehensive evaluation of the 1990 census and preparation for adjustment, the decision was that the apportionment counts for House representation and published census figures would not incorporate an adjustment for undercoverage (Mosbacher 1991). Under court challenge, this decision was found in 1994 to have been made with insufficient foundation in the U.S. Second Circuit Court of Appeals. The administration supported that ruling by default so that there could be a reallocation of federal funding.

If House representation had been changed accordingly, Arizona and California might have each gained a seat, and Pennsylvania and Wisconsin might have lost seats (Pérez-Peña 1994). There was close scrutiny to the Census 2000 decision.

Simultaneous to states' concerns with the adjustment issue, Californian politicians were positioning themselves to benefit from lack of standing of other states for pursuing reapportionment to exclude undocumented residents. Parker and Rea (1993) and LA County Internal Services Division (1992) reported on state and local costs associated with undocumented residents. In 1993, several lawsuits were filed against the federal government for reimbursement of costs to states from the presence of undocumented migrants through failure of federal enforcement policies. Vernez (1992) made a logical presentation for federal support to communities burdened with immigration. With passage of Proposition 187 in California to limit immigrant access to public benefits, the political climate became anti-immigrant with conservative ideology narrowing the immigration debate to a fiscal basis (Newton 2008). From the West Coast to the East Coast, ideologies contrasted as New York City officials disavowed any policies that would require medical, law enforcement, or educational officials to report unlawfully resident individuals. In stepping down from 35 years as Manhattan District Attorney, Robert M. Morgenthau stated his intention to push for legislation to help immigrants, and his office had a longstanding policy of not reporting illegal immigrants who were victims of crimes (Eligon 2009).

The INS estimates by state, shown in column (h), were widely publicized, and the INS derived them by allocating national-level estimates of unauthorized immigrants specific to country-of-citizenship to states by using legalization applications by states (Warren 1993). The critical flaw is, again, a static assumption that these immigrants live in various states in the same relative pattern as aliens who legalized under the Immigration Reform and Control Act of 1986. That is, the state-by-state distribution is not based on actual net undocumented migration to states or on nonimmigrants in various states who overstay their visas. Finally, column (i) shows the results of extrapolation of column (h) to April 1994 by assuming that average annual population change due to net undocumented migration was about 300,000 for 1992–1994. As discussed earlier, the INS figures may have seriously underestimated net undocumented migration of persons entering without inspection, mostly Mexicans, implying underestimation for states, especially California, with concentrations of Mexican legalized immigrants. Finally, Table 5.2 includes state estimates as available in Clark et al. (1994b) (column (j)), and Huddle (1993, 1994) (column (k)). Huddle's figure for Texas for 1990 is higher than the INS figure in column (h), but not out-of-range if high uncertainty is accepted for the 1990 range or if the INS estimate for Texas were too low on Mexicans.

From having scarcely any studies putting forth estimates of unauthorized residents in states, multiple studies are available this decade. There are legitimate reasons to be concerned about accuracy, and these estimates take on significance with immigration restrictionist groups and politicians. What is perceived as a failure of national immigration policy led to trickledown policies at state and local levels. With the inability of Congress to agree on immigration legislation, the Bush Administration continued border enforcement and intensified interior enforcement strategies, with ICE

Table 5.2 Estimates of undocumented populations (populations in thousands)

	PW		KWL			FR	FR	INS		UI	Huddle
	1980		1990			1994	1994	1992	1993	1990	1990
State	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
U.S.	2,057	3,000	1,000	5,000	3,000	–	–	3,379	3,829	1,975	4,800
California	1,024	1,493	498	2,489	1,493	1,321	1,784	1,441	1,633	875	
New York	235	342	114	570	342	462	539	449	509	284	
Texas	186	272	91	453	272	300	427	357	405	217	550
Florida	80	117	39	195	117	243	385	322	365	186	
Illinois	136	198	66	329	198	157	225	176	199	78	
New Jersey	37	54	18	89	54	98	168	116	131	90	
Other	360	525	175	874	525	451	992	518	587	245	

Table 5.3 Selected estimates of unauthorized residents in selected states of residence

	1980	1990	1992	1992	1993	1994	1995	1996	2000	2000	2000	2004
State	PW	INS	INS	INS	n.s	FR	P	INS	KWL	P	PVB	P
US total	3,000	3,500	3,379	3,200	4,000	3,750	4,823	5,000	6,929	8,500	8,326	10,300
California	1,493	1,476	1,441	1,275	2,083	1,550	2,172	2,000	2,578	2,300	2,255	2,400
Florida	117	239	322	345	137	310	381	350	534	700	552	850
Illinois	197	194	176	170	270	190	117	290	369	500	1,111	400
New Jersey	54	95	116	125	70	130	165	135	290	300	350	350
New York	341	357	449	485	371	500	428	540	1,005	700	676	650
Texas	271	438	357	320	521	360	605	700	686	1,200	1,111	1,400
Other states	526	701	518	480	531	710	954	985	1,467	2,900	2,910	3,150

Table 5.4 DHS estimates of unauthorized residents in selected states of residence

	2000	2000	2005	2006	2007	2008	2009
State	INS	OIS-DHS	OIS-DHS	OIS-DHS	OIS-DHS	OIS-DHS	OIS-DHS
US total	7,000	8,460	10,500	11,600	11,780	11,600	10,750
California	2,209	2,510	2,770	2,830	2,840	2,850	2,600
Florida	337	800	850	980	960	840	720
Illinois	432	440	520	550	560	550	540
New Jersey	221	350	380	430	470	400	360
New York	489	540	560	540	640	640	550
Texas	1,041	1,090	1,360	1,640	1,710	1,680	1,680
Other states	2,271	2,730	4,060	4,630	4,600	4,640	4,300

conducting worksite raids and arresting day laborers. In Table 5.3 and 5.4, we examine several state-level estimates for unauthorized residents for pre-2000 dates (Passel and Woodrow 1984a; Fernandez and Robinson 1994; Warren 1997; INS 1998a; Passel 1999), for 2000 (INS 2003; Hoefer et al. 2006; Passel 2002; Passel et al. 2004), and for post-2000 dates (Hoefer et al. 2006, 2007, 2008, 2009, 2010; Passel 2005). Shown in regard to the Fernandez-Robinson working estimates is the average of the low and high figures. Showing these estimates for 1980–2008 does not imply meaningful value to year to year comparisons, but this collection of research studies in pursuit of elucidating a hidden population must be remembered as a resource within which different strengths, weaknesses, errors, and clues may be found.

The first set of 2000 estimates is drawn from an analysis of the impacts of immigration in the 1990s for apportionment (Woodrow-Lafield 2001). This distribution was made before release of census counts and based on census estimates for foreign migration to states in the 1990s and augmented with an "extra" 1.4 million immigrants over the decade according to Woodrow-Lafield (1998b). This set shows New York as having higher unauthorized residents than Texas, and, incidentally, the findings on apportionment resembled the actual apportionment while illustrating that, hypothetically, the presence of undocumented residents may have contributed to gains of a congressional seat each for California and Georgia.

Finally, Table 5.4 selectively shows INS and OIS-DHS estimates of unauthorized immigrants over January 2000–January 2009. The OIS-DHS is charged with publishing state-level statistics on unauthorized residents.

The geographic distribution of the legally resident foreign-born population may shift over time due to gains in lawful status, migrant choices, return migration, and patterns of internal migration. The geographic distribution of unauthorized residents may shift over time due to similar reasons plus the added jeopardy of status. With some caveats, California's share of the unauthorized population declined over 1980–2000 from 49.8% to 37.2%, consistent with Johnson (1996), and declined over 2001–2005 until reaching a plateau over 2006–2008. These findings could indicate a real decline for California, although that seems counterintuitive given agricultural labor demands. Legalization pursuant to IRCA, high naturalizations, and family reunification may have resulted in a broad transformation of California's foreign-born population as more lawful than unauthorized. The new methodology may have affected estimation of the 2008 unauthorized populations in New York and Florida, as mentioned earlier (Woodrow-Lafield 2008a, b). If distributional shifts for unauthorized residents in the latter part of this decade were as characterized by the distribution for 2001–2005, state labor markets in several nontraditional states of destination would have been incorporating increased numbers of unauthorized residents, more so than California, Florida, Illinois, New Jersey, and New York. This seems most unlikely to have occurred given the economic crisis.

A hot topic has been whether immigrants have been leaving due to the economic crisis. Measuring emigration is complicated conceptually and empirically (Woodrow-Lafield and Kraly 2004). Prior to the 1990 census, national population surveys were detailed not only by nativity and citizenship but also included detailed data for family networks, resident and living abroad, with supplementary data on emigrants and Americans living abroad. Census immigration activities included measuring emigration based on CPS data with multiplicity sampling along with evaluation of census and CPS data by nativity and country of birth, estimating undocumented populations in the CPS, included in the census, and resident, estimating immigration components for estimating census coverage by demographic analysis, beginning a statistical matching study of CPS data with INS data for estimating the legal status distribution by state and evaluating such an approach with census data, creating a new division working group for research on immigration and foreign-born population, an inter-agency research on illegal immigration and reports mandated by Congress, and planning immigration initiatives.

Measuring emigration based on surveys with multiplicity sampling through questions on residence of consanguineal relatives and prior residence is an approach that may not have been sufficiently explored. The data collection and analyses were funded through decennial census evaluation sources and by the INS, and the purpose was to gather information about former U.S. residents who had emigrated. There are some developments in measuring emigration by analyzing CPS attrition and Social Security Administration work history data. Of the November 1989 CPS estimate of about one million emigrants, about one-half were foreign-born, mostly aliens, and the majority resided in Canada, Mexico, or other North American countries (Woodrow-Lafield 1996). There were more emigrants in Mexico in 1988 than in 1987, and the same pattern was found for Mexico-born emigrants. This pattern of possible Mexican return migration for 1987–1988 coincided with the application period for IRCA legalization. Possible explanations for these results are (1) that border control and employer sanctions provisions of IRCA could have forced some undocumented aliens to temporarily return to Mexico during 1987–1988, or (2) that some legally resident aliens may have temporarily returned for visits once they had obtained amnesty or travel documents.

Unfortunately, data from a 1991 survey were never analyzed or released. These surveys were discontinued and development of this research infrastructure ended. We can surmise that such data collection in the early 1990s would have been enlightening as to post-IRCA migration behavior. Durand et al. (2001) found Mexican return migration for the early 1990s. Nor was the time series of emigrant estimates from multiplicity sampling surveys available in 2007–2009 when questions about continued unauthorized migration and return migration arose with the current economic crisis and intensified enforcement measures of the Bush administration after immigration reform was not enacted by Congress. These surveys might well have measured recent patterns, and some experts expected significant levels (Beith 2009).

Conclusion

Given the political implications of unauthorized estimates, OIS-DHS, and previously the INS, may not be the ideal federal agency for assessing net undocumented migration as population change since that task is inseparable from evaluation of the agency's enforcement accomplishments. OIS-DHS unauthorized estimates serve that evaluation function in some degree (GAO 2005). In the early 1990s, INS estimates suggested that the undocumented population was not growing and, by inference, that persistence of border strategies might be key to extending such a "trend." A few years later, INS unauthorized estimates (Warren 1997, 1998) were the basis for asserting that unauthorized migration had slowed in the late 1990s, which seemed implausible given high labor demand, high employment rates, and high wages. Subsequent analyses showed higher unauthorized migration in the later 1990s than earlier in the decade (Passel 2005). Institutional goals of satisfying the enforcement mission may contribute to interpretation and creation of unauthorized statistics. The process of developing unauthorized estimates should be deductive rather than inductive. Neither is the Census Bureau to be considered ideal because gauging completeness of census count depends on moderating the upper limit on the numbers of undocumented residents. Upper limits on undocumented residents are directly correlated with census undercoverage levels. Both agencies would be well served by underestimating net undocumented migration to the United States. If Census 2010 more accurately enumerates the population than Census 2000 as an overenumeration, then estimating undocumented residents, counted and total, especially affects net undercount.

This review cannot fully address all of the relevant questions. Has this elaborate discussion been a useful exercise? Can we say that, in 2009, the number of undocumented residents in California is about 2.8 million or might there be 4 or 5 million unauthorized residents in California? Can we say that the number is not lower than 2.8 million? There are few bases for stating a range or point estimate for undocumented aliens now in any single state. Figures focusing on individual states or the relative distribution may be misleading for use in conjunction with per capita cost estimates, simply because data limitations are severe and major assumptions are needed. The value of these numbers is further diminished when we consider that undocumented residents may have minimal footprints and may be working in a state other than the one in which they are living. In considering undocumented workers as a segment of the undocumented population, not all undocumented residents would be participating in the labor force at a single point in time as many would be children or elderly. The size of a state's work force may also be affected by out-of-state commuters as indicated in 1990 census data on journeys to work. Displacement and competition questions probably require geographic-specific analyses of labor markets. In general, there is no clear support for these arguments.

Recent concern about immigrants and immigration may be intermeshed with a number of social issues and social problems involving other population subgroups, including public education financing, school and housing desegregation, health delivery, health insurance, unemployment, poverty and income stratification, literacy, and criminal and drug activities. Contemporary debate may provoke more social science research to investigate various immigration impacts at national and subnational levels, commensurate with a long-term trend toward state and local responsibilities for own population statistics (de Neufville 1987). Subnational perceptions may be disproportionately affected by the contemporary phenomenon of undocumented migration than based on extant undocumented estimates that are subject to data constraints and high on uncertainty. Immigrant composition, especially by undocumented and legal status, for states and metropolitan areas may take on greater importance. Experiences of selected states and cities as loci of social and demographic change will persist into the next century (Massey 1995, 2008).

Legal immigration is increasing under provisions of the Immigration Act of 1990. Although IRCA had clearly visible impacts in legalization of long-term undocumented residents and agricultural workers, the true impacts from these programs incorporated admissions of relatives sponsored by these legalized individuals, probably between one and two million (Woodrow-Lafield 1995, 1999). With immigration anticipated to continue as a major source of population growth, with subsequent fertility related impacts, there will be implications for the United States in the areas of religious, ethnic, environmental, economic, and natural situations throughout the world. For the 1990s, assumptions about immigration led to “placeholder” amounts in the population estimates until the new census benchmarked population estimates. With reengineering of the 2010 census, evaluating immigration remains crucial.

Another legalization program for some categories of long-term unauthorized residents would provide valuable statistics for evaluating extant estimates and methodologies. Researchers might also engage in studies of the role of voluntary organizations in helping individuals file applications and complete the process. If there were marked differences between derived estimates of unauthorized residents eligible for legalization and counts of legalization applicants/beneficiaries, these would arouse concerns about fraudulent applications and appropriate agency processing and review. Thus, creation of rules and regulations for such a legalization program should include steps designed to avert mistakes in processing and to promote legitimate filing of applications. In addition, mechanisms are desirable for allowing scientific research on the legalization applicant population, processing, decisionmaking, outcomes, and evaluation of prior unauthorized statistics through accessible data sources.

Federal statistics tell the stories of the nation about poverty, child abuse, unemployment, crime, health, voting, etc. Social conditions removed from individuals’ realities become salient issues politically and morally. Being measured as a group is to be politically noticed and “to be noticed is to have a claim on the nation’s resources” (Prewitt 1987, p. 270). Statistical measurements are usually subject to imperfection, and social scientists must resist reification of the statistics as the actual phenomenon. Statistical identification may be appropriate to certain groups, but “these same statistics make invisible to the policy process other groups at the margins of social and economic life, where measurement often fails – the undocumented workers, the illegal aliens, and the vagrant, homeless populations” (Prewitt 1987, p. 272). Having emerged as a mensurable group in regard to 1980 census coverage research, the undocumented population is attracting greater notice than can be properly addressed statistically. Certainly, undocumented immigration is likely to persist until there has been substantial economic development in sending nations and perhaps more economic integration across nations, especially within North America. Debate about costs of undocumented immigrants should acknowledge uncertainty limits on the magnitude of the population and the fluid character of undocumented immigration. Immigrants may serve to enhance our linkages to international labor markets in an increasingly global economy.

Evaluations of contributions of immigrants (or undocumented immigrants, in particular) relative to costs are complicated by nature and susceptible to flaws. The several research studies are inherently more appropriate for the specific time period and immigrant cohorts. One review (Rothman and Espenshade 1992, p. 410) reported that “. . . no universal conclusion about the fiscal impacts of immigrants on government budgets is possible. . . . It appears that the fiscal costs of U.S. immigration fall most heavily on state and, especially, on local governments. . . . fiscal impacts at the federal level alone are uniformly positive.” In an assessment for Los Angeles County (Clark and Passel 1993; also, Clark et al. 1994a, b), local deficits attributed to recent immigrants were found to have been overstated and long-term immigrants were found to have substantial fiscal contributions for their residential areas. Revenues from immigrants are often understated, and local spending on all groups, including natives, generally exceeds contributions through local taxes. Controlling for immigrants' greater likelihood of having incomes below the poverty level, immigrant households were less likely to receive public assistance (Bean et al. 1994).

From limited recent evidence, the current economic crisis has affected foreign-born persons more than natives, but those currently residing here are staying for the time being although there are indications that fewer are migrating into the U.S. Whether return migration has increased is not known (Passel and Cohn 2009). One study in the Yucatán in Mexico found "reduced circularity in migration (less return migration)" (Cornelius et al. 2009), and this reaction to border enforcement strategies may be lasting regardless of economic shifts. Anecdotal accounts refer to migrants' consideration of returning to home communities because work has become harder to find in the recession.

Will the ACS and Census 2010 include ~40 million foreign-born persons, possibly including 27–30 million legal residents and 10–13 million unauthorized residents? Without these three research programs, we may have less information than possible about international migration this decade. With emphases on border and interior enforcement strategies, job losses, recession, and suggestions of return migration flows, network sampling surveys to assess emigrants and transnational migrants are important. Collaborative binational studies should be regular rather than sporadic. Given the biases and limitations of unauthorized statistics, surveys of foreign-born populations as to immigration status, such as described by Larson and Droitcour (2010) and implemented by Marcelli (2010), are to be considered, so long as appropriate measures are taken to safeguard respondent confidentiality and promote participation. In terms of the two-card approach, the potential uses of the data are numerous for microsimulation modeling to improve immigration statistics.

Returning to one of Starr's key questions, what processes should shape statistical systems for quantifying unauthorized migration? Statistical policy focused on improving estimation of unauthorized populations and migrants, especially within North America, would provide benefits for population programs and public policies on enforcement, global development, and international trade. Better unauthorized statistics would be useful in sorting out myths and realities of immigration patterns. Nevertheless, one has to wonder about the value of state-level unauthorized estimates and the implicit tension between estimating net population change due to unauthorized migration and gauging unauthorized migration for purposes of evaluating enforcement strategies.

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Part II
Demographic Issues in a Globalized World

Chapter 6
English Language Learners: An Exercise in Applied Demography

Richard R. Verdugo

Introduction

Demography and social policy have never been strange bedfellows. Size, distribution, and population change greatly impact societal institutions and social issues. The new settlement patterns among immigrants, especially Hispanics, have had such effects. Specifically, it has meant that English Language Learner (ELL) students are now spread across greater geographic areas of the United States (Capps et al. 2005; Bartel 1989). While there are many challenges facing America's educational systems – e.g., school reform, the *No Child Left Behind Act*, student performance, the achievement gap, and currently the Obama Administration's "Race to the Top" program, to name just a few-one set of challenges is not as well documented. This particular challenge is brought about by students whose primary language is not English, or English Language Learners (ELL).

ELL students bring to school learning issues related not only to their English language proficiency, but also economic and cultural differences that challenge educational systems.[1] We know, for instance, that ELL students are characterized by the diversity of their primary language, and their poor to lower social class backgrounds (Verdugo and Flores 2007). Differing language backgrounds among the ELL student population also highlights their cultural diversity; that is, norms and values about what is expected in school, level of parental involvement, and other education-related topics, vary by their cultural and social class backgrounds. Moreover, ELL children who leave war-torn countries for the U.S. carry these experiences with them to school, perhaps affecting their educational performance.

The views expressed in this paper are not necessarily those of the National Education Association

[1] See Verdugo and Flores (2007).

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_6, © Springer Science+Business Media B.V. 2012

Finally, research points out that economic status is positively related to school performance. The relationship is so well established that it has generated a law-like proposition: the better is one's socio-economic status, the better will be one's educational performance.[2] And since it appears that many ELL students come from humble origins, we can expect them, generally, to perform less well in school.

But there are other challenges as well. Recent literature indicates that white students leave schools when immigrant students begin moving in (Betts and Fairlie 2003), that schools with high percentages of immigrant students are also highly segregated (Santillano 2009), and that schools with high percentages of minority or poor children are schools educators wish to leave (Jackson 2009). In short, schools with high levels of immigrant students and high proportions of ELL students are also highly segregated.

In this paper I use an applied demographic framework in examining several key issues regarding ELL students: their number, distribution, segregation, isolation, and the likelihood of their interacting with students who are enrolled in free/reduced lunch programs.

By an applied demographic framework I mean the utilization of selected demographic tools in examining social problems. Using data from the U.S. Department of Education's *Common Core of Data*, I find that ELL students tend to be highly concentrated in certain parts of the country, are segregated from non-ELL students, and are likely to interact with students who are enrolled in free/reduced lunch programs. These are important results that are not well researched in the extant literature on ELL students. Indeed, in the most comprehensive summary to-date of the status of ELL students in the U.S., the authors state that the degree to which ELL students come from poor to lower-class origins is not well understood and that further research is needed (August and Hakuta 1997).

Methods

Data

Data for my study are from the 2002–2003 *Common Core of Data (CCD)* collected each year by the U.S. Department of Education. The smallest unit of analysis used in my study is the school district, which allows researchers to conduct their analyses at that level and then aggregate up to the state and region.

It should be pointed out that I limit the analyses to students in public, K-12 regular schools. By regular schools I mean schools that are not vocational, special education, or other/alternative educational environments. Given these constraints,

[2]For example, Espinosa (2005) finds that 39% of LEP students are on free/reduced lunch programs. Though the SES-Attainment relationship is well-known, a recent study suggests that such a relationship is tempered by the community in which one resides (Starkey 2009).

we are left with 7,716 school districts in 49 states (including the District of Columbia). Two states have been removed from the analysis: Pennsylvania and Tennessee (ELL data are missing for both states). Hawaii is used in some analyses, but not in others because there is only one district in the state and therefore there will be no variation among some concepts I will be examining. Consequently, national totals reported in my paper might not equal other published results. The U.S. Department of Education has indicated that data for the school year 2002–2003, the most recent data available at the time of this writing, are preliminary, and so at a later time Pennsylvania and Tennessee may have data available.

Measures and Variables

Segregation Measures

Two measures of segregation are used in this study: the *Dissimilarity Index (D),* and a *Segregation Index (S)*. The formulas for each measure are listed below:

$$D = \Sigma\left\{\left(\left|\mathrm{e_i} / \mathrm{E} - \mathrm{ne_i} / \mathrm{NE}\right|\right) / 2\right\}$$

$$S = \Sigma\left[\left(\mathrm{x_i} / \mathrm{X}\right)\left(\mathrm{y_i} / \mathrm{T}\right)\right]$$

First, for the *Dissimilarity Index (D)*, e_i = ELL students in the i^{th} district, E = total ELL students in the state, ne_i = non-ELL students in i^{th} district, and NE = total non-ELL students in the state. Second, for the *Segregation Index (S)*, x_i = number of ELL students in the i^{th} district, y_i = number of non-ELL students in the i^{th} district, X = total ELL students in the state, and T = total students in the state. The greater the *Dissimilarity Index*, the greater the percent change that has to occur for both groups to be equally distributed. Also, the greater the *Segregation Index*, the more segregated are ELL students from non-ELL students.

In addition, I computed an interaction measure (*I*), which tells us about the likelihood ELL students have in interacting with students who are enrolled in free/reduced lunch programs. The *Interaction Index (I)* is:

$$I = \Sigma\left[\left(\mathrm{e_i} / \mathrm{E}\right)\left(\mathrm{f_i} / \mathrm{F}\right)\right]$$

Where e_i = number of ELL students in the i^{th} school district, E = total ELL students in the state, f_i = number of students who are enrolled in free/reduced lunch programs in the i^{th} school district, and F = total number of students who are enrolled in free/reduced lunch programs in the state. The greater the interaction score, the greater the likelihood that ELL students will interact with students who are enrolled in free/reduced lunch programs. The Interaction Index is used as a proxy for the socioeconomic status (SES) of ELL students and the school districts they attend.

Table 6.1 Regions used in the analysis[a]

Region	States
NE	Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont
MW	Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin
WE	Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming
SO	Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia

[a]Note that Pennsylvania and Tennessee are not used in the present analysis due to missing data. Also, because there is only one school district in Hawaii, results are reported for this state only when aggregated results are used

Other Variables

Other variables in the analysis include students who are enrolled in a free and reduced lunch program, and two geographic areas: state and region.

Free-reduced lunch program. Students who are enrolled in free-reduced lunch programs are used in my study. I use this group as a proxy to compute how likely ELL students are to interact with low SES students. My working hypothesis is that there is a high likelihood of such interaction. In the school year, 2003–2003 there were 15,083,949 students in free and reduced lunch programs attending regular public schools in the U.S.

Geographic concepts. Region and state are used in the analysis. Region is divided into the four census concepts: Northeast (NE), Midwest (MW), West (WE), and South (SO). States making up these regions are found in Table 6.1.

Findings

The ELL Student Population: 1992 to 2003

National Figures

Data in Table 6.2 present total student enrollment and total ELL student enrollment for the years 1992–2003. Also presented in Table 6.2 are data representing ELL students as a percent of the total K-12 student population, the growth of the ELL population, and the growth of the total K-12 student population.

In 1992, there were 44.4 million public school students enrolled in regular school grades K-12 in the U.S. By the year 2002–2003, the K-12 public school student population had increased to 49.5 million, or an increase of 11.5%. In contrast, the

Table 6.2 ELL students: 1992–2003

School year	(A) Total enrollment	(B) ELL enrollment	(C) ELL as a percent of total enrollment	(D) Growth of ELL enrollment	(E) Growth of total student enrollment
1992–1993	44,444,939	2,735,952	6.16		
1993–1994	45,443,389	3,037,922	6.69	11.04	2.25
1994–1995	47,745,835	3,184,696	6.67	4.83	5.07
1995–1996	47,582,665	3,228,799	6.79	1.38	−0.34
1996–1997	46,375,422	3,452,073	7.44	6.92	−2.54
1997–1998	46,023,969	3,470,268	7.54	0.53	−0.76
1998–1999	46,153,266	3,540,673	7.67	2.03	0.28
1999–2000	47,356,089	4,416,580	9.33	24.74	2.61
2000–2001	47,665,483	4,584,946	9.62	3.81	0.65
2001–2002	48,296,777	4,747,763	9.83	3.55	1.32
2002–2003	49,509,923	5,044,361	10.19	6.25	2.51
% Change: 1992–2002	11.40%	84.37%			

Source: National Clearinghouse for English Language Acquisition: www.ncela.gwu.edu

ELL student population grew from 2.7 million in 1992 to over 5 million in 2002–2003, or an increase of 84%.[3] The biggest increase in the ELL population was between the 1998–1999 and 1999–2000 school years in which the ELL population grew from 3.5 million to 4.4 million; indeed, column D in Table 6.2 indicates that between these two school years, the ELL student population grew by nearly 25%.

The growth of the ELL student population can also be indexed by their share of the total K-12 student population. In 1992, ELL students were 6.2% of the total student population and by 2002 ELL students had grown to 10.2% of the total regular U.S. public school population. While this growth has remained fairly steady since 1992, there was a sharp increase between the school years 1998–1999 and 1999–2000. Figure 6.1 presents the growth curves for both ELL students and the total student population in the U.S. from 1992 to 2003. As can be seen, the ELL student population has grown at a greater rate.

State Level

Not all states have been equally affected by the growth of the ELL student population. Some states are facing greater educational challenges than others. Table 6.3 displays data on the total K-12 student enrollment and total ELL student enrollment by state for the school year 2002–2003. Data refer to "regular" schools only and thus totals may differ from other published reports.

[3] Note that this figure is larger than the total used in our paper. The difference is due to our limiting the analysis to K-12 public regular schools and to missing data.

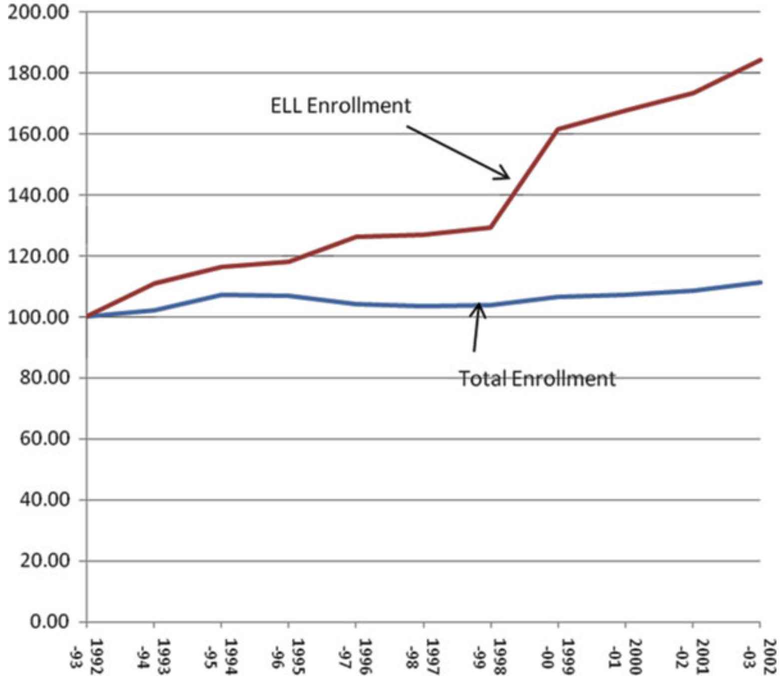

Fig. 6.1 Growth rates of total K-12 public school enrollment and ELL enrollment, 1992–2003 (1992 = 100)

Table 6.3 Student data by state: 2002–2003

State	Total students (state)	Total students (school)	LEP/ELL students	Percent ELL of total (state)
AK	134,364	134,364	16,378	12.19
AL	739,678	726,545	10,568	1.43
AR	450,985	450,985	15,146	3.36
AZ	937,755	929,111	133,124	14.20
CA	6,356,348	6,244,403	1,589,346	25.00
CO	751,862	751,056	86,118	11.45
CT	570,023	570,009	22,157	3.89
DC	76,166	76,166	5,798	7.61
DE	116,342	116,342	3,430	2.95
FL	2,539,929	2,532,566	203,710	8.02
GA	1,496,012	1,496,012	70,464	4.71
HI	183,829	183,829	12,853	6.99
IA	482,210	482,210	13,961	2.90
ID	248,515	248,366	18,747	7.54
IL	2,084,187	2,084,187	168,591	8.09
IN	1,003,875	1,003,321	42,629	4.25
KS	470,957	468,342	17,942	3.81
KY	660,782	628,894	6,343	0.96

(continued)

Table 6.3 (continued)

State	Total students (state)	Total students (school)	LEP/ELL students	Percent ELL of total (state)
LA	730,464	730,354	11,074	1.52
MA	982,989	982,989	51,212	5.21
MD	866,743	866,743	27,311	3.15
ME	204,337	203,966	2,632	1.29
MI	1,785,160	1,772,123	56,499	3.16
MN	846,891	846,891	51,258	6.05
MO	924,445	923,194	13,091	1.42
MS	492,645	492,645	2,250	0.46
MT	149,995	149,995	6,642	4.43
NC	1,335,954	1,335,954	59,849	4.48
ND	104,225	104,225	883	0.85
NE	285,402	285,402	13,803	4.84
NH	207,671	207,671	3,270	1.57
NJ	1,367,438	1,367,473	57,301	4.19
NM	320,234	320,264	65,317	20.40
NV	369,498	368,376	58,753	15.90
NY	2,888,233	2,888,233	178,907	6.19
OH	1,838,285	1,830,639	15,938	0.87
OK	624,548	624,548	40,192	6.44
OR	554,071	550,168	52,331	9.44
RI	159,205	159,074	10,050	6.31
SC	694,584	692,956	7,466	1.07
SD	128,039	128,049	3,340	2.61
TX	4,259,823	4,258,009	628,302	14.75
UT	489,072	484,983	43,299	8.85
VA	1,177,229	1,177,229	49,845	4.23
VT	99,978	99,978	1,046	1.05
WA	1,014,798	1,014,798	70,411	6.94
WI	881,231	881,017	25,764	2.92
WV	282,455	282,455	1,281	0.45
WY	88,116	86,448	3,483	3.95
Totals	48,202,324	47,965,364	4,050,105	

Source: U.S. Department of Education website: www.ed.gov

The five states with the largest ELL student populations are California, Texas, Florida, New York, and Illinois. These numbers are important because they tell us about the scope of potential educational challenges, but still they fail to tell us about the breadth or impact ELL students have on a state's educational system. One strategy for obtaining such a picture would be to look at ELL students as a percent of the total student population. These data also may be found in Table 6.3. The discussion will be limited to states in which ELL students are 10% or more of the total student population. Seven states meet this standard: Alaska, Arizona, California, Colorado, New Mexico, Nevada, and Texas. Note that five of these states are in the Southwestern portion of the U.S.

The distribution of the ELL student population affects some regions more than others. The Western and Southern regions of the country have the largest number of ELL students: 2.15 and 1.14 million, respectively. Of the four regions, the West is home to a majority of ELL students: .524%.

Concentration of ELL Students

As we saw in Table 6.2, ELL students as a percent of the total U.S. student population has increased over time. Indeed, as of 2002 ELL students accounted for slightly over 10% of the total U.S. K-12 student population. In this section I examine the concentration of ELL students by state. It is my contention that certain states are more pressed than others in meeting the needs of their growing ELL student population. The analysis attempts to look at variation in the concentration of ELL students by school district within a state. The following five percentage categories are used: 0–4%, +4–9%, +9–15%, +15–20%, +20% or more. I also include data on the number of districts in a state with percentages of ELL students greater than the state percentage. Essentially, the question being asked is, "What percent of school districts in a state have x percent ELL students within their boundaries?" These data may be found in Table 6.4.

Table 6.4 Number of districts with selected percent ELL students by state 2002–2003

State	0–4%	4–9%	9–15%	15–20%	GT 20%	GT state per	Total districts
AK	14	5	4	2	13	17	38
AL	85	10	1	2	0	27	98
AR	112	18	7	1	5	28	143
AZ	44	46	20	15	67	74	192
CA	194	136	136	78	353	269	897
CO	66	29	11	10	18	33	134
CT	102	13	8	1	0	19	124
DC	3	1	3	0	2	5	9
DE	14	5	0	0	0	5	19
FL	43	13	7	2	0	10	65
GA	111	19	8	1	3	26	142
IA	127	18	6	4	4	32	159
ID	24	15	11	11	18	41	79
IL	240	85	38	20	15	62	398
IN	191	37	9	7	7	55	251
KS	33	11	7	3	12	30	66
KY	80	2	0	0	0	14	82
LA	59	1	0	0	0	12	60
MA	135	23	12	5	3	26	178
MD	21	2	0	0	0	2	23
ME	91	1	2	0	2	11	96

(continued)

Table 6.4 (continued)

State	0–4%	4–9%	9–15%	15–20%	GT 20%	GT state per	Total districts
MI	74	26	12	6	14	44	132
MN	151	35	12	5	18	46	221
MO	136	11	4	3	2	39	156
MS	68	2	0	0	0	24	70
MT	58	11	2	3	39	48	113
NC	85	35	11	3	1	45	135
ND	18	2	1	0	0	11	21
NE	67	12	12	3	9	28	103
NH	67	4	0	0	0	11	71
NJ	347	70	24	6	5	87	452
NM	8	13	11	7	31	30	70
NV	3	5	2	2	1	3	13
NY	408	56	22	5	3	48	494
OH	309	8	0	1	3	36	321
OK	180	73	38	18	53	137	362
OR	60	28	17	10	17	41	132
RI	19	3	1	0	2	3	25
SC	72	3	0	0	0	23	75
SD	20	4	3	3	4	12	34
TX	437	285	149	40	84	125	995
UT	14	16	3	3	3	9	39
VA	96	6	4	1	4	15	111
VT	46	3	3	0	0	10	52
WA	89	39	24	6	28	67	186
WI	22	20	6	2	0	17	50
WV	28	1	0	0	0	4	29
WY	26	8	0	2	4	12	40
Totals	4,697	1,269	651	291	847	1,773	7,755

Source: U.S. Department of Education's Common Core of Data. Website: www.ed.gov
Note (1) Data are calculated for "regular" schools only. Vocational, special education, and other/alternative schools are not included in the calculations
Note (2) Pennsylvania and Tennessee are not included due to lack of data

National Figures

Nationally (see totals at the bottom of Table 6.4), there were 1,773 school districts with percents of ELL students greater than their state's percent. The figure translates to about 23% of all school districts in my study (7,755). In terms of actual percentages, 4,697 districts (about 61% of all districts) had between 0% and 4% of ELL students; 1,269 had more than 4% but not greater than 9% or about 16.4% of the total. Interestingly enough, about 11% of all districts in the study had 20% or more of their student population who were ELL students. The latter finding, to my mind, suggests an important set of challenges facing many U.S. public schools.

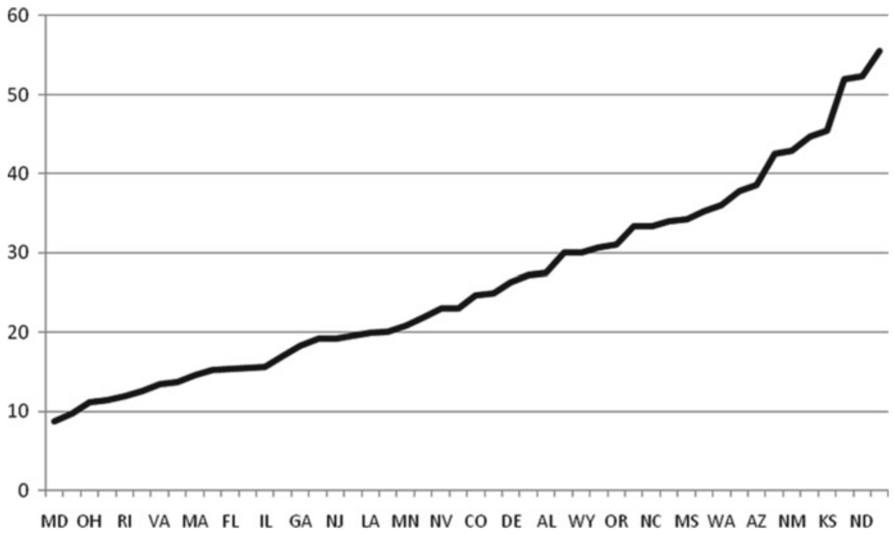

Fig. 6.2 School districts with percent ELL students greater than state percent, as a percent of all school districts in a state, by state

State Level

Table 6.4 also presents data on the number of school districts within a state with selected percentages of ELL students.

- ***0–4%***: For most states, the majority of school districts have between 0% and 4% ELL students. The five states with the largest number of districts in this column are Texas, New York, New Jersey, Ohio, and Illinois.
- ***4–9%***: In the 4–9% range, the five states with the largest number of districts are Texas, California, Illinois, Oklahoma, and New Jersey.
- ***9–15%***: In this percentage category, the six states with the largest number of districts are Texas, California, Illinois, Oklahoma, New Jersey, and Washington.
- ***15–20%***: The five states with the largest number of districts are California, Texas, Illinois, Oklahoma, and Arizona.
- ***20%+***: The five states with the largest number of districts are California, Texas, Arizona, Oklahoma, and Montana.

Also presented in Table 6.4 is the number of districts with a percentage of ELL students that is greater than their state's average. The five states with the highest number are California (269), Oklahoma (137), Texas (125), New Jersey (87), and Washington (67). Data on districts, though revealing, do not quite express the impact ELL students are having on a state's educational system. One strategy is to look at the percent of school districts in a state that have an ELL percent of their total student body greater than their state's percent. These data are displayed in Fig. 6.2.

There are 19 states where 30% or more of the districts have a percentage of ELL students that is greater than the state average—(in ascending order of percentage)

California, Wyoming, South Carolina, Oregon, Michigan, North Carolina, Wisconsin, Mississippi, South Dakota, Washington, Oklahoma, Arizona, Montana, New Mexico, Arkansas, Kansas, Idaho, North Dakota, and the District of Columbia.

In addition, there were 11 states where at least 20% of the school districts had percentages of ELL students that were greater than the state average. Generally, then, a significant number of states are facing important educational challenges regarding ELL students.

Segregation

Two measures are often used to measure student school district segregation: the *Dissimilarity Index* (*D*), and the *Segregation Index* (*S*). I employ both measures in examining the school district segregation of ELL students. Data in Table 6.5 present dissimilarity indices by state.

The national dissimilarity index (*D*) is .46, suggesting that nationally there would need to be a 46% change across all districts in the U.S. for the ELL and non-ELL student populations to be equally distributed. This is a sizable percentage and suggests that the ELL student population is highly segregated. But, of course, this is somewhat unfair because some states, as we have seen, have more ELL students than others. State data provide a better picture of segregation.

State data indicate that the ELL student population is highly segregated. The five states with the highest dissimilarity scores are: Ohio (.50), West Virginia (.498), Mississippi (.496), South Carolina (.495), and Alabama (.494). In contrast, states with the smallest dissimilarity scores are California (.327), New Mexico (.363), Arizona (.395), Texas (.413), and Alaska (.417). So even at the state level, ELL students appear to be highly segregated.

Segregation scores are also presented in Table 6.5. The segregation measure (*S*) is different from *D* in that it is not influenced by changes in the distributions among those groups being examined. This trait is referred to as "Compositional Invariance." There are two types of compositional invariance assumptions: weak and strong. Weak compositional invariance occurs when the number of one or both of the groups being compared changes. To be strongly invariant, an index cannot be affected by the changes in the relative frequencies of groups being compared; *S* has that property. In discussing male and female employment distributions, Watts (1998, p. 40) says: "Compositional invariance refers to the invariance of the index, following uniform changes in the number of males and females in each occupation reflecting the overall, but typically unequal, percentage change in male and female employment…" This said, the segregation data (*S*) point out the following:

- Nationally, the average segregation score is .41. The implication is that 41% of ELL students are segregated from non-Ell students.
- In terms of states, the five states with the most segregation are Montana (.674), South Dakota (.669), Wyoming (.642), Maine (.554), and Arkansas (.541).

Table 6.5 Dissimilarity and segregation indices by state

State	Dissimilarity	Segregation
AK	0.417	0.421
AL	0.494	0.394
AR	0.479	0.541
AZ	0.395	0.408
CA	0.327	0.260
CO	0.445	0.371
CT	0.478	0.457
DE	0.485	0.215
FL	0.454	0.336
GA	0.476	0.439
IA	0.478	0.530
ID	0.457	0.421
IL	0.454	0.392
IN	0.478	0.438
KS	0.467	0.393
KY	0.493	0.421
LA	0.492	0.342
MA	0.465	0.463
MD	0.480	0.431
ME	0.492	0.554
MI	0.463	0.353
MN	0.462	0.493
MO	0.492	0.454
MS	0.496	0.398
MT	0.440	0.674
NC	0.479	0.249
NE	0.470	0.388
NH	0.490	0.493
NJ	0.476	0.446
NM	0.363	0.298
NV	0.435	0.072
NY	0.459	0.399
OH	0.500	0.367
OK	0.465	0.394
OR	0.451	0.322
RI	0.461	0.495
SC	0.495	0.290
SD	0.450	0.669
TX	0.413	0.356
UT	0.452	0.371
VA	0.479	0.524
VT	0.488	0.466
WA	0.459	0.397
WI	0.467	0.209
WV	0.498	0.448
WY	0.482	0.642
Average	0.463	0.411

Source: U.S. Department of Education, Common Core of Data, 2002–2003. Website: www.ed.gov

Note: (1) Hawaii, Pennsylvania, Nevada, and Tennessee have been omitted due to lack of data

Interaction with Students Enrolled in Free or Reduced Lunch Programs

Finally, I examine the likelihood of ELL students being from poor backgrounds. The small body of extant research suggests that ELL students tend to have low SES origins (see August and Hakuta 1997). In my analysis, rather than using a direct measure of SES origins, because no such measure is available in the CCD, I compute an *Interaction* Index (*I*) between the ELL students in a school district and students enrolled in free/reduced lunch programs. Data may be found in Table 6.6.

Nationally, the average Interaction Index score is .10, suggesting that, nationally, ELL students have a 1-in-10 chance of interacting with students who are enrolled in free/reduced lunch programs. There is, however, a considerable amount of variation across states.

Data in Table 6.6 also point out the between-state variation in the interaction ELL students have with students who are enrolled in free/reduced lunch programs. The five states with the highest interaction scores are the District of Columbia (.893), Nevada (.597), Illinois (.288), Rhode Island (.273), and Nebraska (.150). In the first four states, the likelihoods range from nearly 1-in-10 to nearly 9-in-10. In the District of Columbia the likelihood is about 90% and about 60% in Nevada. These data are surprising, but if we examine states where ELL students have at least a 10% chance of interacting with poor students, the results indicate that there are 16 such states: Alaska (.129), Arizona (.119), the District of Columbia (.893), Delaware (.107), Florida (.102), Illinois (.288), Kansas (.111), Kentucky (.109), Maryland (.138), North Dakota (.118), Nebraska (.150), New Hampshire (.105), Nevada (.597), Rhode Island (.273), South Dakota (.127), and Wisconsin (.135). Thus, in some states ELL students have a significant probability of coming from poor to low SES origins, but in other states, such a probability is not nearly as high. A large body of research indicates that SES is positively related to school resources and student achievement, so states in which there is a high likelihood of ELL students interacting with students enrolled in free/reduced lunch programs are states more likely to face challenges related to language and poverty.

Table 6.6 Exposure to students in free/reduced lunch program

State	Exposure index
AK	0.129
AL	0.024
AR	0.025
AZ	0.119
CA	0.042
CO	0.075
CT	0.059
DC	0.893

(continued)

Table 6.6 (continued)

State	Exposure index
DE	0.107
FL	0.102
GA	0.039
IA	0.052
ID	0.029
IL	0.288
IN	0.020
KS	0.111
KY	0.109
LA	0.062
MA	0.077
MD	0.138
ME	0.037
MI	0.062
MN	0.082
MO	0.055
MS	0.023
MT	0.016
NC	0.035
ND	0.118
NE	0.150
NH	0.105
NJ	0.024
NM	0.073
NV	0.597
NY	0.017
OH	0.019
OK	0.043
OR	0.033
RI	0.273
SC	0.026
SD	0.127
TX	0.020
UT	0.094
VA	0.050
VT	0.069
WA	0.018
WI	0.135
WV	0.061
WY	0.046
Average	0.102

Source: Common Core of Data, 2003–2003. U.S. Department of Education
See website: www.ed.gov. Note that Hawaii, Pennsylvania, and Tennessee have been eliminated from the analysis. Hawaii because it is one district, Pennsylvania and Tennessee due to lack of data

Conclusion

ELL students are among the fastest growing student populations in the U.S. Their rapid growth is an important educational issue because they pose significant challenges for educational systems. Challenges that frequently arise as a function of their increasing numbers include the need for bilingual education teachers, increased school finances, and educational programs aimed at this student population, such as dual language instruction or language immersion. These are fairly straightforward concerns and have been well researched. What have not received an equal amount of attention for ELL students are topics such as their school segregation and their SES origins. Another issue in need of research is the geographic distribution of ELL students because ELL students are not equally distributed across schools, districts, states, or regions. As a result, some areas are more affected than others. The purpose of my paper has been to use an applied demographic framework in investigating several issues related to the number, distribution, isolation, and socioeconomic status of ELL students.

Results from my analyses point out several things. First, the ELL student population has been growing at a phenomenal rate. In fact, from 1992 to 2005, the ELL student population in the U.S. grew by 84%. This growth was not, however, evenly distributed across the country, with Western and Southern states being more affected than states in other regions. Second, ELL students appear to be segregated from non-ELL counterparts, as I find that within states ELL students tend to be concentrated in certain districts. Third, using two measures of segregation (D and S), I find that on average there is a 46% difference in the distributions of ELL and non-ELL students. Finally, we have some corroborating information that ELL students tend to come from poor backgrounds because in many states there is a significant likelihood that they interact with students who are enrolled free and reduced lunch programs.

In conclusion, I find that ELL students tend to be highly segregated in districts and that they are in all likelihood from poor backgrounds. This suggests, as well, a lack of access to appropriate resources and is a significant challenge for U.S. educational systems. Nevertheless, there is still a need for more specific research on selected economic and demographic traits of ELL students. One specific set of studies, for instance, should use the school as the unit of analysis.

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Chapter 7
Elderly Asian Immigrants and Challenges of Living in the United States of America

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Introduction

Asian immigrants started emigrating from their home countries to the U.S. during the 1800s (Mui et al. 2007). Asian immigrant populations tend to live in three states: California, New York, and Texas. These three states account for about 50% of Asian immigrant populations in the U.S. (California, 35%, New York, 10%, and Texas, 6%). The primary Asian immigrant populations include Chinese, Filipino, Japanese, Korean, Vietnamese, and Cambodian (Mui et al. 2007).

In the past, the reasons for their immigration were either to work or to seek refuge. However, modern Asian immigrants, especially the elderly, come to this country for family reunification and to provide assistance with raising grandchildren (Kalavar and Willigen 2005). Still, many Asian immigrants, especially those who are in working ages, come to this country for work.

Like immigrants from other parts of the world, Asian immigrants are still struggling for their lives in this country. Though some may be successful in their work, many Asian immigrants, especially the elderly and those who do not have strong family supports, are at greater risk of having health and other social problems.

The growing number of Asian immigrants has economic as well as social implications for American society. That is, Asian immigrants are sources of labor market and, at the same time, they can create concerns and/or tensions about social policy in this country, especially in terms of resource distribution and social service delivery. Thus, studying this population and challenges faced by them may not only help improve their quality of life but also increase a source of quality labor as well as improve immigration and social policies in the future.

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_7,

Changes in Elderly Asian Populations

Among the elderly populations, Asians are the third largest minority in the U.S. In 2000, there were about 690,000 elderly Asian immigrants and in 2008 the number had climbed to about 1.2 million (See Fig. 7.1). This number is projected to reach 33.4 million people by 2050. The number of elderly Asians rapidly increases every year (See Fig. 7.2). In terms of gender, Census data suggest that the number of elderly Asian women immigrants is slightly higher than that of men (See Table 7.1).

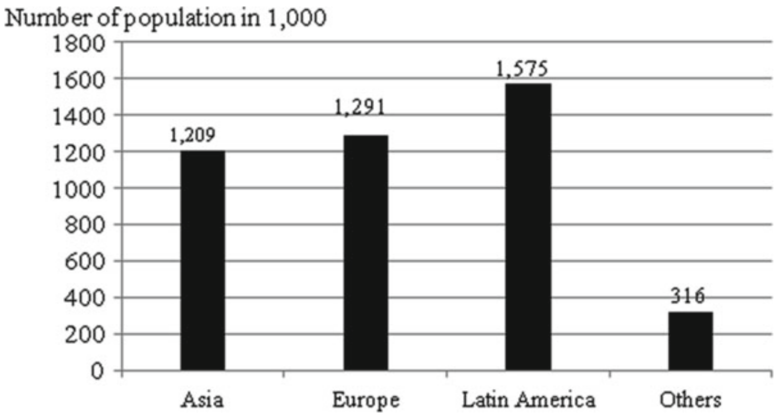

Fig. 7.1 Number of elder foreign-born population by world region of birth (2008) (Source: U.S. Census Bureau, Current Population Survey 2008)

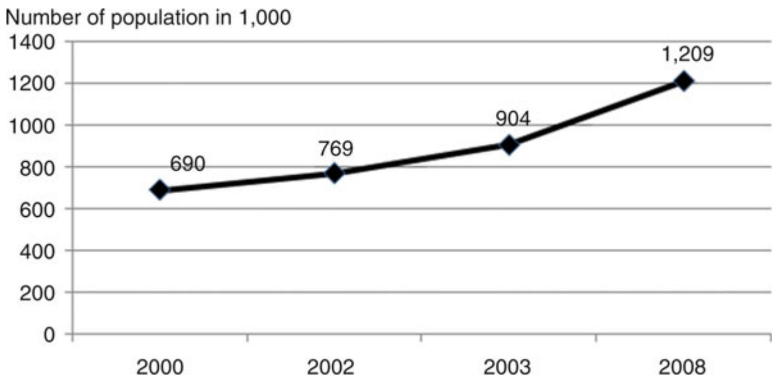

Fig. 7.2 Number of elder Asian immigrants (2000–2008) (Source: U.S. Census Bureau, Current Population Survey, 2008 and American Community Survey 2003)

Table 7.1 Percentage of Asian populations by sex and age: 2004

Both sexes	
Under 65 years	89.2
65 years and over	10.8
Male	
Under 65 years	89.8
65 years and over	10.2
Female	
Under 65 years	88.6
65 years and over	11.4

Source: U.S. Census Bureau, Current Population Survey 2004

Challenges of Living in the U.S.

Generally, four major challenges that elderly Asian immigrants working and living in the U.S. often face include: a language barrier, poverty, mental health problems, and barriers to health care. In this section, we elaborate on each of these challenges and its impact on the quality of life for elderly Asian immigrants.

Language Barrier

Age is significant when considering language barriers in the ethnic communities. Currently, individuals who are over 85 years are more likely to be monolingual than the younger generation. In the future, the proportion of the older group with some knowledge of English may increase; however, barriers in the use of English may continue to exist (Ramsey et al. 2009). The language barrier facing older Asian immigrants affects their communication concerning and access to medical, social, and welfare services. In addition, poor English proficiency is associated with negative health outcomes and acculturation as it is more difficult for people with limited English to understand health care systems and, thus results in less use of these systems. Previous study supports this claim. For example, Yoo et al. (2009) find a strong positive relationship between language discrimination and chronic health conditions in immigrant populations, especially Asians.

English proficiency is a key factor in the well-being and health status of elderly Asian immigrants living in the U.S. Fluency in English plays an important role in immigrants' negotiation in social and daily life, networks and resources. Choi and Thomas (2009) conducted a study examining the correlation between English proficiency among immigrant families and social well-being. They find that increased English proficiency in immigrant families is highly correlated with economic and social well-being, especially among elders. This means that elderly Asian immigrants who can speak English quite well are more likely to be wealthier than those who have poorer English ability. As a result, elderly Asian immigrants

Table 7.2 U.S. poverty rate in 2008

Race and hispanic origin		Foreign-born only			
All ages, both native and foreign born			Asian	Europe	Total Latin
		Both sexes (all ages)	10.7	9.2	21.3
White	11.2	18–64 years	9.2	8.2	19.9
Black		65 years and Over	12.4	10.6	20.5
Asian	11.8	**Male (all ages)**	10.5	7	18.8
Hispanic	23.2	18–E64 years	11.6	6.9	17.4
		65 years and Over	11.6	5.3	17.1
		Female (all ages)	11	11	24
		18–84 years	10	9.3	22.7
		65 years and Over	13	13.7	22.8

Source: U.S. Census Bureau, Current Population Survey – March 2008

with poor-English proficiency are more likely to go without health services (Kretsedemas 2005), face more difficulty in communicating with health care providers, and thus are less satisfied with their care services (Green et al. 2005).

In sum, individuals with limited English proficiency are at greater risk of having social and health problems. Research on stress associated health status of adult immigrants in the U.S facing language barriers finds that such immigrants are more likely to report poor health and generally more stress, especially at the beginning of their lives as immigrants (Ding and Hargraves 2009).

Poverty

Another challenge that elderly Asian immigrants may face is poverty. The following section discusses poverty among elderly Asian immigrants, its contributing factors and its negative impacts.

Elderly Asian immigrants are living in poverty, though their situations seem to be better than that of African Americans and Latin immigrants. Current census data show that elderly Asian immigrants' poverty rate is lower than their Latin counterpart's. However, on average, they are poorer than elderly European immigrants, White Americans, and the average Asian-American populations (See Table 7.2).

There are several factors that account for poverty among elderly Asian immigrants. These factors can be categorized into three groups: policy constraint, physical constraint, and socio-cultural constraint.

Policy constraint includes the passage of laws that prevent elderly Asian immigrants from accessing or obtaining government services by making them ineligible for certain programs. For example, a study on the impact of welfare reform by Friedland and Pankaj (1997) finds that the passage of the Personal Responsibility and Work Opportunity Reconciliation Act of 1996 (PRWOA) prevents elder immigrants from obtaining cash assistance, food stamps, and other services such as

Medicaid because it makes them ineligible for such federal assistances (Friedland and Pankaj 1997). A study of elder immigrants' disentitlement for Supplemental Security Income (SSI) provides the same conclusion. Particularly, it finds that elder immigrants are treated as "undeserving" population for such entitlements because the government perceives them as "noncontributing" members of society (Yoo et al. 2008).

Other regulations such as the Immigrant Responsibility Act of 1996 and the Immigration Control and Financial Responsibility Act of 1996 also reduce the opportunity of elderly Asian immigrants to obtain public services. These two regulations limit access to government services. These services include Medicare, Medicaid, TANF, and other programs that help lessen the impact of poverty (Phua et al. 2007, p. 74). Ultimately, the reduction in social services results in an increased percentage of Asian immigrants living in poverty.

Elderly Asian immigrants are also plagued with chronic health disabilities. This physical constraint contributes to their poverty status because it prevents them from obtaining full-time employment and, hence, limits their income and other benefits. One possible explanation is that retirement age represents a negative attribute in a competitive labor market, and the elderly tend to become one of the last choices for employers. Being unemployed or having only short-term employment then prevents elderly Asians from obtaining government resources. A short or nonexistent work history affects eligibility of elderly immigrants for social security income and other potential retirement benefits. As noted by Phua et al. (2007), "the lack of viable work history and unfamiliarity with local labor markets create barriers among elderly immigrants that limit access to stable retirement income" (Phua et al. 2007, p. 78).

Socio-cultural constraint that impedes elderly Asian immigrants includes little education, lack of career training, and limited English proficiency. These factors, especially limited English proficiency, intensify unemployment and poverty situations among elderly Asian immigrants. For example, the Asian American Federation reports that the vast majority (91%) of poor senior Asians[1] who lived in New York in 2006 had limited English ability (Asian American Federation 2008).

Because of poverty, many elderly Asian immigrants are uninsured, living below standard, and are at greater risk of having health problems. Poverty does not only pose such direct effects on elderly Asian immigrants, it also makes them more vulnerable in times of disasters. It has been documented that the elderly experience greater loss and need the most services in a disaster (Friedsam 1960). Physically, hearing and visual impairments prevent them from performing necessary actions, such as evacuation. However, the most critical issues affecting elderly Asian immigrants during disasters are culture, language, and poverty.

Limited ability in English prevents them from fully understanding warning messages and evacuation instructions. Thus, they are in a higher risk of being affected by a disaster compared to other groups of people. The language barrier also reduces

[1] Ninety-seven percent of Asian seniors in New York City in 2006 were foreign-born or immigrants (Asian American Federation 2008).

their opportunity to obtain public resources necessary to recover from a disaster. Poverty does make them more vulnerable to disasters. Poor elderly Asian immigrants who cannot afford items for emergency situations tend to be more affected than those who can afford such items. Moreover, poor elderly can be more affected by a disaster simply because they lack transportation or have limited choices of transportation. Finally, because of poverty, elderly Asian immigrants tends to have less options for temporary shelter, temporary housing, and permanent housing during and after a disaster.

Mental Health Issues

Historically, underserved and underrepresented immigrant populations are hesitant to receive medical treatment through the U.S. health care system. This fear may stem directly from acts of violence and cruelty perpetrated by American citizens in their country of origin (U.S. Department of Health and Human Services (DHH) 2001). Therefore, immigrant and refugee populations may avoid mental health treatment services for fear of mistreatment by government agencies (DHH 2001).

Individuals who suffer from mental illness are often shunned by the community and family members, and the stigma associated with mental illness often hinders immigrants from accessing appropriate mental health treatment. Accurate data reporting on the need for mental health services among immigrant populations are minimal (DHH 2001).

Likewise, few cross-cultural studies have explored the correlation between race and mental illness (DHH 2001). Zhang and associates examined the relationship between race and mental health in a cross-cultural study comparing Asian Americans and Whites living in Los Angeles. Results indicated that only 4% of Asian American respondents would contact a mental health professional, compared to 26% of White respondents. Three percent of Asian American respondents found it acceptable to discuss mental health concerns with a professional, while 13% of White respondents found it acceptable to discuss mental health concerns with a professional. Further analyses showed that 25% of Whites would share mental health problems with a friend, compared to 12% of Asian Americans (Zhang et al. 1998).

Yet, contemporary research studies provide sparse data reporting advancements in mental health treatment among Asian populations, especially among Asian immigrant communities. Mui et al. (2007) further expanded the study of cross-cultural mental health issues among Asian elders by measuring the association between acculturation and symptoms of depression. Study participants were selected from the following six most represented Asian ethnic groups in the United States: Chinese, Filipino, Indian, Korean, Japanese, and Vietnamese (Mui et al. 2007). A total of 407 foreign-born Asian elders were interviewed in their homes. Research findings indicated that nearly 40% of the study sample reported episodes of depression, a significantly higher percentage compared to findings in other studies examining depressive symptoms among elders living in Asia and American elders

Table 7.3 Percentage of health insurance by race 1999–2008

Race	Covered by private health insurance	Government health insurance	Not covered
All races	66.7	29.0	14.4
– White	69.3	28.0	14.5
– Black	52.2	37.2	19.1
– Asian	68.2	20.3	17.6
– Hispanic	43.8	30.4	30.7

Source: U.S. Census Bureau, Current Population Survey 2008

(Mui and Kang 2007). Among this sample of Asian immigrant elders acculturation stress significantly influenced perceptions of health, family relationships, informal support networks, and socialization. Predictors of depression were measured through number of stressful life events, number of years living in the United States, health status, and number of medical conditions, family expectations, and perceived cultural gaps (Mui and Kang 2007).

Similar studies measuring socialization among U.S. elders indicate a significant decline in mental health status when periods of extended isolations were reported. Bassuk et al. (1999) recruited 2,812 older adults (65 years or older) who resided in their homes to assess the relationship between social disengagement and mental health. During 1982, 1985, 1988, and 1994, researchers tested the cognitive function of study participants in their homes using the Short Portable Mental Status Questionnaire (SPMSQ). Also, a global social disengagement assessment tool was used to measure the following indicators: frequent social activities; organization membership; church attendance; yearly nonvisual communication with ten or more family and friends; monthly visits with three or more family and friends; and living with spouse. Survey question responses were scored as high, medium, or low. SPMSQ results that were lower at follow-up than at baseline were reported as cognitive decline. After adjustment for health status, socioeconomics, and baseline cognitive function, statistical analysis showed that older adults who had no social networks were at greater risk for incident cognitive decline, compared to those who had five or six social networks (Bassuk et al. 1999). These studies suggest that elderly Asian immigrants are at high risk of having mental health problems.

Barriers to Health Care

Immigrants living in the U.S. are less likely to have adequate health insurance than U.S. citizens. The Center for Immigration Studies (2007) points out that nearly half of the total immigrant population (47.4%) is reported as uninsured. The data support results of a previous study that immigrants have limited opportunity to receive employer-sponsored or government insurance coverage to access medical care (Frisbie et al. 2001; Carrasquillo et al. 2000) (see Table 7.3).

The elderly are more likely to use health care resources than young people. However, elderly Asian immigrants still have limited access to health care services. There are several factors limiting access to health care in elderly Asian immigrants which can be categorized into three major groups: language barrier, cultural difference, and policy change.

Language barrier is one of the most important factors affecting access to health care in elderly Asian immigrants. A study on well-being of Asian American elders by Mui and Shibusawa (2008) finds that the language barrier limits Asian Americans' understanding of the U.S. health care systems, which, in turn, limits access to health care.

Cultural differences also affect health care access. Elderly Asian immigrants come from eastern cultures that are different from western societies. While elderly Asian immigrants have health care needs, western medication may not be the only choice. Kuo and Torres-Gil's (2001) study discusses factors that affect the utilization of health care services among newly arrived Taiwanese elderly immigrants in California. The results suggest that, for older Asian immigrants, cultures matter in health care issues. A study by Mui and Shibusawa (2008) also concludes that cultures affect Asian immigrants' attitudes in receiving health care. That is, they may not recognize and believe in western treatment. Rather, they still strongly believe in culturally traditional treatment. Late diagnosis of disease and deadly risk in these populations may be the result.

Policy change can limit immigrants' access to health care as well. For example, the Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA) of 1996 set several requirements that immigrants need to meet in order to be eligible for obtaining health care services. These requirements limit newly arrived immigrants' access to some health care program. PRWORA also restricts the undocumented immigrants to access several services and government-funded programs. For example, undocumented immigrants are not eligible to access Medicaid except emergency treatment. PRWORA definitely increases the uninsured rate amount immigrants, especially for noncitizens who have more limited access to regular ambulatory and emergency care (Ku and Matani 2001).

Conclusion and Recommendations

Our study finds that elderly Asian immigrants are at greater risk of having health and other social problems because of their limited English proficiency, poverty, limited access to health care and mental health. To improve quality of life and overall well-being, public engagement and changes in social and immigration policies may be required. Following are some policy and administrative recommendations for helping elderly Asian immigrants living in the U.S.

Policy Recommendation for Reducing/Eliminating Language Barrier

Training culturally competent health care providers is one effective way to reduce the language barrier faced by Asian immigrant clients. Professional medical interpreters may be another key. Previous studies find that when language barriers are reduced by the use of professional medical interpreters, limited English proficiency patients are enrolled longer and more consistently in Medicaid and, thus, have more access to preventive care through a primary care home (Graham et al. 2008). Moreover, professional medical interpreters can also help improve access to health prevention and promotion services for elderly Asian immigrants.

Public and community-based organizations should work to reduce language barriers. For example, at the community level, responsive government agencies may provide language learning programs such as English as a second language classes (ESL) for elder Asian immigrants. These classes would help them use English language more effectively both in daily life and for health care-related issues. In addition, local governments or communities should develop infrastructure and services that accommodate needs of elder Asian immigrants. For example, infrastructures and services may be designed to accommodate their cultures and ways of life. This would help them to improve the quality of life.

Policy Recommendation for Reducing/Eliminating Poverty

Many Asian elderly immigrants are among the poor citizens and the most vulnerable populations in the U.S. To improve this situation and reduce vulnerability, government and other agencies, both profit and nonprofit such as the Asian American Federation and Area Agencies on Aging, should work together to build capacity and give more opportunities to elderly Asians. Some policy and management recommendations include improving economic opportunities for immigrants, supporting economic development that encourages a diversified, vibrant business community, educating workers to file income tax returns and pay employment taxes, increasing the availability of low-income housing, expanding health insurance coverage and making health care more linguistically accessible and culturally appropriate, enabling elderly Asian immigrants to benefit fully from the social safety net, and providing opportunities for active Asian seniors to participate in the economy and community (Asian American Federation 2008, p. vii).

Policy Recommendation for Reducing/Eliminating Barrier to Health Care and Improving Mental Health

Previous research suggests that, because of their traditional beliefs, ways of life, and cultures, many elderly Asian immigrants living in the United States trust and rely heavily on community-based services rather than institutional, formal health care services. This finding implies that agencies responsible for health care services should work proactively in order to help expand access to health care for people in this group. For example, institutional health care service providers may partner with community-based service providers and faith-based organizations in providing health care services to the foreign-born elder populations. In addition, ministers, priests, those who work in monk services, and other community leaders need to be more involved. These people might be helpful to build trust among elderly Asian immigrants. Put simply, collaboration between institutional health care providers and community-based organizations can help increase access to health care and improve the mental health status of elderly Asian immigrants.

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Chapter 8
Characteristics of Afro-Descendants in Mexico: A Survey of the Costa Chica Area of the Oaxaca and Guerrero States

Komanduri S. Murty and Jehad Yasin

Mexico: A General Overview

> More than in most countries, the passage of time has been a factor in the Mexican experience. Continuities from the past in Mexico leave an indelible imprint on the present. Like the living splendors of Greece and Rome, the artifacts of classical antiquity that engulf Mexico assault one's historical consciousness and conjure up powerful images of times gone by. Like Egypt, Mexico has its ancient pyramids; like Spain, its ancient aqueducts; like Persia, its ancient hieroglyphics; like China, its collections of ancient art. Public murals, frescoes, and statuary, all attentive to history and all with unmistakable messages, as well as cultural programming on radio, television, and film, reinforce these powerful legacies of Mexico' ancestry. The collective memory strongly reflects the heritage bequeathed by the centuries. Moreover, it permits a wonderfully personal engagement with the nation's past.
>
> Michael G. Meyer, William H. Beezley

Mexico's total territorial area covers 1,972,550 km^2 (1,923,040 km^2 of land and 49,510 km^2 of water) including approximately 6,000 km^2 of islands in the Pacific Ocean, Gulf of Mexico, Caribbean Sea, and Gulf of California (see Fig. 8.1). This area compares to slightly less than three times the size of Texas. On its north, Mexico shares a 3,326-km border with the United States. The meandering *Río Bravo del Norte* (known as the Rio Grande in the United States) defines the border from *Ciudad Juárez* east to the Gulf of Mexico. A series of natural and artificial markers delineate the United States-Mexican border west from Ciudad Juárez to the Pacific Ocean. On its south, Mexico shares an 871-km border with Guatemala and a 251-km border with Belize. Mexico has a 10,143-km coastline, of which

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_8, © Springer Science+Business Media B.V. 2012

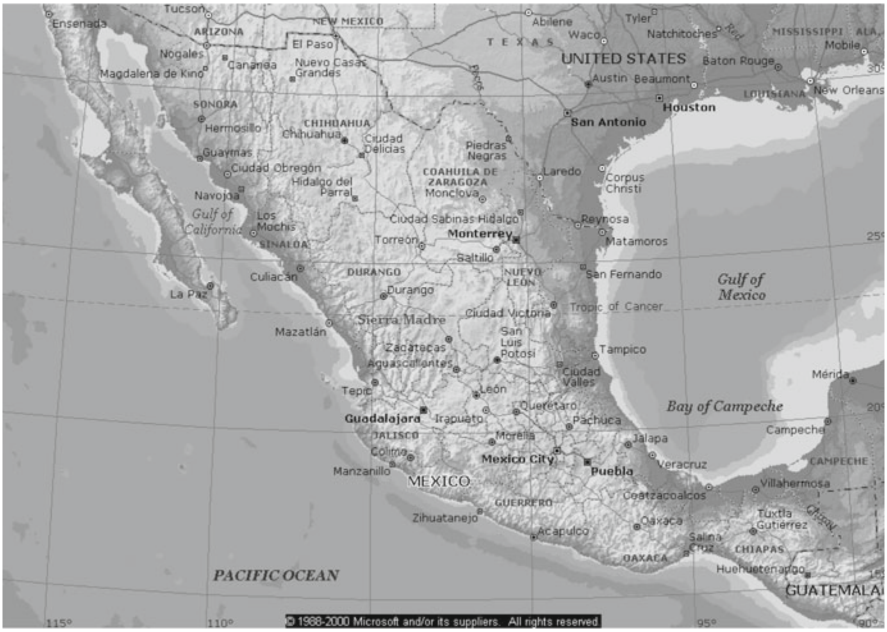


Fig. 8.1 Mexico

7,338 km face the Pacific Ocean and the Gulf of California, and the remaining 2,805 km front the Gulf of Mexico and the Caribbean Sea. Mexico's exclusive economic zone (EEZ), which extends 200 nautical miles off each coast, covers approximately 2.7 million square kilometers. The landmass of Mexico dramatically narrows as it moves in a southeasterly direction from the United States border and then abruptly curves northward before ending in the 500-km-long Yucatan Peninsula. Indeed, the capital of the Yucatán State, Mérida, is farther north than Mexico City or Guadalajara (Fig. 8.1). The climate varies from tropical to desert. Its natural resources are petroleum, silver, copper, gold, lead, zinc, natural gas, and timber. Its arable land is about 12.66%, of which 1.28% is utilized for permanent crops and 86.06% for other. Corn (maize), one of the world's major grain crops, is thought to have originated in Mexico. Apart from corn, Mexico also produces wheat, soybeans, rice, beans, cotton, coffee, fruit, tomatoes, beef, poultry, and dairy products. The nation, in general, is vulnerable to such natural hazards as tsunamis along the Pacific coast, volcanoes and destructive earthquakes in the center and south, and hurricanes on the Pacific, the Gulf of Mexico, and the Caribbean coasts. Furthermore, its environmental challenges include: scarcity of hazardous waste disposal facilities; rural to urban migration; scarcity of natural fresh water resources and pollution in north Mexico and inaccessible and poor quality water in the center and extreme southeast; raw sewage and industrial effluents polluting rivers in urban areas; deforestation; widespread erosion; desertification;

deteriorating agricultural lands; serious air and water pollution in the national capital and urban centers along the U.S.-Mexico border; and land subsidence in Valley of Mexico caused by groundwater depletion.

Mexico was under Spanish rule for three centuries before achieving independence early in the nineteenth century (16 September 1810). A devaluation of the peso in late 1994 threw it into economic turmoil, triggering the worst recession in over half a century, but the nation continues to make an impressive recovery. Ongoing economic and social concerns include low real wages, underemployment for a large segment of the population, inequitable income distribution, and few advancement opportunities for the largely Amerindian population in the impoverished southern states. Elections held in July 2000 marked the first time since the 1910 Mexican Revolution that the opposition defeated the party in government, the Institutional Revolutionary Party (PRI). Vicente Fox of the National Action Party (PAN) was sworn in on 1 December 2000 as the first chief executive elected in free and fair elections.

The population of Mexico is estimated to be 107,449,525 (July 2006 est.), of which 30.6% are 0–14 years (male 16,770,957/female 16,086,172), 63.6% are 15–64 years (male 33,071,809/female 35,316,281), and 5.8% are 65 years and over (male 2,814,707/female 3,389,599). The median age is 25.3 years (male: 24.3 years and female: 26.2 years). The population growth rate is 1.16%—with a birth rate of 20.69 births/1,000 population; death rate of 4.74 deaths/1,000 population; and a net migration rate of −4.32 migrant(s)/1,000 population. Its infant mortality rate is 20.26 deaths/ 1,000 live births (male: 22.19 deaths/1,000 live births and female: 18.24 deaths/1,000 live births). Life expectancy at birth is 75.41 years (72.63 years for males and 78.33 years for females). The 2003 estimates disclose the HIV/AIDS – adult prevalence rate in Mexico is 0.3%; the number of people living with HIV/AIDS is 160,000, and HIV/AIDS related deaths are 5,000. Ethnically, 60% of the population is Amerindian-Spanish, 30% is Amerindian or predominantly Amerindian, 9% is white, and the remaining 1% is other. Most (89%) are Roman Catholic, followed by Protestant (6%) and other (5%). The languages spoken in the nation are Spanish and various Mayan, Nahuatl, and other regional indigenous languages. The literacy rate, defined as *age 15 and over who can read and write,* is 92.2% (male 94% and female: 90.5%). The size of labor force is 43.4 million, of which 18% is in agriculture, 24% in industry, and 58% in services. The unemployment rate in Mexico is 3.6% and underemployment is 25% (2005 est.). Forty percent of the nation's population falls below the poverty line.

Mexico has 31 states and one federal district. The executive head of the federal government is the president, who is directly elected and who may serve only one 6-year term. The bicameral legislature is made up of a 128-member Senate and a 500-member Federal Chamber of Deputies. More than half of the deputies' seats are directly elected; the remainder are allocated on a proportional basis. Senators are elected for 6-year terms, deputies for three-year terms, and state governors for 6-year terms. Each state has the authority to levy local taxes and to legislate on certain matters. The voting age is 18.

Political Units (Population)

1. Aguascalientes 944,285 (2000 census)
2. Baja California 2,487,367 (2000 census)
3. Baja California Sur 424,041 (2000 census)
4. Campeche 690,689 (2000 census)
5. Chiapas 3,920,892 (2000 census)
6. Chihuahua 3,052,907 (2000 census)
7. Coahuila de Zaragoza 2,298,070 (2000 census)
8. Colima 542,627 (2000 census)
9. Distrito Federal 8,605,239 (2000 census)
10. Durango 1,448,661 (2000 census)
11. Guanajuato 4,663,032 (2000 census)
12. Guerrero 3,079,649 (2000 census)
13. Hidalgo 2,235,591 (2000 census)
14. Jalisco 6,322,002 (2000 census)
15. México 13,096,686 (2000 census)
16. Michoacán de Ocampo 3,985,667 (2000 census)
17. Morelos 1,555,296 (2000 census)
18. Nayarit 920,185 (2000 census)
19. Nuevo León 3,834,141 (2000 census)
20. Oaxaca 3,438,765 (2000 census)
21. Puebla 5,076,686 (2000 census)
22. Querétaro de Arteaga 1,404,306 (2000 census)
23. Quintana Roo 874,963 (2000 census)
24. San Luis Potosí 2,299,360 (2000 census)
25. Sinaloa 2,536,844 (2000 census)
26. Sonora 2,216,969 (2000 census)
27. Tabasco 1,891,829 (2000 census)
28. Tamaulipas 2,753,222 (2000 census)
29. Tlaxcala 962,646 (2000 census)
30. Veracruz 6,908.975 (2000 census)
31. Yucatán 1,656,233 (2000 census)
32. Zacatecas 1,353,610 (2000 census)

Mexico has a free market economy that recently entered the trillion-dollar class. It contains a mixture of modern and outmoded industry and agriculture, increasingly dominated by the private sector. Recent administrations have expanded competition in seaports, railroads, telecommunications, electricity generation, natural gas distribution, and airports. Per capita income is one-fourth that of the U.S. and income distribution remains highly unequal. Trade with the U.S. and Canada has tripled since the implementation of NAFTA in 1994. Mexico has 12 free trade agreements with over 40 countries including, Guatemala, Honduras, El Salvador, the European Free Trade Area, and Japan, putting more than 90% of its trade under free trade agreements.

The Study and Its Methodology

The purpose of the present study is to document the existence and experiences of the Afro-descendant population in Mexico's Costa Chica Region. The Mexican government has consistently denied the existence of the population, which has made socioeconomic efforts for this marginalized group difficult. Without government recognition, the black population has not easily garnered the attention of international funders who might have been willing to improve transportation and educational institutions, alleviate poverty, and strengthen healthcare delivery.

The Costa Chica of Guerrero and Oaxaca – The Study Site

The Costa Chica (meaning 'short coast' in Spanish) is one of two regions in Mexico with significant black communities, the other being the state of Veracruz on the Gulf coast. The Costa Chica is a 200-mile long coastal region beginning just southeast of Acapulco, Guerrero, and ending near the town of Puerto Angel, Oaxaca (Fig. 8.2).

http://www.mexconnect.com/mex_/feature/ethnic/bv/towns.htm. The Costa Chica is one of the poorest regions of Mexico, and the traveler is not likely to find many conveniences. The climate is almost unbearably hot in the summer

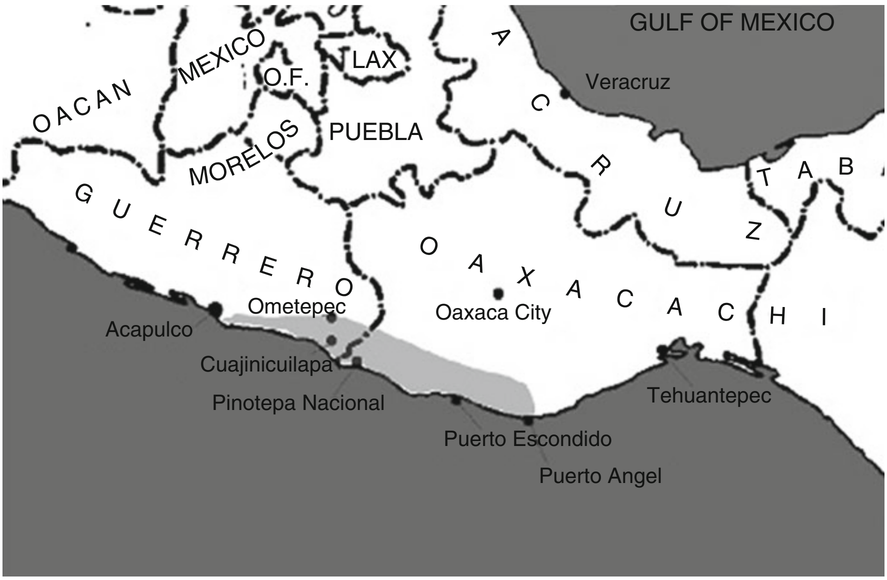


Fig. 8.2 Costa Chica region

months, and the summer rains can make transportation somewhat difficult, as the roads don't generally hold up well. There are no real tourist attractions in the areas of the Costa Chica, where most blacks live, although there are a few pleasant local beaches: Marquelia, Guerrero, and Punta Maldonado, Guerrero. The wildlife reserve in Chacahua, Oaxaca, is located near the black town of the same name.

While the Costa Chica is home to many blacks, there are also many indigenous groups, such as the Amuzgos and the coastal Mixtecs, (and to a lesser extent, Tlapanecos and Chatinos). There is very little social interaction between blacks and indigenous people. Part of the reason for this is a language barrier. There has been a long history of hostility between the two groups, and while today there is no open hostility, negative stereotypes abound on both parts.[1]

Most of the homes in the region were round mud huts, whose roots have been traced back to what is now Ghana and the Ivory Coast. Now, the norm is a one-room house with walls of adobe. While some of the better houses are constructed with brick or cinderblock, others can be rather makeshift structures of sticks, mud and cardboard.

The economic base of the Costa Chica, not unlike most of the rest of the country, is agricultural. These campesinos, or peasant farmers, concentrate most of their efforts in the cultivation of corn, almost exclusively in order to make tortillas for their own consumption. Other common crops are coconut, mango, sesame, and some watermelon.

The Sample Frame and the Sample

The sample frame for this study involved two states—Oaxaca and Guerrero within the Costa Chica region. Then a total of 22 communities from these two states were selected based on the recommendations of Mexico Negro, AC, in terms of concentrations of Afro-descendant population. Although the Census of Mexico does not provide data for Afro-descendant population, Table 8.1 provides a quick comparison of the number of households in 2000 census vs. those selected for sample in each of the communities under study.

As shown in the above table, a total of 1,867 households, or 10%, (18,170 census households) were interviewed. The Oaxaca communities (n = 12) provided 52% of the households and the Guerrero communities (n = 10) provided the remaining 48%. These percentage distributions of households are similar between the sample and the census, as evidenced by columns two and four. The last column shows that the percentages of sample to census households varied from 4% to 25%. The relatively larger percentages of samples to census households in smaller communities (i.e., where number of census households is smaller) indicate that many in the Afro-descendant population are likely to concentrate in smaller communities.

[1] Vaughn, B. (2004), *Black Mexico*. http://www.mexconnect.com/mex_/feature/ethnic/bv/brief.htm

Table 8.1 Comparison of number of households in census vs. sample

State/community	Census households[a] Number	Census households[a] Percent	Sample households Number	Sample households Percent	Percent of sample to census households[b]
Estado de Oaxaca	**10,592**	**58**	**968**	**52**	**9**
Santiago Tapextla	285	2	70	4	25
Santa Maria Cortijo	198	1	46	2	23
San Jose Estancia Grande	185	1	44	2	24
Callejon de Romulo	109	1	26	1	24
Santiago Pinotepa Nacional	5,329	29	231	12	4
Corralero	328	2	68	4	21
El Ciruelo	479	3	81	4	17
Cerro de la Esperanza	215	1	50	3	23
Jose Maria Morelos	469	3	55	3	12
Charco Redondo	97	1	23	1	24
Rio Grande	2,757	15	240	13	9
Cacalote	141	1	34	2	24
Estado de Guerrero	**7,578**	**42**	**899**	**48**	**12**
Cuanjinicuilapa	1,928	11	205	11	11
San Nicolas Tolentino	630	3	107	6	17
Maldonado	194	1	48	3	25
Huehuetan	403	2	88	5	22
Tenago	176	1	44	2	25
San Juan de los Llanos	185	1	41	2	22
El Capricho/La poza	102	1	24	1	24
Marquelia	1,473	8	128	7	9
Juchitan	587	3	80	4	14
Cruz Grande	1,900	10	134	7	7
All communities combined	**18,170**	**100**	**1,867**	**100**	**10**

[a] Source: Cenus of Mexico 2000

[b] Percent of sample to census households = (sample households ÷ census households) × 100

The Survey Instrument

A survey questionnaire was developed, pre-tested, and finalized for data collection purposes. The final instrument consisted of several questions to solicit information on at least seven dimensions: (1) Socio-Demographic Characteristics (size of household, gender, age, marital status, education, duration of stay in the community, major decision-makers in family, types of decisions that father and mother make, whether any family members live in other communities within the region, and frequency of visiting family members living in other communities); (2) Household Population Composition (relationship to head of household, gender, age, marital status, education, religion, and duration of stay in the community); (3) Employment and

Occupation Data (respondent's occupation, occupation of household population, employment status, number of hours working per week, personal income, etc.); (4) Housing Characteristics (number of rooms excluding kitchen, home ownership, home improvement, source of funds for improvement, cost of rent (if renting), possession of valuables); (5) Household Economics (number of dependents, dependents' relationship with head of household, financial support from a family member away from home, supporter's relationship with head of household, supporter's place of residence, amount of support received, and frequency of support); (6) Household Health (family member falling sick in the past year, nature of sickness, duration of sickness, treatment particulars, number of visits to hospital or doctor, family member physically disabled); (7) Land Ownership and Utilization (ownership of land property, method of acquiring, source of inheritance, time since inherited, amount of land purchased, cost of land, land used for agriculture, land used for livestock, land used for other purposes, whether any land sold, time sold, amount of land sold, price sold for, person sold to, and post sale land use). The questionnaire was translated into Spanish before it was administered.

The Data Collection Process

Originally we planned to identify two interviewers from each community, totaling 44 interviewers, to collect the data. However, 36 were successfully identified by the time the field training was conducted. A 3-day training workshop was held for all interviewers from July 21–23, 2005. Several crucial issues of data collection, including, but not limited to, methods and mechanics of inquiry, limits of probing (if and when needed), procedures for recording information obtained, ethical considerations, the role of interviewer, interviewer integrity, and importance of collecting accurate and quality data, were discussed in the training. Role playing, narrating, and observation methods were introduced through discussions, question-answer sessions, and small group breakout sessions. Then, the interviewers were asked to pretest the questionnaires and meetings were held with interviewers and field supervisors to obtain their feedback. Based on that feedback, the questionnaire was finalized. A few additional interviewers were added during data collection period, and they were trained by the trained interviewers. All data collection was completed under the supervision of Mexico Negro, AC, between August and December of 2005.

Data Coding and Measurements of Variables

A codebook was developed and supplied to Universidad del Mar for the purpose of coding and entering the data. A research team under the guidance of Dr. Luis Sautto, completed coding all survey instruments and entered data before sending them in several Excel formatted data files. All data were then combined into a master file, converted into SPSS format, and analyzed. Some variables needed recoding and/or grouping of values.

Head of the Household Characteristics

Gender: As the chart shows, 77% of the 1,867 households (n = 1,437) were headed by males and 16% (n = 302) by females. The head of the household's gender was not reported for nearly 7% of the cases. These percentages are comparable to those of Mexico Census 2000, as shown in Table 8.2.

Age: The average age of head of household is 46.9 years. Ninety-five percent of the household heads were aged 30 years or over. The remaining 5% were in the age group of 20–29. Only 2 heads reported to be in the age group of 15–19. The age distribution of the household heads by conventional 5-year age groups is shown in Fig. 8.3.

Marital Status: Nearly 85% of the household heads were or had ever been married and 7% were never married. The ever-married category includes 75% married,

Table 8.2 Number of census households

Number of households: Mexico census 2000				
Households	Guerrero	Oaxaca	Total	Pct. (%)
Male heads	508,497	593,047	1,101,544	77
Female heads	165,680	170,245	335,925	23
Total	674,177	763,292	1,437,469	100

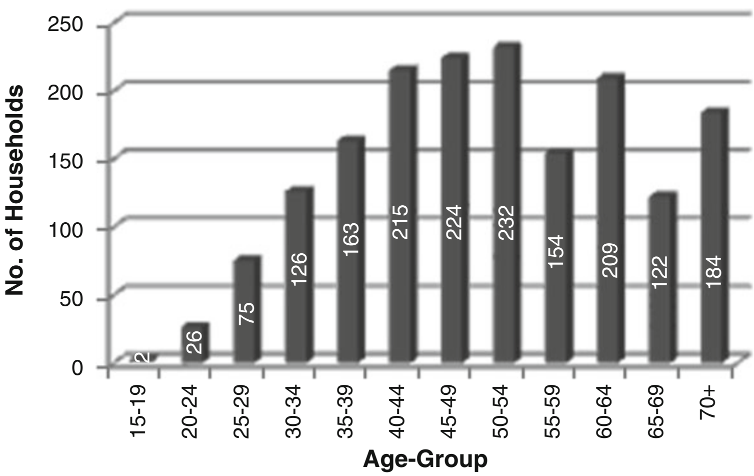


Fig. 8.3 Head of household by age

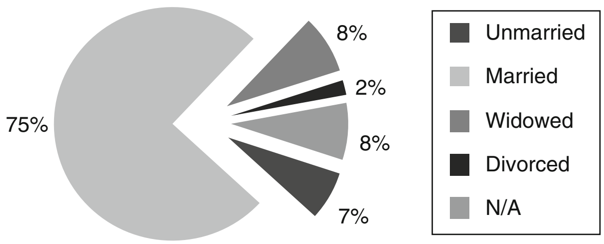


Fig. 8.4 Head of household by marital status

Fig. 8.5 Head of household by education

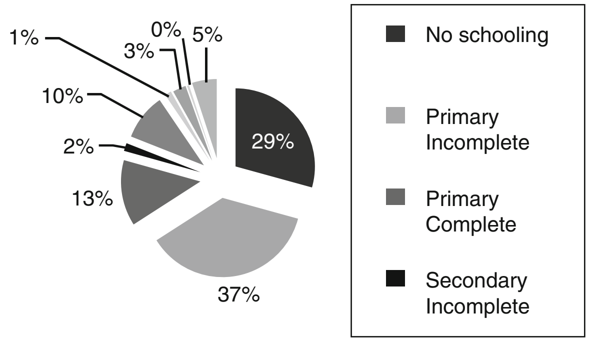
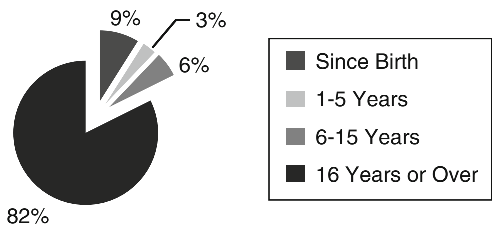


Fig. 8.6 Head of household by duration of stay in the community



8% widowed and 2% divorced heads. The remaining 8% did not report their marital status (Fig. 8.4).

Education: More than one-fourth of the households surveyed had no formal schooling. About 46% had just primary education; only 10% had secondary education; and very few (4%) had high school education. Thus the education level on the whole is very low for these household heads (Fig. 8.5).

Duration of Stay in the Community: Only 92% of the households answered this question. Of them, most heads (82%) were residents of their respective communities for a long period (16 years or over) and an additional 9% lived there since their birth. About 6% reported their duration of stay between 6 and 15 years. Only 3% moved into their communities within the last 5 years (Fig. 8.6).

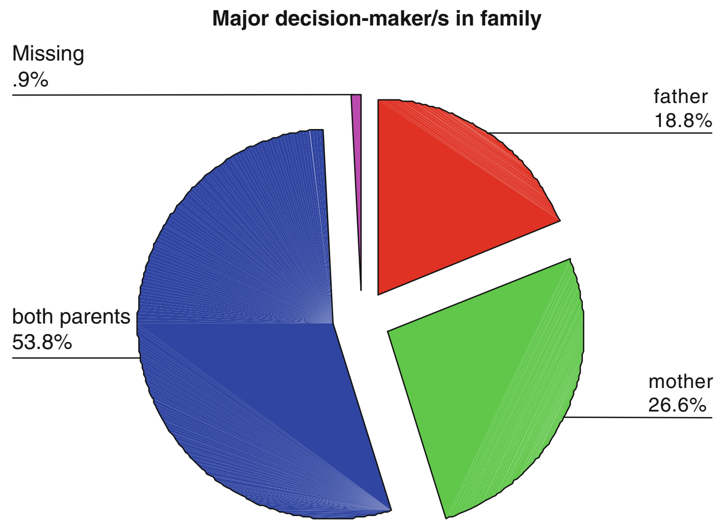


Fig. 8.7 Major decision makers

Major Decision-makers in Family: Over one-half of the households (54%) reported that both parents jointly make decisions in their families, while 27% stated it was the task of mother only, and the remaining 19% indicated it was only done by father (Fig. 8.7).

Types of Decisions that Father and Mother Make: When asked for specific types of decisions that each parent makes within their households, "father" was more frequently cited for financial decisions that are non-domestic in nature—e.g., buying and selling of property, leasing, business, investment, etc. On the other hand, over two-thirds of the households indicated that the mother makes domestic financial decisions. Fathers apparently make disciplinary decisions more frequently, although the gap between both parents is somewhat narrow (52% for father vs. 48% for mother). Both parents are equally mentioned for making decisions relating to social order. Surprisingly, mothers seem to make academic/career related decisions more often than fathers (Table 8.3).

Whether any Family Members Live in other Communities within Region: Eight out of every ten households confirmed that some of their family members live in other communities within the region (Fig. 8.8).

Frequency of Visiting Family Members Living in other Communities: Of those who indicated they had family members living in other communities within the region (n = 1,501), 7% reported regular visits and another 46% disclosed occasional visits from them. While 36% were certain of their rare visits, 10% claimed that they were never visited. Thus, on the whole, interpersonal communications and support systems among family members living in different communities appear to exist for the most part (Fig. 8.9).

Table 8.3 Decision-making by father and mother

	Father		Mother	
Decision type	Number	Percent	Number	Percent
Financial/non-domestic	571	56.04	448	43.96
Financial/domestic	768	36.82	1,318	63.18
Disciplinary	697	52.21	638	47.79
Social order	299	49.59	304	50.41
Academic/career related	546	40.47	803	59.53
Other	120	66.67	60	33.33

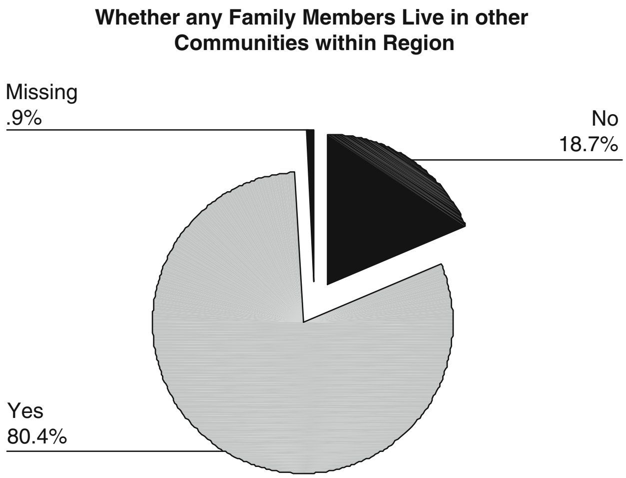


Fig. 8.8 Family members in other communities

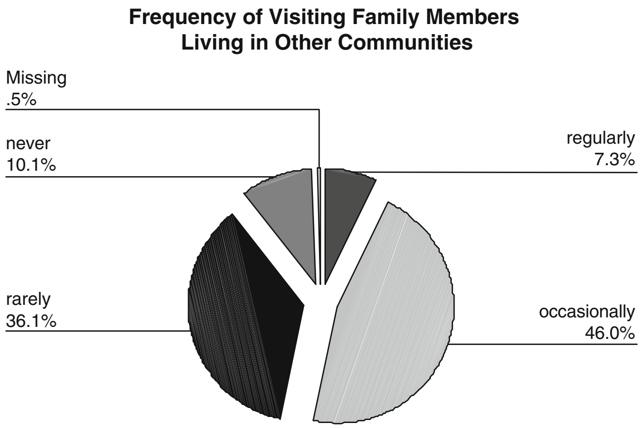


Fig. 8.9 Frequency of visiting family members

Household Population Composition

Size of Household: The household size in the Costa Chica region is about 5.5 members on average. Over one-half of the households had 1–4 members and another 31% had 5–6 members. A few households (n = 63) had more than 9 members (Table 8.4).

Relationship to Head of Household: The households surveyed (n = 1,867) contained a total population of 8,228. One-third of this population consisted of heads and their spouses and another 46% consisted of sons and daughters. Grandchildren constituted about 10%, and parents 5%. Mothers stayed mostly with households (351 mothers – or 90.5% – vs. . 37 fathers), perhaps because of their desire to stay with their children or to avoid loneliness caused by widowhood (Fig. 8.10, Table 8.5).

Table 8.4 Size of household

		Frequency	Percent	Valid percent	Cumulative percent
Valid	1–4 members	1,033	55.4	55.4	55.4
	5–6 members	576	30.9	30.9	86.3
	7–8 members	193	10.3	10.3	96.6
	9 or more	63	3.4	3.4	100.0
	Total	1,865	100.0	100.0	

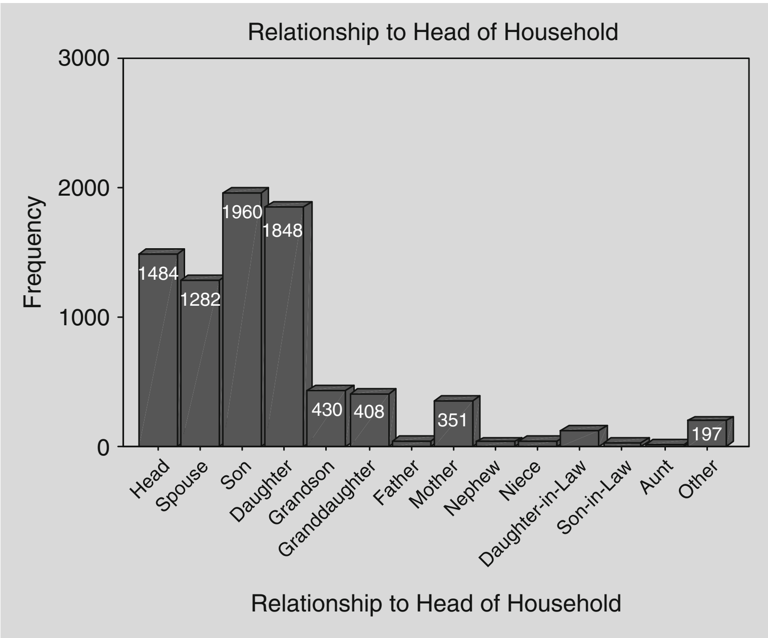


Fig. 8.10 Relationship to head of household

Table 8.5 Relationship to head of household

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Head	1,484	18.0	18.0	18.0
	Spouse	1,282	15.6	15.6	33.6
	Son	1,960	23.8	23.8	57.4
	Daughter	1,848	22.5	22.5	79.9
	Grandson	430	5.2	5.2	85.1
	Grandaughter	408	5.0	5.0	90.1
	Father	37	.4	.4	90.5
	Mother	351	4.3	4.3	94.8
	Nephew	35	.4	.4	95.2
	Niece	37	.4	.4	95.7
	Daugther-in-law	122	1.5	1.5	97.2
	Son-in-law	26	.3	.3	97.5
	Aunt	11	.1	.1	97.6
	Other	197	2.4	2.4	100.0
	Total	8,228	100.0	100.0	

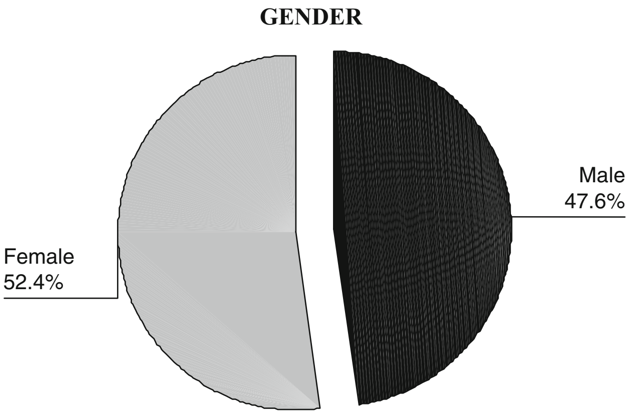


Fig. 8.11 Gender distribution

Gender: There were slightly more females (52%) than males (48%), constituting a sex ratio[2] of 91 males for every 100 females (Fig. 8.11).

Age Composition: The data on age were collected in terms of *actual number of years completed* by each person in the household and then combined into 5-year age groups. For comparative purposes with the 2000 census, the ages were collapsed according to the census categories. As Table 8.6 discloses, the survey data encountered a small percentage of under-representation for young population of 0–4 years

[2]The sex ratio is the principal measure of sex composition used in technical studies. The sex ratio is usually defined as the number of males per 100 females, or $[(p_m/p_f)\times 100]$, where p_m represents the number of males and p_f the number of females.

Table 8.6 Population comparison by age: census vs. survey

	Census 2000				Survey data	
Age	Oaxaca	Guerrero	Total	%	Survey	%
0–4	395,993	391,873	787,866	12	583	7
5+	3,019,103	2,646,132	5,665,235	88	7,615	93
5–14	812,745	723,229	1,535,974	24	2,298	28
15–24	652,911	598,460	1,251,371	19	1,669	20
15+	2,116,722	1,840,111	3,956,833	61	5,317	65

Table 8.7 Distribution of household population by age

Age group					
		Frequency	Percent	Valid percent	Cumulative percent
Valid	0–4	583	7.1	7.1	7.1
	5–9	1,009	12.3	12.3	19.4
	10–14	1,289	15.7	15.7	35.1
	15–19	1,137	13.8	13.9	49.0
	20–24	532	6.5	6.5	55.5
	25–29	419	5.1	5.1	60.6
	30–34	422	5.1	5.1	65.8
	35–39	459	5.6	5.6	71.4
	40–44	461	5.6	5.6	77.0
	45–49	442	5.4	5.4	82.4
	50–54	394	4.8	4.8	87.2
	55–59	292	3.5	3.6	90.7
	60–64	292	3.5	3.6	94.3
	65–69	181	2.2	2.2	96.5
	70+	286	3.5	3.5	100.0
	Total	8,198	99.6	100.0	
Missing	System	30	.4		
Total		8,228	100.0		

(12% for Census vs. 7% for Survey) and, over-representation for population aged 5 years or over. The one-tailed chi-square value ($\chi^2=2.367$, df = 1) shows no significant difference between the two distributions at significance level p = .01. The difference between the two data sets is at a minimum for the age group of 15–24 years (19% for Census vs. 20% for Survey).

The age-composition of the household population shows that nearly one-half were less than 20 years old (Table 8.7). Forty-five percent of the population is in the age group of active labor-force (20–64 years). Less than 5% are elderly, aged 65 or over. This age-structure implies high mortality rates among the elderly, which, in turn, translates into lower life expectancy at birth.

Another demographic measure that could be computed from this age structure is the age dependency ratio, which takes the variations in the proportions of children, aged persons, and persons of *working age* into account. The age dependency ratio

Fig. 8.12 Age – sex composition of household population

for the surveyed household population is 69 persons in non-working age to every 100 persons in working age.[3]

Age-Sex Composition: The following population pyramid (Fig. 8.12) is designed to provide a detailed picture of the age-sex structure of the Costa Chica survey population for 5-year groups. The bars for males are given on the right of the central vertical axis and the bars for females on the left of the axis. The pyramid indicates a larger young population, a modest size working-age population, and a small size elderly population. Gender difference seems to be uniformly modest among all age groups.

The child-woman ratio[4] of the surveyed population, an indirect measure of fertility, is 277 children per 1,000 women (583/2,102 × 1,000). The shrinking bars between 10–14 years and 0–4 years at the base of the pyramid indicate two possibilities: first, a recent decline in fertility among this population; or second, a net out-migration of families with younger children from this region.

Marital Status: The survey data show a disproportionately high percentage of single population compared to that of the census (Table 8.8). This could be the striking characteristic of Afro-descendents in Costa Chica region. However, the percentage of married population between the two data sets is very similar.

The unmarried population constitutes nearly 58%, followed by married (37%), widowed (3.3%) and divorced (1%) (Fig. 8.13). Thus divorce among the survey population is a rare occurrence. When compared by age, only one-half of 1%

[3]The age dependency ratio represents the ratio of the combined child population and aged population to the population of intermediate age. The formula for computing this ratio is: $[(p_{0-14}+p_{65+})/p_{15-64})\times 100]$. Applying the formula to the survey data, the computed value is: $[(2{,}881+467)/4{,}850]\times 100=69.03$.

[4]Child-woman ratio is also known as 'general fertility ratio' or 'ratio of children to women.' This measure is commonly used to compute the ratio of children under 5 years old to women of childbearing age—that is, by dividing the number of children under 5 years old in the population by the number of women 15–49 years old.

Table 8.8 Population comparison by marital status: census vs. survey

	Census 2000				Survey data	
Marital status	Oaxaca	Guerrero	Total	Pct. (%)	Survey	Pct. (%)
Single	895,120	754,237	1,649,357	26	4,797	58
Married	1,283,887	1,134,437	2,418,324	37	3,076	37

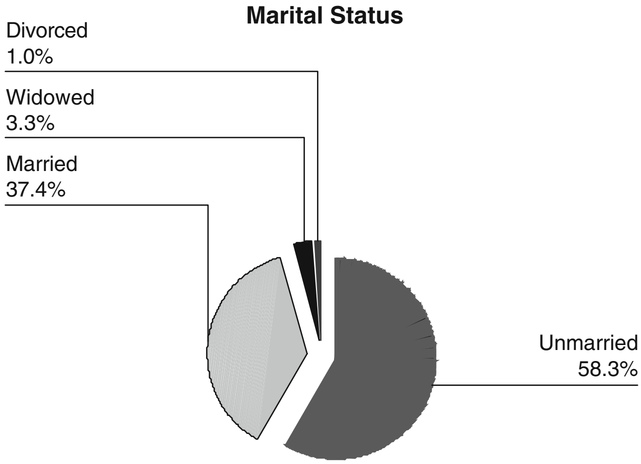


Fig. 8.13 Marital status of household population

Table 8.9 Marital status by age

	Marital status				
Age groups	Unmarried	Married	Widowed	Divorced	Total
0–14 years	2,863	17		1	2,881
	99.38	0.59		0.03	100.00
15–24 years	1,399	265		5	1,669
	83.82	15.88		0.30	100.00
25–34 years	269	553	5	14	841
	31.99	65.76	0.59	1.66	100.00
35–49 years	139	1,153	42	28	1,362
	10.21	84.65	3.08	2.06	100.00
50 years or older	116	1,069	221	32	1,438
	8.07	74.34	15.37	2.23	100.00
Total	4,786	3,057	268	80	8,191
	58.43	37.32	3.27	0.98	100.00

among those less than 15 years of age was married. This percentage increased to 16 for the age group 15–24 and jumped four-folds by the time the individuals reach 25–34 years (Table 8.9).

Education: The distribution of the population aged 15 years or older by selected educational categories shows a close comparison between the population surveyed and census figures. One-fifth of the population had no formal schooling, over 40%

Table 8.10 Population (aged 15+ years) comparison by education: census vs. survey

	Census 2000				Survey data	
Education	Oaxaca	Guerrero	Total	Pct. (%)	Survey	Pct. (%)
No schooling	429,069	394,583	823,652	21	1,038	20
Primary incomplete	525,111	369,058	894,169	23	1,404	26
Primary complete	437,357	316,153	753,510	19	880	17
Secondary incomplete	90,889	96,352	187,241	5	170	3
Secondary complete	274,571	247,642	522,213	13	893	17
Post primary	704,139	742,124	1,446,263	37	1,778	33

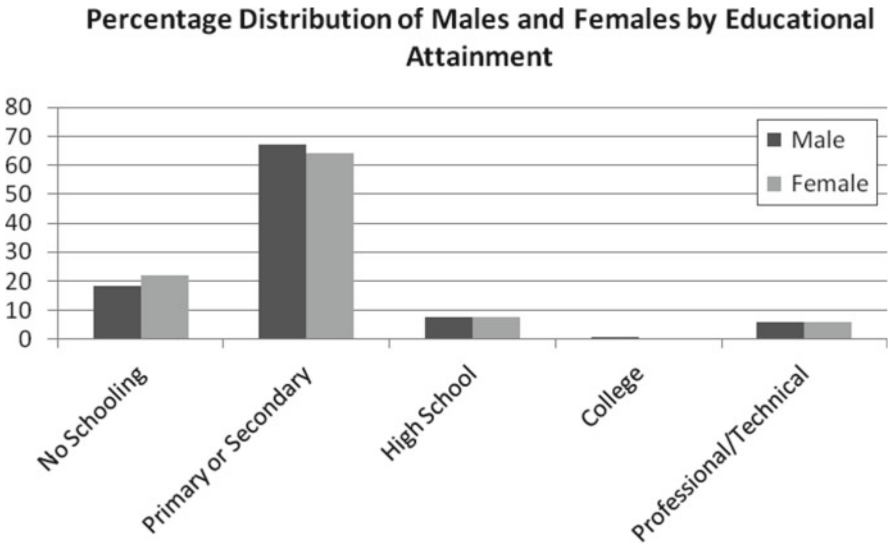


Fig. 8.14 Distribution of males and females by educational attainment

had primary education (incomplete or complete), and 37% had post primary education, mostly secondary education (Table 8.10).

A comparison of educational attainment by gender among those aged 16 or older indicate slightly higher levels for males than their female counterparts (Fig. 8.14). However, these differences are not statistically significant.

When all survey population was taken into account, 30% happened to be students (i.e., currently enrolled) in preschool (2.4%), primary school (17.4%), secondary school (5.7%), high school (2.8%), or professional/technical school (1.4%). Thus the educational levels are slowly increasing, at least among the younger generation (Table 8.11). On the other hand, the challenges continue to exist for this region as well as for the nation as a whole. Students' access and retention remain critical concerns for educators. The government reported[5] in 1989 that each year, 300,000

[5] *A Country Study: Mexico*, Federal Research Division, Library of Congress, November 18, 2005. http://lcweb2.loc.gov/fnd/cs/mxdoc.html

Table 8.11 Education

Education		Frequency	Percent	Valid percent	Cumulative percent
Valid	Currently enrolled in preschool	196	2.4	2.4	2.4
	No schooling	1,036	12.6	12.6	15.0
	Primary incomplete	1,404	17.1	17.1	32.1
	Primary complete	880	10.7	10.7	42.8
	Secondary incomplete	170	2.1	2.1	44.8
	Secondary complete	893	10.9	10.9	55.7
	High school incomplete	99	1.2	1.2	56.9
	High school complete	288	3.5	3.5	60.4
	College incomplete	24	.3	.3	60.7
	College complete	1	.0	.0	60.7
	Professional/technical	303	3.7	3.7	64.4
	Currently enrolled primary	1,428	17.4	17.4	81.7
	Currently enrolled secondary	467	5.7	5.7	87.4
	Currently enrolled high school	232	2.8	2.8	90.2
	Currently enrolled professional/technical	115	1.4	1.4	91.6
	N/A	690	8.4	8.4	100.0
	Total	8,228	100.0	100.0	

children who should be in first grade do not attend. An additional 880,000 students drop out of primary school annually, 500,000 of them in the first three grades. Nationally, in 1989 only 55% of students successfully completed their primary education, and graduation rates were only 10% in many rural areas. However, the government reported that in 1995 the national graduation rate reached 62%.

Religion: In general, Mexico as a nation experienced a steady decline in the Roman Catholic share of the population during the period from 1970 to 1990. In 1970, 96.2% of the population 5 years of age and older identified itself as Roman Catholic. That dropped to 92.6% of the population by the 1980 census and to 89.7% by 1990. The 1990 census revealed significant regional variations in the number of Roman Catholics. Roman Catholics made up more than 95% of all Mexicans in a band of central-western states extending from Zacatecas to Michoacán. In contrast, the least Roman Catholic presence was found in the southeastern states of Chiapas, Campeche, Tabasco, and Quintana Roo. The Costa Chica region, however, is still largely Roman Catholic, as evidenced in both Census 2000 (81%) and Survey statistics (93%). See Fig. 8.15 and Table 8.12.

Duration of Stay in the Community: A total of 8,155 respondents specified the duration of their stay in their native communities. Of those, over one-half (55%) reportedly stayed there for 16 years or more, 32% for a length of 6–15 years, and 13% for less than or equal to 5 years. See Table 8.13 and Fig. 8.16. When these patterns are compared to those of heads of households in the earlier chapter, it is

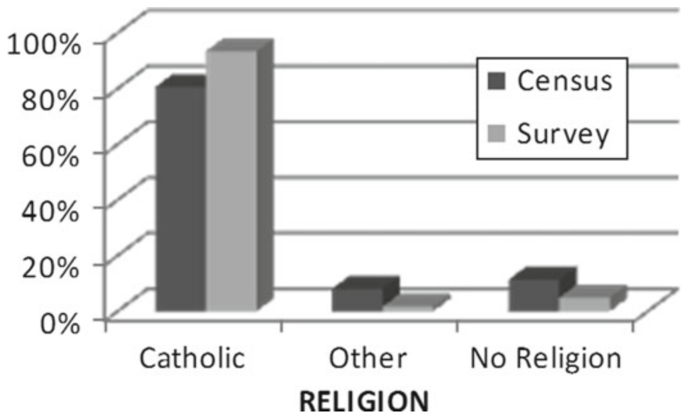


Fig. 8.15 Comparison of population by religion: census vs. survey

Table 8.12 Comparison of population by religion

	Census 2000		Survey	
Religion	Number	Percent (%)	Number	Percent (%)
Catholic	4,921,364	81	7,367	93
Other	492,693	8	132	2
No religion	694,209	11	389	5

Table 8.13 Duration of stay

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Since birth	15	.2	.2	.2
	1–5 years	1,026	12.5	12.6	12.8
	6–15 years	2,614	31.8	32.1	44.8
	16 years or over	4,500	54.7	55.2	100.0
	Total	8,155	99.1	100.0	
Missing	System	73	.9		
Total		8,228	100.0		

evident that many members of the household had moved in and out of communities, perhaps because of marriage and/or education or employment.

Employment and Occupation Data

Occupation of Household Population: Since no occupational categories from the census data were readily available, respondents were asked to specify the occupation they were engaged in at the time of survey and they were grouped into the following categories:

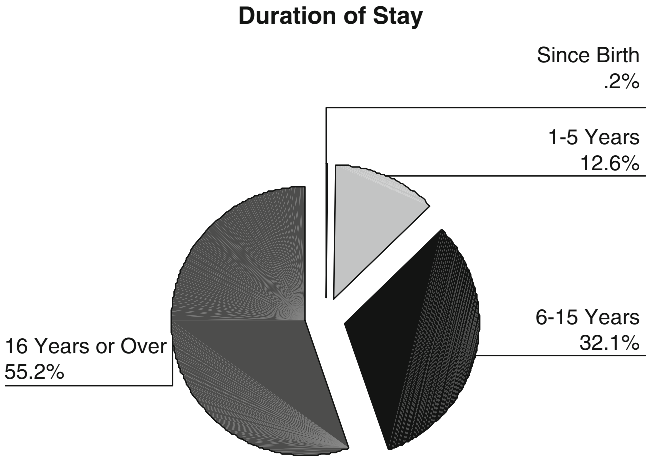


Fig. 8.16 Duration of stay

1. Unemployed (no empleado)
2. Not Applicable (too young or too old) *This category typically includes population aged 10 years or younger, those aged 70+ years, or those not gainfully employed.*
3. Homemaker (hogar, ama de casa)
4. Student (estudiante, estudiar)
5. Professional, technical, and managerial workers
    - Director (director)
    - Professor/Teacher/Instructor/Tutor (Profesor, profesora, maestro, maestra, Instructor, Tutor)
    - Bank Manager (el banco)
    - Accountant (contable)
    - Nurse (ninera, enfermera)
6. Clerical and kindred workers
7. Sales workers
    - Businessman (comerciante, vendedor)
8. Craftsmen, foremen, and kindred
    - Tailor (sastre, cortar, costurera)
9. Operatives and welding
    - Factory job/industrial (industrial)
    - Conductor (conductor)
10. Transport
    - Taxi driver (chafer, transportista)

11. Laborers except farmwokers
    - Masons/brick layers (albanil)
    - Day laborer (jornalero)
    - Waiters/waitress (restaurante)
12. Peasants and farm workers (campesino, ganadero, agricultur, aldana, granjero)
13. Fishermen, hunters, loggers (pescador/cazador/hachero)
14. Service workers (servicio)
15. Workers not classified by occupation (they just say empleado-employed)

In Mexico, during the decades of 1970–1990, dramatic changes occurred in the role of women. In 1990 women represented 31% of the economically active population, double the percentage recorded 20 years earlier. The demographics of women in the workforce also changed during this period. In 1980, the typical female worker was under 25 years of age. Her participation in the workforce was usually transitional and would end following marriage or childbirth. After the 1970s, however, an emerging feminist movement made it more acceptable for educated Mexican women to pursue careers. In addition, the economic crisis of the 1980s required many married women to return to the job market to help supplement their husbands' income. About 70% of women workers in the mid-1990s were employed in the tertiary sector of the economy, usually at wages below those of men. However, the Costa Chica region does not reflect this change. The survey data disclosed that 60% of the population (n = 5,659) were economically inactive—i.e., homemakers, students, and the 'not applicable' category. Eighty-six percent of the women fall into this inactive population category and almost one-half of them were homemakers.

Table 8.14 Occupation of household population

	Gender		
Occupational category	Male	Female	Total
Unemployed	23	9	32
	0.59	0.21	0.39
Homemaker	23	1,729	1,752
	0.59	40.13	21.29
Student	1,469	1,575	3,044
	37.47	36.56	37.00
Professional, technical, and managerial workers	96	107	203
	2.45	2.48	2.47
Clerical and kindred workers	1		1
	0.03		0.01
Sales workers	111	243	354
	2.83	5.64	4.30
Craftsmen, foremen, and kindred workers	27	3	30
	0.69	0.07	0.36
Operatives, welding	1		1
	0.03		0.01

(continued)

Table 8.14 (continued)

	Gender		
Occupational category	Male	Female	Total
Transport	104	1	105
	2.65	0.02	1.28
Laborers except farmers	110	61	171
	2.81	1.42	2.08
Peasants and farm workers	1,176	33	1,209
	30.00	0.77	14.69
Fishermen, hunters, loggers	115	1	116
	2.93	0.02	1.41
Service workers	44	6	50
	1.12	0.14	0.61
Workers not classified by occupations	179	118	297
	4.57	2.74	3.61
N/A	441	422	863
	11.25	9.80	10.49
Total	3,920	4,308	8,228
	100.00	100.00	100.00

Table 8.15 Comparison of population by employment status: census 2000 vs. survey data

	Census 2000				Survey	
Employment status	Oaxaca	Guerrero	Total	Percent (%)	Number	Percent (%)
Economically active population	1,076,829	899,191	1,976,020	44	2,569	31
Economically inactive population	1,297,849	1,168,244	2,466,093	56	5,659	69
Population actually occupied/employed	1,066,558	888,078	1,954,636	99	2,537	99
Population employed in primary sector	438,312	237,618	675,930	35	1,325	52
Population employed in secondary sector	206,516	179,984	386,500	20	172	7
Population employed in tertiary sector	400,105	449,029	849,134	43	743	29
Population employed without classification	21,625	21,447	43,072	2	297	12
Total employed	1,066,558	888,078	1,954,636	100	2,537	100

Among the actively employed population, peasants and farm workers was the leading category, dominated mostly by males. The occupational distribution of males and females is shown below (Table 8.14).

Employment Status: The comparison of Census 2000 and Survey data (Table 8.15) indicate the following differences: (a) that fewer African descendents are economically active when compared to the general population in the region; (b) that fewer African descendents were engaged in secondary and tertiary sectors than the general population; and (c) that more African descendents were engaged in primary sector than the general population. The low literacy rates and lower educational levels among the African descendants as observed in the preceding section could be the reasons for these differentials.

Number of Hours Working per Week: The comparison of Census 2000 with Survey data disclosed that the African descendants were more frequently engaged in sporadic employment than the general population in the region (Table 8.16).

Personal Income: Although many people in the Costa Chica region in general do not receive salaries or earn below minimum wages,[6] the situation is further deplorable for African descendants. The survey data showed that 14% of the working population does not receive salaries, and an additional 23% earns below minimum wage (Table 8.17). These two categories by themselves constitute over one-third of the working population. Given that only 31% of the population is economically active, these earning deficiencies create a tremendous economic burden for African descendants; i.e., a combination of high dependency ratio and low wage earnings.

Table 8.16 Comparison of population by weekly employment: census 2000 vs. survey data

	Census 2000				Survey	
Employment status	Oaxaca	Guerrero	Total	Percent (%)	Number	Percent (%)
Sporadic (not fixed weekly) employment	20,568	16,449	37,017	2	230	9
Less than 32 h weekly employment	234,799	201,942	436,741	23	555	22
32–40 h weekly employment	176,690	132,881	309,571	17	413	16
41–48 h weekly employment	274,355	205,121	479,476	26	463	18
More than 48 h weekly employment	315,393	294,575	609,968	33	876	35
Total	1,021,805	850,968	1,872,773	100	2,537	100

Table 8.17 Comparison of population by weekly employment: census 2000 vs. survey data

	Census 2000				Survey	
Employment status	Oaxaca	Guerrero	Total	Percent (%)	Number	Percent (%)
Population employed not receiving salary	300,977	177,233	478,210	11	355	14
Population employed receiving below minimum wage	219,171	125,182	344,353	8	584	23

(continued)

[6]Minimum wages for the year 2005 (i.e. at the time of survey) were 46.80 pesos for Guerrero state and 44.05 for Oaxaca state. For further discussion on this subject, visit the website of the National Commission of Minimum Wages, http://www.mexicanlaws.com/minwages2005.html

Table 8.17 (continued)

	Census 2000				Survey	
Employment status	Oaxaca	Guerrero	Total	Percent (%)	Number	Percent (%)
Population receiving between 1 and 2 minimum wages	885,539	233,832	1,119,371	26	736	29
Population receiving between 2 and 5 minimum wages	1,120,312	367,110	1,487,422	35	609	24
Population receiving between 5 and 10 minimum wages	219,171	125,182	344,353	8	178	7
Population receiving above 10 minimum wages	225,539	233,832	459,371	11	76	3
Total	2,970,709	1,262,371	4,233,080	100	2,537	100

Housing Characteristics

Number of Rooms Excluding Kitchen: Thirty-one percent of the households surveyed did not have any rooms excluding the kitchen; that is, they are single-room units used for kitchens as well as all other living purposes. Over one-half (57%) of the households had only one room apart from the kitchen and another 10% had two rooms. Less than 2% had three or more rooms. Thus, the norm is a one-room house with wall of adobe (Fig. 8.17). Also, while some of the better houses are constructed with brick or cinderblock, others can be a rather makeshift structure of sticks, mud and cardboard.[7] The average occupancy rate per room (excluding the kitchen) is 5.2 persons—higher than the census rate of 4.6 for the states of Oaxaca or Guerrero.

Homeownership: Most of the residents own their houses and only a few rent them (Fig. 8.18). This pattern is similar in both Census 2000 and the survey data sets. According to Census 2000, 92% (1,183,327/1,285,476) owned their houses and the others (8% or 102,149/1,285,476) were renters. Similarly, 95% of the surveyed households (n = 1,678) were owners and the remaining 5% were renters.

Home Improvement: Of the 1,678 homeowners, nearly 60% made no improvements, while 10% completely rebuilt their homes, 8% had undertake major repairs and 20% minor repairs (Fig. 8.19).

Source of Funds for Improvement: For those who had to incur expenses for home improvement, the most common source of revenue was the sale of harvests (33%). Remittance from migrant relatives (30%) was almost of equal importance and perhaps a necessary source of revenue especially when a home needs to be completely rebuilt or major repairs need to be done. Government subsidy (8%) was a rarely relied upon option (Fig. 8.20, Table 8.18).

[7] Vaughn, B. (2004), *Black Mexico*. http://www.mexconnect.com/mex_/feature/ethnic/bv/brief.htm

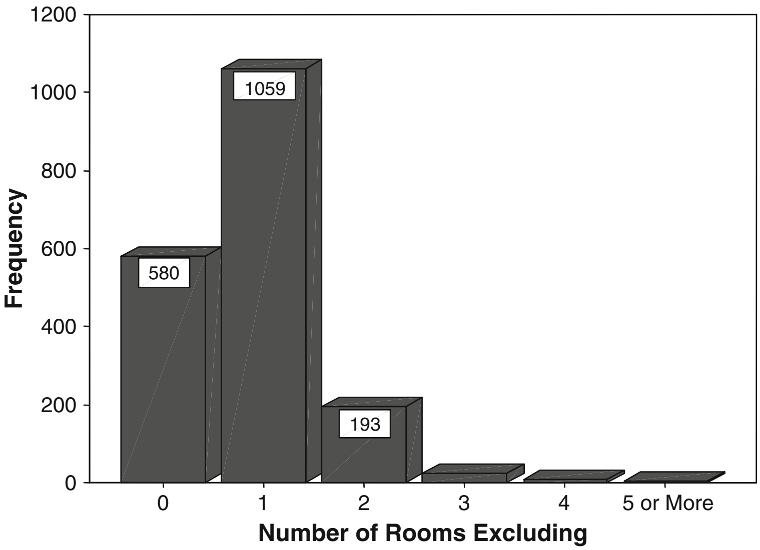


Fig. 8.17 Number of rooms excluding kitchen

Fig. 8.18 Comparision of homeownership

Cost of Rent (if renting): The renters (n = 96) were asked to specify the amount of money they had to pay each month (10 of them did not know). Of the remaining 86 renters, 85 paid a minimum of 100 pesos – 100–299 pesos by 13 households, 300–499 pesos by 34 households, and 500 or more pesos by 38 households (see Fig. 8.21 for corresponding percentages).

Possession of Valuables: Most of the households (90%) possessed a television and/or a radio (62%). The other valuables possessed were a motor vehicle (16%), a computer (6.3%) or a boat (1.6%). Given their low personal income levels, these patterns are not surprising (Fig. 8.22).

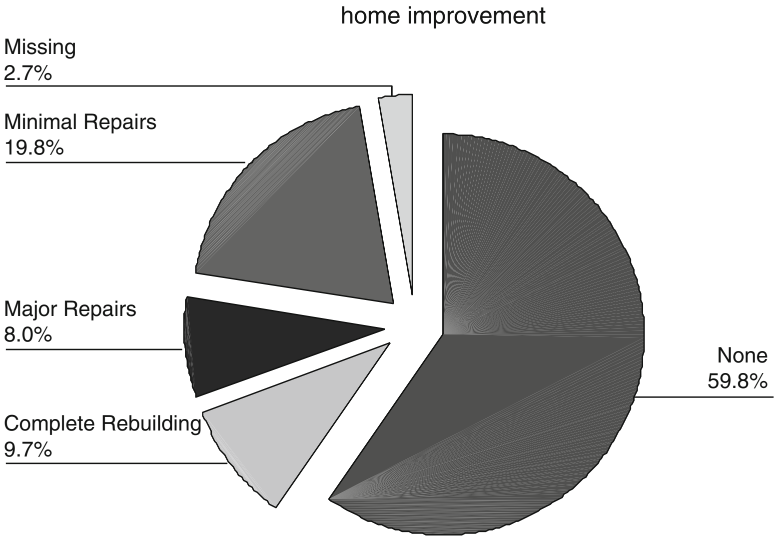


Fig. 8.19 Home improvement

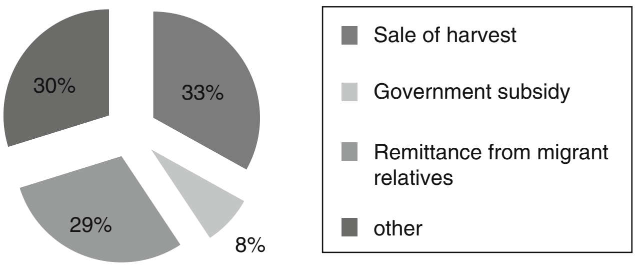


Fig. 8.20 Source of funds for home improvement

Table 8.18 Source of funds by home improvement type

	Home improvement type		
Source of funds	Complete rebuilding (%)	Major repairs (%)	Minimal repairs (%)
Sale of harvest	25	35	34
Government subsidy	10	10	5
Remittance from migrant relatives	40	36	22
Other	25	19	39

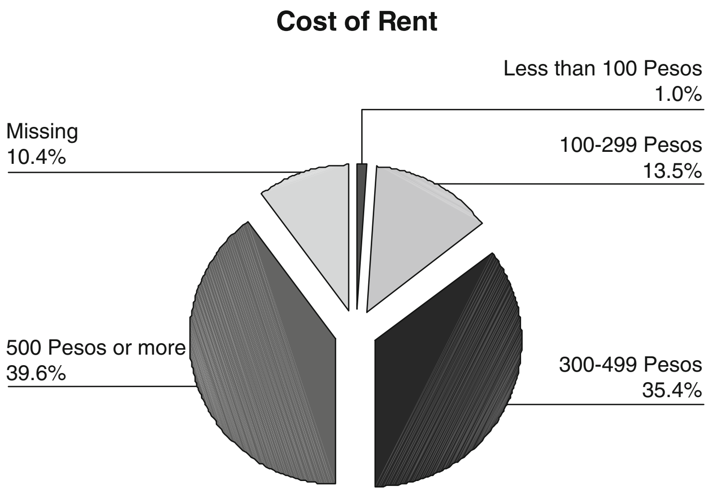
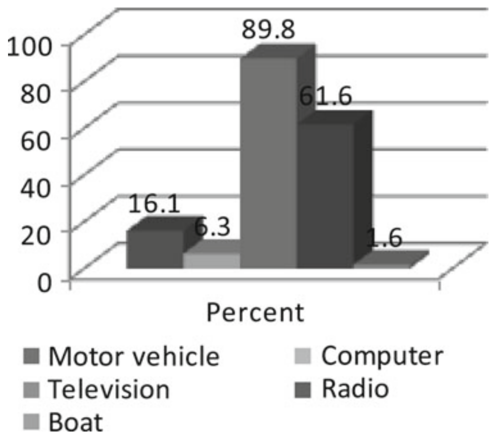


Fig. 8.21 Cost of rent

Fig. 8.22 Possession of valuables



Household Economics

Total Family Income: Nineteen percent of the households reported total family income of less than 100 pesos per week, 12% between 100 and 299 pesos, 16% between 300 and 499 pesos, 22% between 500 and 699 pesos. Nearly 20% reported 1,000 pesos or more per week (Fig. 8.23). To further investigate the determinants of these family income levels, a set of regression equations was tested and three significant variables were identified as presented in the following table: size of household, marital status, and education. In other words, the households with larger family incomes tend to correlate with larger size of household, married persons, and with relatively high educational levels (Table 8.19).

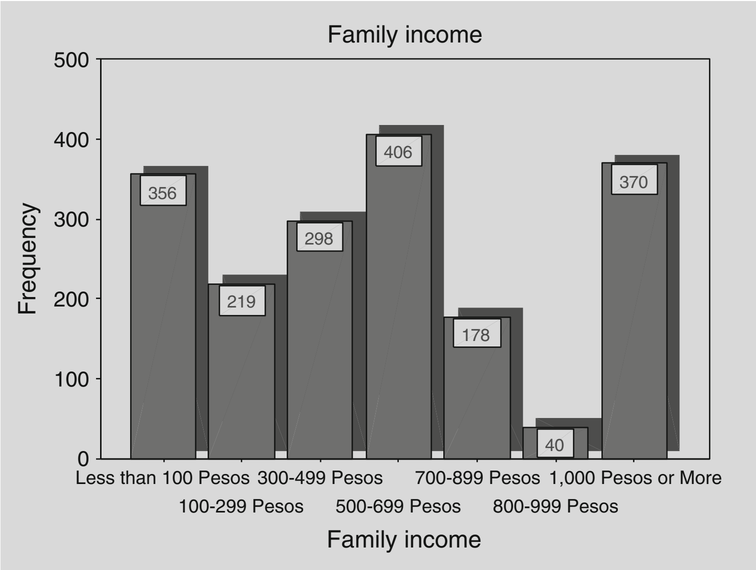


Fig. 8.23 Total family income

Table 8.19 Regression analysis of determinants of family income

		Unstandardized coefficients		Standardized coefficients		
Model		B	Std. error	Beta	t	Sig
1	(Constant)	167.788	63.008		2.663	.008
	Size of household	92.826	23.843	.129	3.893	.000
	Marital status	39.680	10.416	.125	3.810	.000
	Education	83.175	10.779	.255	7.717	.000

Dependent variable: total family income per week

Number of Dependents: Although many families keep every member engaged in some sort of employment to reduce their dependency on family, some (n = 224) cannot avoid the dependency. As Table 8.20 shows, the number of dependents vary anywhere from one to as many as seven.

Dependents' Relationship with Head of Household: These dependents are mostly children, parents, and grandparents (Table 8.21). Other dependants include cousins, nephews, nieces, etc. (see relationship to head of the household in the preceding chapter on *Household Population Composition*).

Financial Support from a Family Member Away from Home: While 224 households reported dependents, 676 households agreed that they receive financial support from a family member who lives away from them (Fig. 8.24).

Table 8.20 Number of dependents

		Frequency	Percent	Valid percent	Cumulative percent
Valid	0	1,623	86.9	87.9	87.9
	1	161	8.6	8.7	96.6
	2	42	2.2	2.3	98.9
	3	13	.7	.7	99.6
	4	4	.2	.2	99.8
	5	1	.1	.1	99.8
	7	3	.2	.2	100.0
	Total	1,847	98.9	100.0	
Missing	System	20	1.1		
Total		1,867	100.0		

Table 8.21 Dependents' relationship with head of household

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Parent	50	2.7	22.4	22.4
	Children	126	6.7	56.7	78.9
	Grandparents	4	.2	1.8	80.7
	Other	43	2.3	19.3	100.0
	Total	223	11.9	100.0	
Missing	System	1,644	88.1		
Total		1,867	100.0		

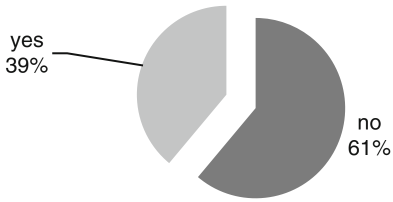


Fig. 8.24 Financial support from a family member away from home

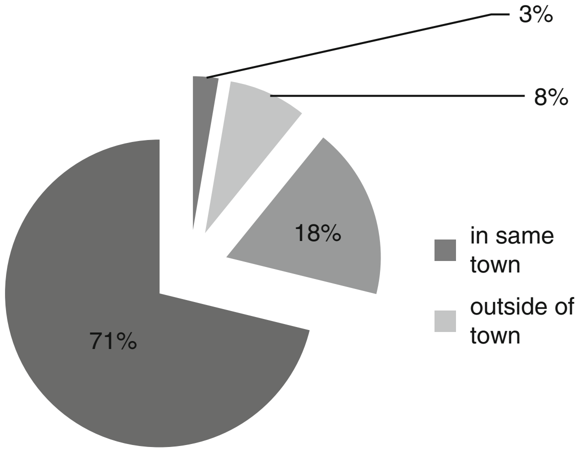
Supporter's Relationship with Head of Household: Three-fourths of the supporters were children and 'other' was the next largest category (23%). See Table 8.22.

Supporter's Place of Residence: Most of the supporters (71%) reside outside the country—most likely in the United States (Fig. 8.25). This is understandable, given the limited opportunity for employment and high rates of poverty within the nation, and the even further economic hardships in the Costa Chica region. The younger people who left were strongly motivated by better employment and economic opportunities outside the country, which helped them to go abroad, earn, and support their parents and families back home. Those who could not go outside the country tended to move in the following order of preference: to an outside state (18%), to an outside town (8%), away but in the same town (3%). This pattern

Table 8.22 Supporters relationship with head of household

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Parent	14	.7	2.1	2.1
	Children	504	27.0	74.4	76.5
	Stepchildren/foster children	3	.2	.4	77.0
	Grandparents	1	.1	.1	77.1
	Other	155	8.3	22.9	100.0
	Total	677	36.3	100.0	
Missing	System	1,190	63.7		
Total		1,867	100.0		

Fig. 8.25 Supporters place of residence



indicates that very limited opportunities exist locally for those who have obligations to support large number of dependents.

Amount of Support Received: Of the 661 households reporting that they had been receiving support, 31% received 2,000 pesos or more. A majority of the households (37%), received between 1,000 and 1,499 pesos; and, 16% received 600–999 pesos. Eight percent reported in each of the categories of "less than 500 pesos" and "1,500–1,999 pesos" (Fig. 8.26).

Frequency of Support: A majority of the supporters (45%) reportedly sent money to their families once a month, 27% once in 2 or 3 months, and the remaining 28% once in 4 months or longer (Tables 8.23 and 8.24). This pattern is similar to all categories of "amount of support," with an exception in 1,500–1,999 pesos. ($\chi^2 = 45.942$, $df = 6$, $p = .000$).

When the data were cross-tabulated by relationship and frequency of support, it is observed that parents and children tended to be more regular in terms of sending their support every month than others. This pattern is understandable as they are the immediate family members and, as such, feel more obligated.

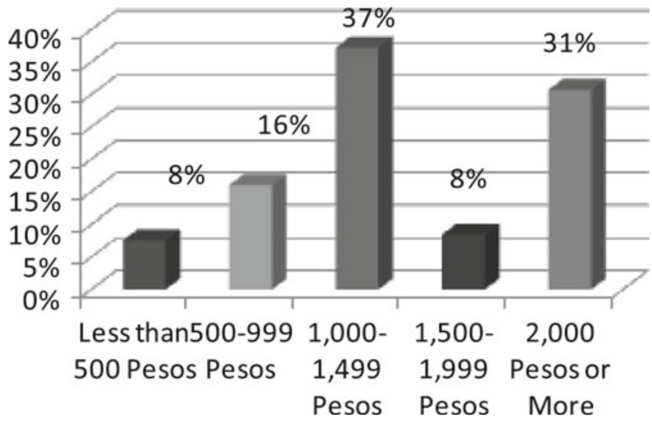


Fig. 8.26 Amount of support

Table 8.23 Relationship to the head of household by frequency of support

Relationship	Frequency of support: Once a month	Once in 2 or 3 months	Once in 4 months or over	Total
Parent	7	3	2	12
	58.3%	25.0%	16.7%	100%
Children	223	146	127	496
	45.0%	29.4%	25.6%	100%
Step/foster children			3	3
			100	100%
Other	63	28	62	153
	41.2%	18.3%	40.5%	100%
Total	293	177	194	664
	44.1%	26.7%	29.2%	100%

Table 8.24 Amount of support by frequency

Amount of support	Frequency of support: Once a month	Once in 2 or 3 months	Once in 4 months or over	Total
500–999 Pesos	38	26	41	105
	36.2%	24.8%	39.0%	100%
1,000–1,499 Pesos	94	77	74	245
	38.4%	31.4%	30.2%	100%
1,500–1,999 Pesos	21	28	7	56
	37.5%	50.0%	12.5%	100%
2,000 Pesos or More	120	34	48	202
	59.4%	16.8%	23.8%	100%
Total	273	165	170	608
	44.9%	27.1%	28.0%	100%

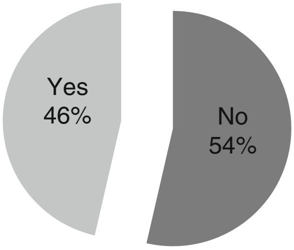


Fig. 8.27 Households reporting sickness in the past 1 year

Table 8.25 Family member falling sick in past 1 year

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Head	327	24.6	24.6	24.6
	Spouse	301	22.8	22.6	47.2
	Son	210	15.8	15.8	63.0
	Daughter	232	17.4	17.4	80.5
	Grandson	47	3.5	3.5	84.0
	Granddaughter	46	3.5	3.5	87.4
	Father	6	.5	.5	87.9
	Mother	106	8.0	8.0	95.9
	Nephew	3	.2	.2	96.1
	Niece	4	.3	.3	96.4
	Daughter-in-law	8	.6	.6	97.0
	Aunt	1	.1	.1	97.1
	Other	39	2.9	2.9	100.0
Total		1,330	100.0	100.00	

Household Health[8]

Family Member Falling Sick in Past Year: A total of 1,187 households answered the question: *Has anyone in your family fallen sick in the past one-year?* Of them, 46% reported that at least one member of their family fell sick in the past year (Fig. 8.27). Of the total 1,330 members who fell sick during this period, 47% were heads of households or their spouses, 34% were sons and daughters, 8% were mothers, and the remaining were others (Table 8.25).

[8] In the early 1990s, Mexico entered a transitional stage in the health of its population by exhibiting mortality patterns closer to those of developed societies. Health officials have also reported substantial reductions in morbidity rates for several diseases typically prevalent in poorer countries. Nevertheless, diseases associated with unsanitary living conditions, minimal access to health care, or inadequate diet continue to affect those in the lowest economic strata. Costa Chica is one such example. In addition, persistent under reporting of diseases in some areas, especially rural areas, distorts the true dimension of the health care challenge.

Table 8.26 Morbidity rates based on survey

Relationship	Persons fell sick	Total	Morbidity rate
Head	327	1,484	22.04
Spouse	301	1,282	23.48
Son	210	1,960	10.71
Daughter	232	1,848	12.55
Grandson	47	430	10.93
Granddaughter	46	408	11.27
Father	6	37	16.22
Mother	106	351	30.20
Nephew	3	35	8.57
Niece	4	37	10.81
Daughter-in-law	8	122	6.56
Son-in-law	0	26	0.00
Aunt	1	11	9.09
Other	39	197	19.80
Total	1,330	8,228	16.16

In order to determine the extent of vulnerability to falling sick, morbidity rates[9] were computed as shown in Table 8.26. While the overall probability of falling sick is about 16%, mothers constitute the major risk with a morbidity rate of above 30; i.e., nearly twice the risk. This may be due to their age combined with unsanitary living conditions, minimal access to health care, or inadequate diet. Heads of households and spouses are the next most vulnerable category. Their vulnerability may be partly because they do not take care of themselves as well as they take care of their children, in addition to long working hours, irregular diet habits, etc. This situation, unfortunately, becomes inevitable when they make only minimum wages (or less) and are burdened with high dependency rates, forcing them to choose between their own health and their children's health.

Nature of Sickness: Nearly one-half of the persons (48.4%) did not know the nature of their sickness (Fig. 8.28). Fever/flu/diarrhea (29.6%) or chronic illness (11.1%) was frequently mentioned. The other types of sickness mentioned were: common cold (.8%), allergy (2.1%), chicken pox/small pox/ measles (1.8%), menopause related (.3%), backache and bodily pains (3.7%), stress related illness (.8%), and thyroid fever (1.4%).

Duration of Sickness: How long had they been sick? Nearly 6 out of every 10 said that they were sick for at least 4 weeks; 11% for 2–3 weeks; and, the remaining 33% for a week or less (Fig. 8.29). As Table 8.27 demonstrates, seasonal sicknesses like the common cold, or fever/flu/diarrhea, lasted for a week or less. However, 75% of the allergy patients suffered for long-periods. Chicken pox/small pox/measles lasted, for the most part, up to 2 or 3 weeks. Other illnesses, like backache and bodily pains, chronic illness, stress related illness, thyroid fever, etc. were among those lasting for

[9]The morbidity rate is usually defined as the percent of persons falling sick in a given population, or $[(p_{sr}/p_r) \times 100]$, where p_{sr} represents the number of persons falling sick in a relationship category 'r' and p_r the number of persons in the same relationship category.

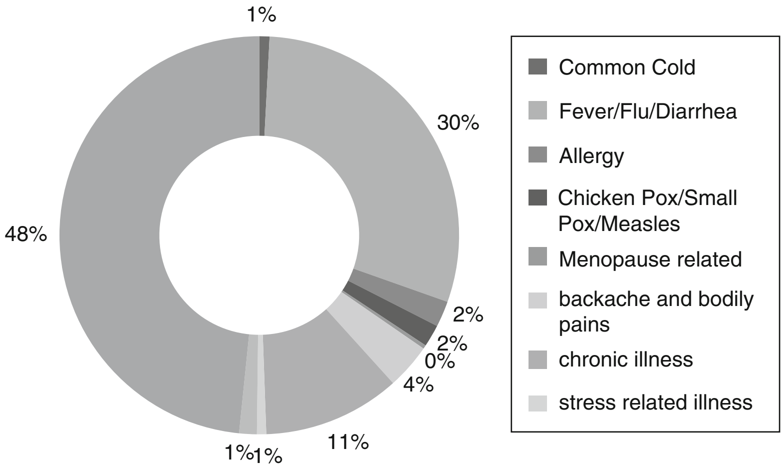


Fig. 8.28 Nature of sickness

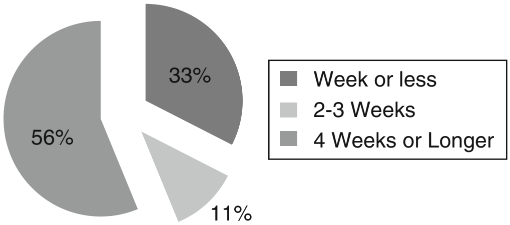


Fig. 8.29 Duration of sickness

Table 8.27 Nature of sickness by duration

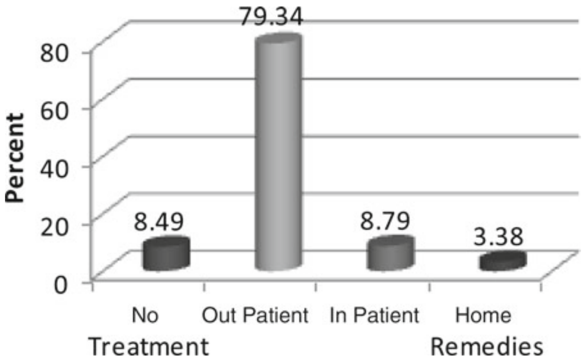
	Duration of sickness				
Nature of sickness	Week or less	2–3 weeks	4 weeks or longer	Unknown	Total
Common cold	9		2		11
	81.82		18.18		100.00
Fever/flu/diarrhea	299	53	41	1	394
	75.89	13.45	10.41	0.25	100.00
Allergy	5	2	21		28
	17.86	7.14	75.00		100.00
Chicken pox/small pox/ measles	11	10	3		24
	45.83	41.67	12.50		100.00
Menopause-related	2		2		4
	50.00		50.00		100.00
Backache and bodily pains	8	5	36		49
	16.33	10.20	73.47		100.00
Chronic illness	6	3	139		148
	4.05	2.03	93.92		100.00

(continued)

Table 8.27 (continued)

	Duration of sickness				
Nature of sickness	Week or less	2–3 weeks	4 weeks or longer	Unknown	Total
Stress-related illness	2		8		10
	20.00		80.00		100.00
Thyroid fever	4	1	14		19
	21.05	5.26	73.68		100.00
Unknown	161	63	417	2	643
	25.04	9.80	64.85	0.31	100.00
Total	507	137	683	3	1,330
	38.12	10.30	51.35	0.23	100.00

Fig. 8.30 Type of treatment



longer periods. Sadly, many of those who suffered for longer periods did not know what they suffered from. This lack of knowledge makes it harder for them to take any precautions to protect themselves from such diseases in future.

Treatment Particulars: An overwhelming majority of 79% received treatment as out-patients, while an additional 8.8% did so as in-patients. Over 8% did not get any treatment, while another 3% relied on home remedies (Fig. 8.30).

Number of Visits to Hospital or Doctor: While 26% visited the hospital or doctor for 10 or more times, nearly 40% made such visits only one or two times. The percentage of patients visiting for the third time and onwards declined drastically for each successive visit (Fig. 8.31). This could be either because they had recovered from their sickness, or refrained from going back as soon as they started feeling better in order to avoid the associated expenses.

Disability: The percentage of population with a disability is the same in both census and survey data sets; i.e., 2% (Table 8.28). However, the disability ratio[10] gives a different

[10]The disability ratio is defined as the number of persons with disability per 1,000 persons without disability, or $[(p_{wd}/p_{wod}) \times 1{,}000]$, where p_{od} represents the number of persons with disability and p_{wod} the number of persons without disability. Therefore, for Census 2000, this ratio is: $[(116{,}938/6{,}330{,}410) \times 1{,}000] = 18.47$; and for survey data: $[(203/8{,}025) \times 1{,}000] = 25.30$.

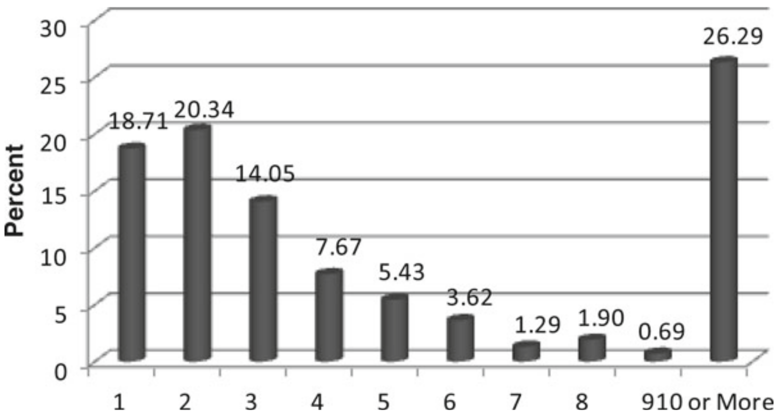


Fig. 8.31 Number of visits

Table 8.28 Disability

	Census 2000				Survey	
Disability status	Oaxaca	Guerrero	Total	Percent (%)	Number	Percent (%)
Population with disability	50,969	65,969	116,938	2	203	2
Population without disability	2,988,465	3,341,945	6,330,410	98	8,025	98
Total	3,039,434	3,407,914	6,447,348	100	8,228	100
Disability type[a]						
Population with physical disability	21,447	24,909	46,356	40	49	24
Population with hearing disability (deafness)	8,485	12,336	20,821	18	64	32
Population with visual disability (blindness)	14,079	20,597	34,676	30	40	20
Population with mental disability	7,831	9,113	16,944	14	n.a.	
Population with linguistic disability	3,952	4,894	8,846	8	26	13
Other	–	–	–		43	21

[a] Percentages do not add up to 100 due to multiple disabilities

picture. While this ratio is about 18 for census population, it is about 25 among the surveyed population. In other words, while it is possible to find 18 persons with disability per every 1,000 persons without disability, on an average, in the states of Oaxaca and Guerrero, we can expect to find as many as 25 disabled persons per every 1,000 persons without disability among the communities surveyed in the Costa Chica region.

Among those with disability, physical disability ranked first in the Census (40%), while deafness topped others in the survey (32%). Blindness was the second most common disability in the Census (30%) and third in survey (20%). The combination of hearing and speech disabilities was reported in the survey by as many as 15 respondents (or 7.4%), and 21% of the survey respondents indicated 'other' forms of disability, which includes mental disabilities.

Land Ownership and Utilization

Ownership of Land Property: Out of 1,722 households responding, 52% (n = 910) claimed ownership of property. The remaining 48% (n = 812) did not own any land (Fig. 8.32).

Method of Acquiring: One-half of the landowners (n = 458) acquired land through inheritance; 37% purchased it; and about 12% acquired their land through other means (e.g., charities, donations, occupancy of unclaimed property, etc. Fig. 8.33). Two respondents did not specify how they acquired their land.

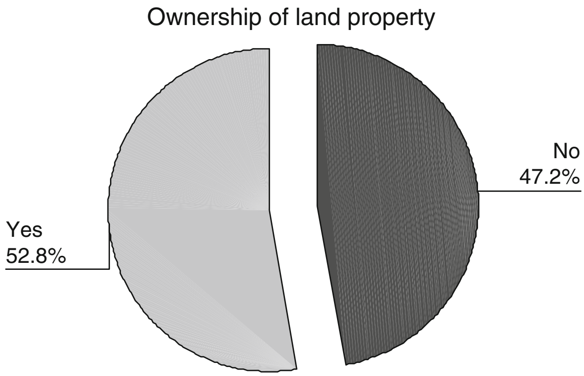


Fig. 8.32 Ownership of land property

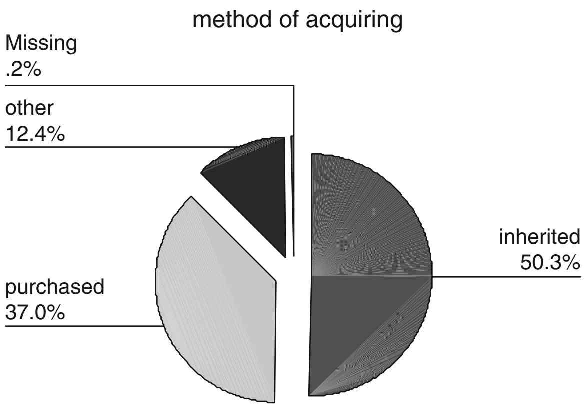


Fig. 8.33 Method of acquiring

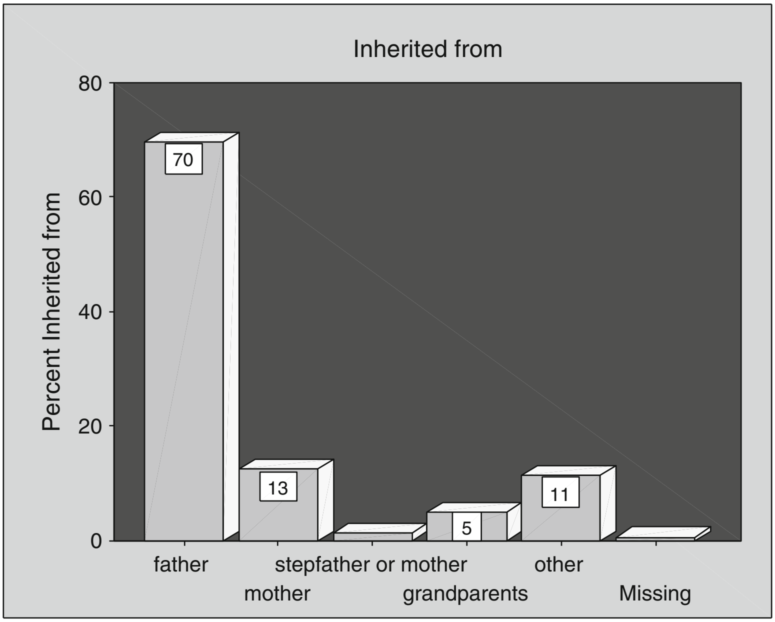


Fig. 8.34 Source of inheritance

Source of Inheritance: Understandably, 70% of those who inherited land (n=317) did so from their fathers, and an additional 13% (n=57) received an inheritance from their mothers, totaling about 83% of respondents receiving their inheritance from parents (Fig. 8.34). While grandparents were the source of inheritance for 5% (n=23) of the households, stepparents were for a few (n=6 or about 1%). However, 11% did mention other sources of inheritance, e.g., siblings, adopted/foster parents, uncles/aunts, etc. Three households failed to specify.

Time Since Inheritance: Most (71%) had inherited their land a long time ago (10+ Years). Fourteen percent (n=63) inherited between 5 and 9 years ago, and the other 15% (n=68) inherited recently, within the last 5 years (Fig. 8.35).

Amount of Land Purchased: Of those who reported that they acquired land by purchasing (n=338), nearly 46% bought less than one acre, 15% between 1 and 5 acres, 9% between 6 and 10 acres, and, 29% more than 10 acres (Fig. 8.36). Many of those who acquired less than 1 acre might have been the buyers of small home sites.

Cost of Land: The cost of land varied from a few hundred to several thousand pesos (Fig. 8.37). Although it is theoretically possible to postulate a positive relationship between the amount of land purchased and the cost associated, the correlation coefficient (r=.103) proved to be insignificant. In the absence of this relationship, at least two other explanations can be suggested: location and land use. In other words, certain neighborhoods cost more than others based on demand.

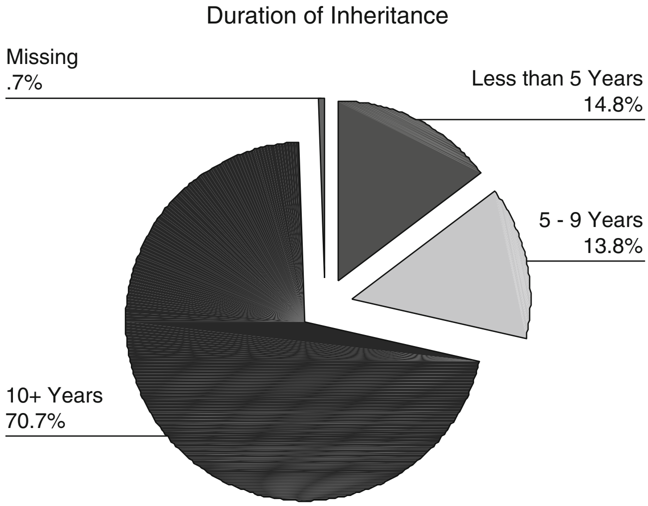


Fig. 8.35 Time since inheritance

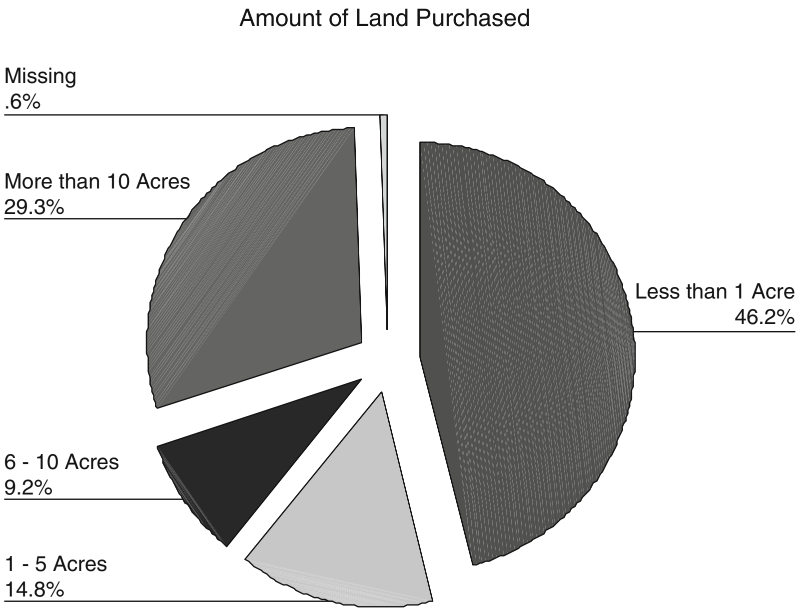


Fig. 8.36 Amount of land purchased

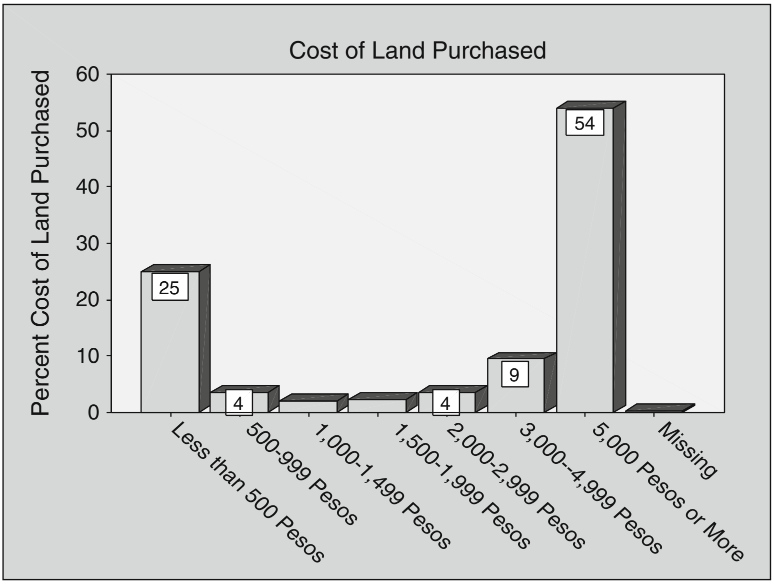


Fig. 8.37 Cost of land

Similarly, farmland may be relatively less expensive than urban land. Then, within the category of farmland, tracts without cultivating facilities may be less expensive than those with such facilities. In any case, over one-half (54%) of the households (n=182) paid over 5,000 pesos for the land they purchased, while 25% (n=84) paid less than 500 pesos.

Land Utilization: The primary use of land was for agriculture (62% of the households; n=551) and land was utilized to livestock by 26% (n=232). About 12% (n=105) indicated 'other' purposes, such as residential, rent or lease, etc., and many of them possessed less than one acre (Fig. 8.38).

Whether Any Land Was Sold: All the households who reported that they possessed land were asked whether they sold any land they once owned. About 11% (n=90) of those who answered this question (n=852) responded positively (Fig. 8.39).

Time Sold: Ten percent (n=9) of those who sold their land (n=90) did so within the last year, 31% between 1 and 5 years, and 32% between 6 and 10 years. Twenty-seven percent (n=24) stated that they sold their land 11 years ago or longer (Fig. 8.40).

Amount of Land Sold: While nearly one-half (48%) sold 1–5 acres of land, 13% (n=12) sold less than one acre, 18% 6–9 acres, and 21% 10+ acres (Fig. 8.41).

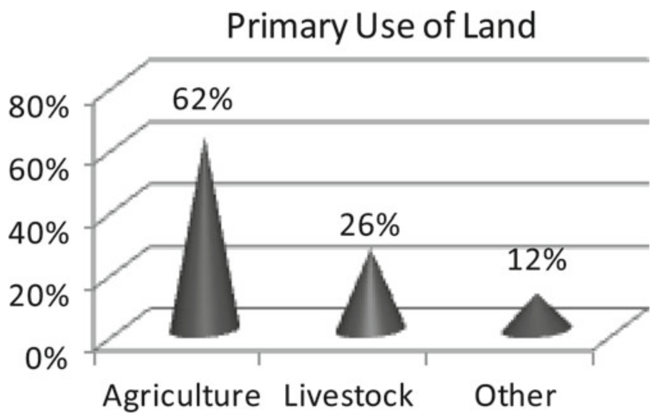


Fig. 8.38 Land utilization

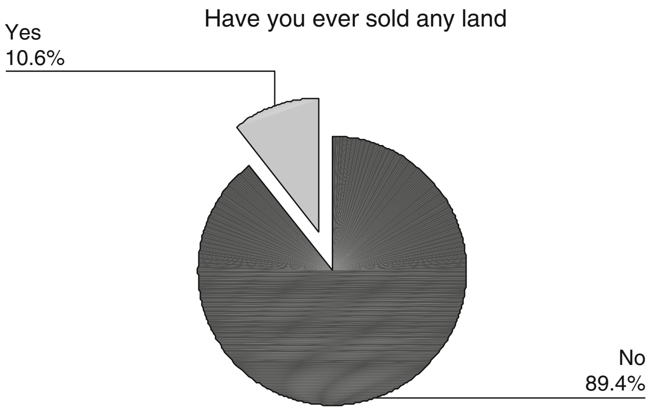


Fig. 8.39 Whether any land was sold

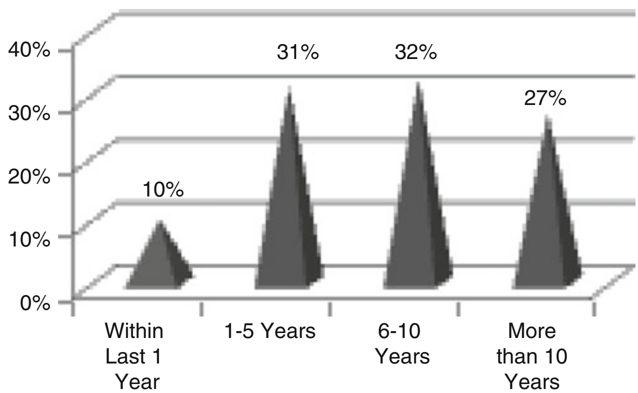


Fig. 8.40 Time since land sold

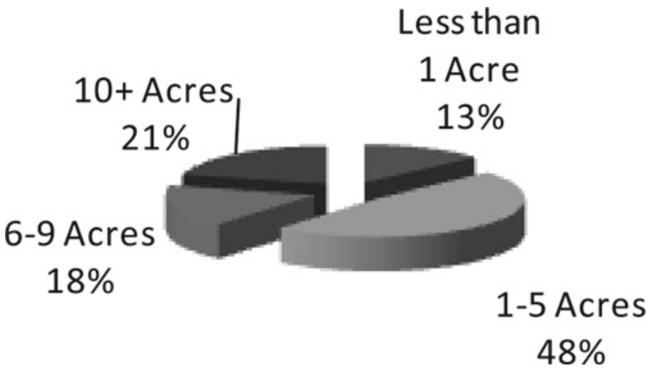
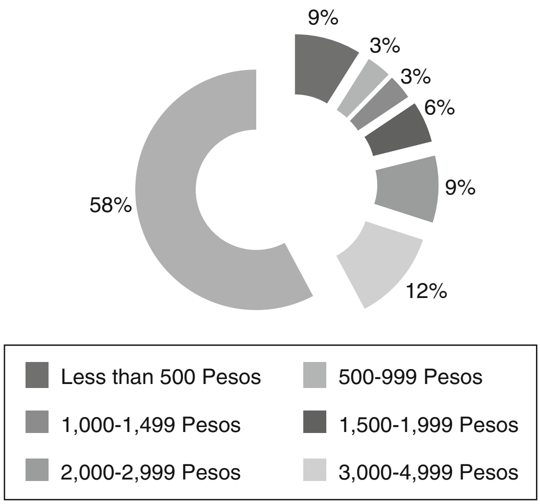


Fig. 8.41 Amount of land sold

Fig. 8.42 Price sold for



Price Sold For: Over one-half of the households who sold their land (58%) received more than 5,000 pesos in return, 12% 3,000–4,999 pesos, 15% between 1,500 and 2,999 pesos. Nine percent received as little as less than 500 pesos, and another 3% 500–999 pesos (Fig. 8.42).

Persons Sold To: Eighty-six percent (n = 77) of land sellers sold to persons within their community, while the remaining 14% (n = 13) sold to buyers outside their community (Fig. 8.43).

Post-Sale Land Use: Fifty-four percent (n = 49) thought that the land use after they sold remained the same, while 46% perceived the land they sold as being used for a different purpose than the way that the original owner had used the land. This may

Fig. 8.43 Persons sold to

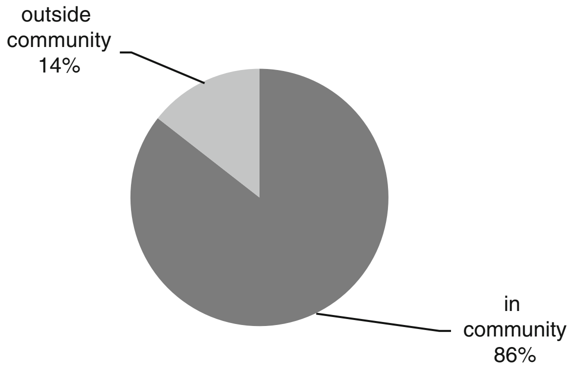
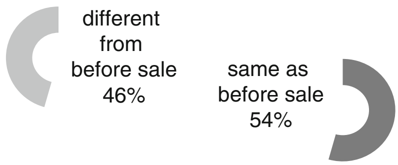


Fig. 8.44 Post sale land use



be partly because of changing demand for the land and partly because 14% of the buyers came from outside the community (Fig. 8.44).

In sum, the survey results indicate that Afro-descendants in Mexico, especially in the Costa Chica region, trail behind the general population in terms of their socio-economic, health, and housing characteristics.

Chapter 9
NAFTA, Industrial Concentration, Employment Volatility, Wages, and Internal and International Mexican Migration: 1990–2009

Miguel Flores, Mary Zey, Cinthya Caamal, and Nazrul Hoque

Introduction

Since the late 1980s, Mexico has launched an extensive process of economic liberalization that culminated with the North American Free Trade Agreement (NAFTA) in 1994. Since then, Mexico's economy has been issuing in a constant flow of international trade. During this process, the internal structure of the economy has altered patterns in terms of the composition, size, and geographic location of economic activities. Consequently, employment and wages are among the economic factors that have been affected. These in turn have direct but different influences on regional socioeconomic development. These coinciding events of liberalization, changing wages for Mexican workers, and internal and external migration have had critical consequences for Mexico's economy and development. We are interested in the changes in wages and internal and external Mexican migration for the past two decades.

On the one hand, the evidence indicates that, in the years after NAFTA was enacted, the number of Mexican-born people living in the U.S. has increased considerably and that most of them have crossed the border illegally. In 2000 the estimated Mexican-born population residing in the United States was about 10% of

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_9,

the Mexican population living in Mexico. Approximately one-quarter of the total arrived before 1980; another one-quarter entered during the decade of the 1980s; while the remainder, nearly 50% of the Mexican-born residents in U.S., arrived during the last two decade largely while NAFTA has been in effect.

On the other hand, before 1990 migration streams originated from rural Mexican locations and moved directly to rural areas in the U.S. More recent research demonstrates that two alternative patterns of migration, which may occur in tandem, have occurred. First, there is internal migration from rural to urban places in Mexico and then, secondly and serially, there is migration from urban areas in Mexico to urban areas in the U.S. Thus the new migration streams to the U.S., which have been employed in urban service and manufacturing jobs, are more highly educated, skilled, and paid, than the previous migration streams, which moved directly from rural Mexico to rural U.S. areas.

This article discusses some of the domestic economic push factors propitiating migration flows either internally or internationally. The aim of this analysis is to tie changes in the law (NAFTA) to internal shifts in Mexico's economy. Specifically, we provide evidence related to regional changes in average wages, industrial concentration, and employment volatility that underlie the incentives for recent migration internally and from Mexico to the U.S.

We focus on a regional economic analysis for two reasons. First, certain Mexican states have historically been sharing a larger proportion of migrants to the U.S. Approximately 50% of all migrants to the U.S. come from the states located in central-western Mexico. Second, the process of economic liberalization of the economy has impacted regions in Mexico asymmetrically. We provide evidence that industrial concentrations and wage differentials among regions have deepened. We discuss implications of Mexico's internal and international migration flows that may be associated with these changing domestic economic conditions.

Review of Literature

We have organized our review of literature into two sections: (1) the impact of NAFTA on institutional arrangements in Mexico and the implication for migration, and (2) past and recent patterns of migrations as defined in the extant literature.

The Impact of NAFTA

The Mexican government started the economic liberalization process after 1983 by eliminating import license requirements, with the objective to make domestic producers more competitive by giving them access to cheaper raw materials and more advanced technology. By 1986, Mexico acceded to the General Agreement on Tariffs and Trade (GATT), currently renamed the World Trade Organization (WTO). Over the following decade from the mid-1980s to 1994, the adherence to GATT led to a major liberalization in bilateral trade relations with the U. S., which was expanded under the North America Free Trade Agreement (NAFTA). NAFTA took effect on January 1, 1994, with the purpose of lowering trade and investment barriers in North America. It was signed with the aim of increasing growth and income levels among the three countries in North America – Mexico, Canada, and the U.S. Under NAFTA, trade and investment liberalization was predicted to lead to higher incomes, investment, growth, and employment in Mexico (Markusen and Zahniser 1997, p. 5). In particular, NAFTA was expected to improve wages in Mexico, and as a consequence, reduce the flow of migration from Mexico to the U.S.

The reality seems to suggest an increasing flow of immigrants to the U.S. after NAFTA. In the 1990s, the number of Mexicans residing in the U.S. more than doubled, growing from 4.3 million in 1990 to 9.2 million in 2000 (U.S. Census Bureau). Thus, both the intended consequences of economic liberalization enacted through NAFTA and the unintended consequences of U.S. economic behavior have impacted international migration from Mexico to the U.S. Specifically, the rate at which Mexico sent migrants to the U.S. was expected to be, as it was, much greater during the growth period of 1990s than during the economic recession period of the subsequent decade. As identified by Escobar (2008), there have been both internal and external factors that have played a major role in the increased number of migrants during the decade of the 1990s. These include: (1) the U.S. legalization of two million Mexicans in 1988, which provided the basis for further migration; (2) the economic conditions in the U.S., with unprecedented levels of U.S. employment growth (almost 2.8 million non-farm jobs from January 1995 to 2000); and (3) the Mexican economic crisis in 1995, followed by rapid levels of economic growth from 1996 to 2000. The combination of all these events generated significant pressures to emigrate (Escobar 2008, p. 9). Nonetheless, as pointed out by Alba (2008), the evidence indicates that almost 15 years after NAFTA, there is still no indication of any downward change in migration trends, other than the one probably associated with the slow-down of the U.S. economy in 2008.

Regardless of the reasons that first initiated the out-migration from Mexico to the U.S. and the factors that have contributed to this emigration, emigrants originated from particular rural areas in Mexico. Several researchers (Chiquiar and Hanson 2005; Durand et al. 2001; Unger 2005) have identified the Mexican states that have historically, disproportionately provided the highest rates of out migration to the U.S. These states are mainly located in central-western Mexico, including Jalisco, Michoacan, Zacatecas, Guanajuato, Aguascalientes, and Colima. Figure 9.1 shows the geography of Mexican states according to migration patterns to the U.S.

Transformation from Past to Current Internal Migration Streams

Significant portions of the Mexican population employed in agriculture have departed from rural areas to become employed in service industries and manufacturing in Mexican urban areas. The passage and implementation of the Immigration

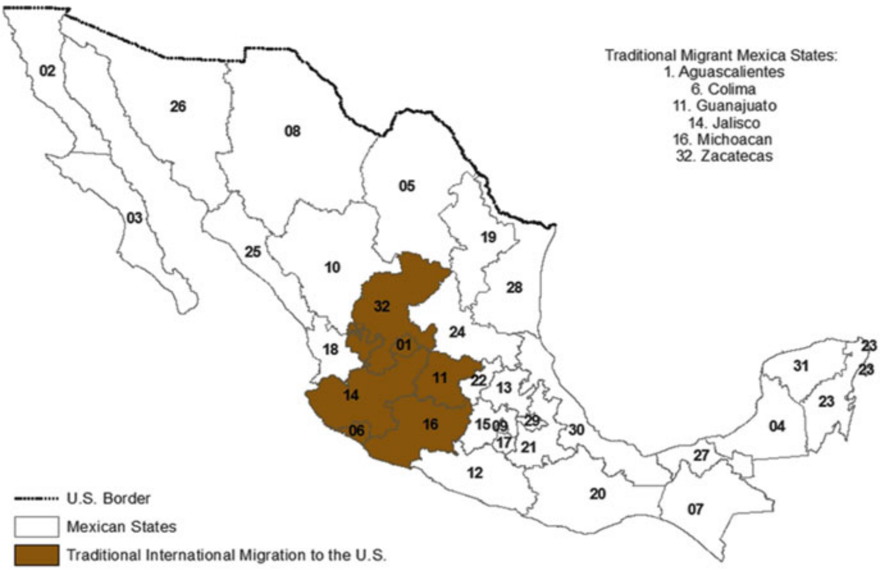

Fig. 9.1 Past established sending area of international migration to the U.S.

Reform and Control Act of 1986, which provided amnesty to 2.3 million undocumented Mexicans, allowing them to continue to occupy service and manufacturing jobs, and at the same time permitting large numbers of subsequently documented migrants to enter and occupy similar jobs under the family reunification provision of the act (Baker 1997; Durand et al. 2000; Hernandez-Leon and Zuniga 2005), had a major impact on emigration to the U.S. During this same period the successive economic crises in Mexico produced changes in the social and geographic selectivity of U.S. bound migrants (Cornelius 1992). These crises triggered the migration of middle-class Mexicans. More single and married women bound for service industry positions in the U.S. joined the migration stream. Finally new migration streams have emerged, originating in central-western Mexico, and giving rise to new migration systems linking internal and international flows (Durand and Massey 2003; Fox and Rivera-Salgado 2004: Hernandez-Leon 2005).

Prior to 1990, researchers of Mexican migration focused on migration streams from rural areas of central and western Mexico to the U.S. An understanding of this research is a solid point of departure for understanding migration after 1990. There is considerable scholarly consensus that since 1990, Mexican migration to the U.S. has been transformed (Durand et al. 1999; Roberts et al. 1999). Perhaps the most direct argument was made by Martin (1997, p. 79) who argues, "Mexico today is on the verge of its *Greatest Migration.*" Transformative change is not gradual evolutionary change; in contrast, transformation is a result of rapid, deep crisis. It is initiated from within, causing deep separations among population sectors.

The most fundamental changes in the migration stream are those of origin and destination. Before 1995, a very few scholars analyzed the role of cities in connection with the population flows to the U.S. (Massey et al. 1987; Verduzco 1990; Cornelius 1992). In the past 15 years, several critical studies on the outcomes of urban-origin migration (Arias and Woo 2004; Lozano 2000; Fussel and Massey 2004; Hernandez-Leon 2005; Zuniga 1993) have appeared, yet little of these studies deal with migration streams. For example, Massey et al. (1994) argue that migration dynamics from big cities are sufficiently different from those from smaller towns and cities to guarantee separate study (Massey et al. 1994, pp. 1503, 1506). Further, Cornelius (1991, p. 162) argues that the severe financial crises in the Mexican economy in the 1980s resulted in a sharp increase in unemployment and saturation of the internal urban labor market and a loss of real wages. It is this type of radical crisis that initiates transformation. This was not just any type of crisis but a political and economic crisis, which resulted in transformative change – a capital crisis (Zey and Camp 1996). In response to this internal economic crisis, "Mexico's current migration streams rather than simply absorbing internal migrations from the countryside and provincial cities, . . . Mexico's large urban centers today serve increasingly as platforms for migration to the United States" (Cornelius 1991, p. 162). This transformative change has led to out-migration to the U.S. of Mexico's most critical human resources, its educated, skilled, higher waged employees. Thus, internal economic conditions in Mexico, which have resulted from changes in the legal structures of trade, have resulted in an economic crisis that initiated first internal migration to urban areas and then external migration to urban areas in the U.S.

Durand et al.'s (2001) response to Cornelius (1991) was that the current migration stream was not due to urbanization, but rather to an increasing bifurcation, with towns of fewer than 15,000 people contributing 57% of the migration and cities of more than 100,000 contributing just 30% of the stream. They reasoned that the international out-migration from cities was due not to the social impact of the economic crisis as much as to the secular urbanization of Mexico. They retained the causal mechanism of the network as they repeated Massey's *Return to Aztlan* argument (Massey et al. 1987) ". . . Mexico has urbanized, families have brought their migratory experiences and network contacts from the country side to the city, so that the flow now embraces urban as well as rural workers" (Durand et al. 2001, p. 124). This explanation begs the question of that has caused the increase in these migration streams in the mid-1990s.

In response, Lozano (2000) has continued to present evidence of a macro causal mechanism related to foreign investment for urban-to-urban Mexican internal migration and urban-origin Mexican migration to the U.S. Using data from a national demographic survey on return migration collected in the late 1990s, Lozano demonstrates that even though migration from places with fewer than 2,500 people increased in the late 1970s, U.S. bound population streams from cities with more than 100,000 people reached a peak in the late 1980s, when they became more than 40% of the total outflow, but then declined in the late 1990s to 28%. By differentiating between traditional and non-traditional regions of migration in Mexico in his analysis, Lozano shows that in the nontraditional states, migration from cities remained higher (with 40% leaving) than the outflow from traditional rural localities (with 32% leaving). Lozano ties these fluctuations in the composition of the stream to the patterns of foreign investment in Mexico during the 1990s, which did not exist in the previous period. He argues that the intersection between macroeconomic transformation and its uneven impact on various regions of Mexico has caused a higher level of sending in some regions of Mexico (the less traditional, urban regions) than others.

Recent studies such as Roberts and Hamilton (2005) determined that 29% of U.S. migrants during the period between 1995 and 2000 came from cities of more than 100,000 people. Then they analyzed the fourth quarter wave of the 2002 Encuesta National de Empleo (National Employment Survey), which collected data on U.S. migration between 1997 and 2002, finding that large- and medium-sized Mexican cities account for 40% of all U.S.-bound migration. Unger (2005) characterizes the nature and effects of migration in relation to intensity form urban and rural municipalities. He found that 96% of Mexican municipalities had migratory activities, from these, 58.6% represent urban municipalities (more than 150,000 people) engaged in migration. Additionally, approximately 67.2% of urban municipalities presented high migration to the U.S. He also found that the number of urban municipalities engaged in migration is larger than the number of rural communities, demonstrating the urban-origin is becoming more important in high migration groups (nearly 70%). He concludes that migration originating from the traditional states of migration from before 1990, those in the Central-Western regions, remains very high. Most significant for our research was the finding that, when size, wealth, wages, and productivity of municipality are analyzed, urban municipalities show a negative relation between wages and migration intensity, indicating that initial migration occurs from small communities where economic conditions are worse.

In general, these recent studies provide evidence that Mexico's urban residents are in significant numbers resorting first to internal and thereafter to international migration. Large- and medium-sized Mexican cities are an important and sizable source of population streams resulting from Mexico's recent economic crisis. This massive movement of populations from Mexico has garnered little attention by demographic analysts. In the contemporary globalized economy, analysts of migration from Mexico to the United States have placed relatively little emphasis on the effects of international policy changes, such as trade agreements, and even less emphasis on major changes in the economic structure of the sending country. Both planned changes in laws and unplanned dramatic economic changes have impacted the flow of migration from Mexico to the U.S.

The connection between structural economic transformations and out-migration from rural areas, both internal and internationally, attracted scholarly interests focused on imminent mass rural exodus due to the effects of agrarian reform, including the privatization of communal farms legitimized by the Mexican Constitution, the elimination of subsidies and guaranteed prices for foods, and the liberalization of agricultural imports. The causal mechanism logic is that these reforms created redundant farm labor and as many as 27–30 million farmers had to find nonfarm employment either by migrating to local urban cities or migrating to the U.S. (Cornelius and Martin 1993; Martin 1993, 1997) As a result of this agrarian revolution, as much as one-third of the agrarian workforce would be displaced in Mexico, followed by the expectation that as many as 3–4 million rural farming households would be displaced (Martin 1997).

To summarize this section, we argue that the associated pattern of rural and urban migration within and from Mexico to the U.S. has changed. Internally, the major shifts in industrial concentration are expected to drive major changes in the internal Mexican labor market from rural farming to urban service and manufacturing jobs.

In addition, migration costs are important to the decision to migrate. Specifically, the cost of migrating to the U.S. has increased after migration laws in the U.S. were strengthened through increased law enforcement. Increased enforcement has reduced the stream of illegal migration while increasing the cost of undocumented migration. This may led to some changes in the profile of Mexican migrants. In this sense, we might not expect these migrant to be originating from the most deprived areas of the county in which there are no resources. Rather, those who are in the middle of the lower class, who have some resources, and who live in populated regions are expected to be more likely to migrate both internally and internationally.

Hence, the Mexican migration process is no longer from rural farm production to U.S. rural farm production. Migration may now involve a multi-staged process of movement from rural to urban places in Mexico, and for some population from urban-Mexican places to urban-U.S. places. In this analysis we are interested in the sending factors of place of origin in Mexico, essentially on the structure of wages in these places of departure.

Methods and Analysis

First we examine the question of the extent to which NAFTA and its resulting sea changes in the arrangement of institutional structures outlined above have resulted in major regional industrial concentration in Mexico. Then we examine the extent to which this industrial concentration has caused greater levels of regional employment volatility in Mexico. Finally we examine trends on regional wage differentials.

We focus on changes in labor market conditions as it has been identified in the migration literature as one of the main factors creating incentives for people to migrate. Specifically, neoclassical economic theory considers that migration results from changes in employment opportunities and wage differentials. Migration is induced by real income differences across locations. Individuals decide to migrate through cost-benefit calculations, which lead them to expect a positive return, usually monetary, from migration (Borjas 1994).

One of the key insights of the new economics of migration is that decisions to migrate are not taken solely as an individual choice, but as a household decision. Households act collectively in order not only to maximize expected income but also to minimize risks associated with the move itself as well as with family capital accumulation in the long run. However, labor market indicators such as employment and wages are measured at the individual level. The relevant economic variables in explaining migration are not exclusively wage differentials, but are also employment security in highly diversified industrial areas to reduce risks while maximizing access to future capital through available jobs. Families and individuals

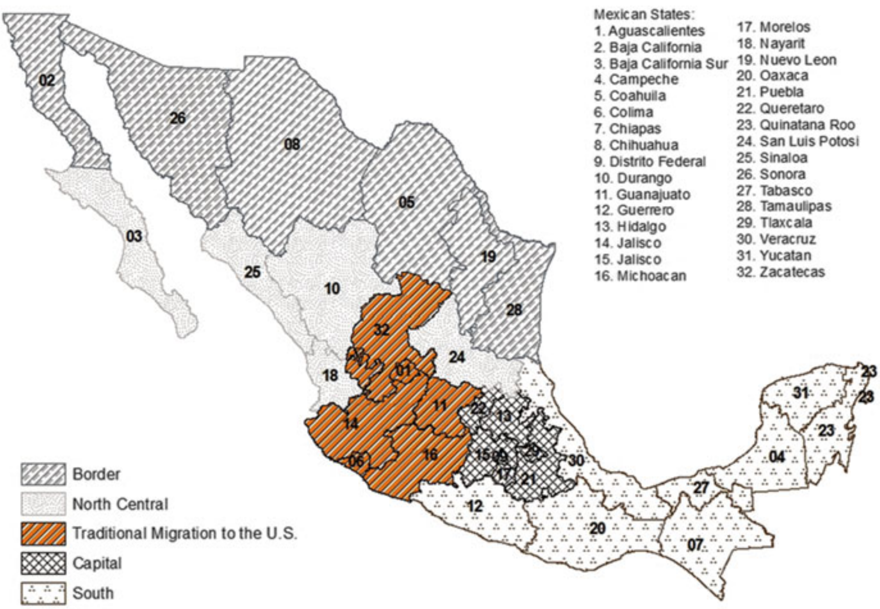

Fig. 9.2 Regional classification of Mexican states

migrate to gain access to better job markets as well as to overcome barriers attributable to access to insurance, capital, and consumer credit markets. Furthermore, this strand of theory argues that people may be motivated to migrate not only to increase their absolute income, but also to improve their household income relative to other households.

To examine the internal factors associated with migration flows, either internal or international, we have chosen a time period from 1988 to 2009, which provides an opportunity to study a 6-year period before the enactment of NAFTA in 1994 and a 15-year period after the enactment of NAFTA. This time frame enables us to measure the full effects of changes in industrial concentration, employment volatility, and wages across periods on both sides of NAFTA.

We divide the Mexican states in five regions, each one is assumed to follow particular dynamics with either internal or international migration. For example, the Border region has acted, primarily after NAFTA, as a pull region for internal migrants; the Traditional Migrant region, as above referred, is the region with long tradition of high international migration rates to the U.S.; the North Central region, characterized for being a predominantly region for high internal emigration rates; the Capital region, from which contemporary migration flows indicates high levels of internal outmigration flows; and finally the South region which has been historically associated with poor levels of socioeconomic development in the country and with high levels of internal emigration rates. This regional classification of Mexican states is showed in Fig. 9.2.

International trade theory states that two or more countries will trade with each other depending on their comparative advantage in the production of goods. It is precisely from this comparative advantage that specialization arises in each country. Specialization in the production process leads countries to benefit from trade. Trade gains are reflected in economic development in the form of industrial concentration, and at the individual level, through higher ranked occupations and with associated higher wages. Levels of endowments are relevant in determining production costs since they can create comparative advantages for each country. The cost of manufacturing labor provides Mexico with an advantage over the U.S.

Logically then, this same paradigm should apply to regional differences. According to each region's comparative advantage, a geographic concentration of production is formed. The geographic concentration of production within a nation often entails the specialization of regions in one or a few main industries (Diamond and Simon 1990). Firms also exploit this concentration of economic activity in order to minimize production costs. The incentive to locate near one another is to reduce the cost of transporting raw material and parts and distribution to the point of sales.

Firms tend to locate in particular areas in order to reduce costs by taking advantage of the agglomeration of the economic activity. Thus, the first goal is to determine whether since trade liberalization of NAFTA, Mexico has followed a pattern of specialization in the production of goods and whether this has occurred asymmetrically across the country.

To demonstrate this asymmetry or the lack of it, we calculate employment location quotient coefficients by economic sector and region for different periods. The economic activities were classified in nine productive one-digit classification sectors.[1] The purpose of this exercise is to compare a region's employment share relative to the nation's employment share and thus identify possible patterns of employment concentration in particular sectors for different time periods. Specifically, the location quotient for each sector in each region is calculated as follows:

$$LQ = \frac{\left(\dfrac{Employment\ in\ sector\ i\ in\ region\ j}{Total\ employment\ in\ region\ j}\right)}{\left(\dfrac{National\ employment\ in\ sector\ i}{Total\ national\ employment}\right)} \tag{9.1}$$

A simple interpretation of this index is as follows: an LQ quotient larger than one indicates a relative concentration of the activity i in region j, compared to the nation as a whole. If LQ quotient is equal to one, the region has a share of employment in accordance with its national share; and if LQ quotient is less than one, the region has less of a share of the employment in a particular sector than the national share.

[1] The industries were classified in nine productive one-digit classification sectors. The sectors included are: Agriculture; Mining; Manufacturing; Construction; Trade; Tourism; Transport, Financial Services; and Government.

The data used for the calculation were obtained from the ENEU[2] for the period 1988–2004, and the ENOE[3] for 2005–2009.

The literature focusing on regional occupational structures offers the hypothesis that the more industrially diverse an area, the more stable its economic growth because, even in a period of crisis, employment would be higher than in less industrially diverse areas (Malizia and Ke 1993, p. 222). Examining this assumption in Mexico requires an examination of regional industrial sector. The financial literature also addresses the relationship between industrial diversity and wage volatility, or risk. In regional economies, industries play the role of assets, and the region's industrial composition represents the portfolio. This approach assumes a trade-off between industrial diversity and wage volatility. In this paradigm, volatility is viewed as an undesirable characteristic mainly because it is associated with higher rates of unemployment. In times of economic downturns, it may involve displacement of workers who have trouble obtaining new jobs. Furthermore, high rates of volatility make it difficult for governments to plan long-term investments in public infrastructure such as roads, schools, and hospitals (Baldwin and Brown 2004, p. 520). For our purposes wage volatility increases the incentive to migrate.

In order to approximate increases in employment volatility for the periods previously defined, we apply a portfolio variance model. This approach is appropriate for our purposes as it measures regional employment variability based on industrial activity and structure. The portfolio variance model has two components: variance and covariance. On the one hand, the variance component measures the risk involved in the stochastic process of the individual industries (Trendle 1999). In other words, the portfolio variance measures to some extent the level of employment fluctuations in a given industrial sector during a particular period. Hence, the higher the employment variance in the industrial sectors, the higher the variability in provincial or regional employment. On the other hand, employment volatility is also determined by the changes in employment inter-sectors. That is, the covariance indicates whether employment changes in sectors move in the same or opposite directions (Chambers 1999). The covariance between sectors is then calculated as follows:

$$\sigma_{ij} = \left[\frac{1}{n-2}\right]\left[\frac{E_{it} - E_i}{E_j}\right]\left[\frac{E_{jt} - E_j}{E_j}\right] \tag{9.2}$$

where n is the number of observations. The variables E_{it} and E_{jt} are the observed quarterly rates of employment changes in sectors i and j, respectively, during quarter t. Then, the variables E_{it} and E_{jt} are the mean rates of change during the period considered.

[2]National Survey of Urban Employment.

[3]National Survey of Occupation and Employment.

Hence, the total employment portfolio variance is calculated as follows:

$$\sigma_T = \sum_j \omega_j \sigma j^2 + \sum_{i \neq j} \sum_{j \neq i} \omega_i \omega_j \sigma_{ij} \tag{9.3}$$

where ω_i and ω_j are the average share of each sector's employment in national employment, σ_j^2 represent the total portfolio variance of sector *j*, and σ_{ij} is the employment covariance between sector *i* and sector *j*. Employment portfolio variance was estimated for quarterly employment data in their natural log differences standardized by the mean change in each quarter for nine sectors of economic activity. The data used in this exercise also come from the ENEU and ENOE for the periods specified above.

Findings

Industry Concentration Across Regions

For purposes of our analysis we divided industry concentration into three time periods, 1988–1994, 1995–2004, and 2005–2009. The first period is the baseline period before the enactment of NAFTA in 1994, while the remaining periods are after the enactment of NAFTA.

The industrial activities across some regions of Mexico have become less diverse over the past two decades. Prior to the enactment of NAFTA (1988–1994), the trade and tourism sectors were consolidated by Mexico's government, while after 1994, with the increased political concentration of trade, the government separated them so that trade would be reported separately. Our objective is to make comparisons of industrial concentration across time periods by region. Table 9.1 shows the regional employment location quotient index for three different periods, 1988–1994, 1995–2004, and 2005–2009.

After trade liberalization through NAFTA occurred in Mexico, industrial activity shifted to the United States-Mexico border region. In particular, the production of manufactured goods has increased considerably since the late 1980s, as can be seen from an examination of Column 3 of Table 9.1. Manufactured goods are produced in *maquiladoras*, factories exempted from taxes, where imported materials and equipment from the U.S. are assembled or manufactured in Mexico into products for final export back to the U.S. or other countries. This reallocation of firms and production of manufactured goods has led to an agglomeration of manufacturing activity in the North Border region.

As expected, the location quotient for the manufacturing sector reveals a higher concentration of employment in this sector along the North Border region for the periods after NAFTA: the concentration of the manufacturing sector increased, from *LQ* = 1.07 in the period before NAFTA, to *LQ* = 1.37 in the second period, and to *LQ* = 1.45 in period 3. An inverse pattern is shown for the Capital region: the

Table 9.1 Regional employment location quotient coefficient by sector of economic activity

Before NAFTA: 1988–1994

	Agriculture	Minning	Manufacturing	Construction	Trade-tourism	Transport	Financial	Government
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Border	0.75	1.74	1.07	1.35	1.00	0.93	0.82	0.94
Capital	0.65	0.57	1.22	0.75	0.99	1.08	1.08	1.33
Traditional migrant	1.70	1.77	0.98	1.25	1.01	0.92	0.73	0.95
North Central	1.50	0.38	0.98	1.25	0.87	0.91	0.68	0.84
Southern	2.06	2.40	0.58	1.29	1.06	1.01	0.72	1.13

After NAFTA: 1995–2004

	Agriculture	Minning	Manufacturing	Construction	Trade		Transport	Financial	Government
	(1)	(2)	(3)	(4)	(5)	Tourism	(6)	(7)	(8)
Border	0.69	1.48	1.37	1.09	0.99	1.01	1.02	1.09	1.06
Capital	0.22	0.86	1.04	0.95	1.13	0.99	1.54	1.65	1.28
Traditional migrant	1.36	1.04	0.90	1.04	1.02	1.09	0.79	0.75	0.98
North Central	1.16	1.05	0.94	1.11	0.96	0.97	0.83	0.79	1.00
Southern	1.61	2.27	0.61	0.96	0.86	1.24	0.88	0.72	0.98

2005–2009

	Agriculture	Minning	Manufacturing	Construction	Trade		Transport	Financial	Government
	(1)	(2)	(3)	(4)	(5)	Tourism	(6)	(7)	(8)
Border	0.57	0.98	1.45	1.09	0.97	1.05	1.02	1.10	1.01
Capital	0.21	0.70	0.98	0.90	1.18	1.00	1.54	1.66	1.22
Traditional migrant	1.53	0.89	0.79	0.97	0.99	1.04	0.76	0.67	1.01
North Central	1.21	0.94	1.01	1.13	0.96	0.98	0.82	0.79	0.98
Southern	1.11	2.01	0.92	1.04	0.96	1.16	0.90	0.85	1.01

Source: Own calculation. 1987–2002: Encuesta Nacional de Empleo Urbano (ENEU). 2005–2009: Encuesta Nacional de Ocupaciony Empleo (ENOE)

Table 9.2 Employment portfolio variance by regions

	Before NAFTA	After NAFTA	% change
North	0.019	0.028	18.3
Capital	0.036	0.043	7.2
South	0.069	0.078	5.7
Center	0.019	0.018	−1.6

Source: Own calculations

concentration of the manufacturing sector decreased from an *LQ* of 1.22 in the period before NAFTA, then for the two subsequent periods, the index shows important reductions, ending in an $LQ = 0.98$ for the period 2005–2009. This pattern confirms past evidence related to the reallocation of the manufacturing sector from the Capital to the North Border region as a consequence of NAFTA (Chiquiar 2008). Nonetheless, the Capital region has experienced a pattern of industrial concentration in the financial service sector; the *LQ* quotient rose from 1.08 in the period before NAFTA to $LQ = 1.66$ for the last period.

The *LQ* related to the agriculture sector shows employment concentration in the Traditional Migrant North Central, and Southern regions. Although the relevance of this sector relative to the national share has decreased in all regions, the Traditional Migrant region shows the highest LQ value for the last period. The percentage of employment in the mining sector for the Southern region has remained at almost twice the national percentage during the three periods analyzed. It is also significant to note that mining, which is often grouped with manufacturing in developing countries, changed dramatically in the Border region, but in contrast to manufacturing, it declined from $LQ = 1.74$ in the period prior to NAFTA to $LQ = 0.98$ in period from 2005 to 2009, as manufacturing replaced mining as the major industry in Border states. In contrast, many industries remained relatively stable throughout the periods of the study. Nonetheless, as was expected, as manufacturing increased, agriculture declined substantially over the three periods from $LQ = 0.75$ before the enactment of NAFTA, to $LQ = 0.69$, and then to $LQ = 0.57$ in the period from 2005 to 2009.

Employment Volatility Across Regions

Table 9.2 presents the employment portfolio variance by regions for the periods before (1987–1994) and after (1994–2002) NAFTA.[4] The North region recorded the highest level of employment variability, with an increase of 18.3% for the second period. The Capital and South regions also experienced increases in employment variance by 7.2% and 5.7%, respectively. In the Center region, variance exhibits a slight decrease of −1.6% in the second period. These results illustrate an increase in

[4] In Table 9.2 the North Central and Traditional Migration regions were grouped into a single one, referred to as Central, given that these two neighboring regions are located in central Mexico and show low variability in employment composition.

the employment volatility in almost all regions across Mexico after NAFTA. While the North Border states have shown higher levels of industrial concentration, they have also exhibited the highest levels of employment volatility.

Wage Differentials Across Regions

There are additional implications of economic activity concentration in terms of affecting the labor market. On one hand, firms require workers to live in geographic areas nearby, in these areas land rents increase due to the industrial agglomeration. To attract workers into a particular industry, firms must compensate workers for such increased costs by paying them relatively higher wages (Diamond and Simon 1990 ver version anterior?). On the other hand, the *maquiladora* industry has evolved over the last three decades from using practically unskilled labor to more skilled labor as more sophisticated production techniques have evolved (Vargas 2001). This in turn has positively affected worker's wages for the skilled labor force. Empirical evidence for the Mexican economy supports the hypothesis that the reallocation of economic activity to the north has positively impacted workers' wages. Mendoza (2001) investigates the effects of agglomeration (concentration) on the manufacturing sector of the northern border cities. One of his findings indicates that globalization has created a shift of manufacturing activities from Central Mexico (Mexico City) towards the northern Mexican border region. He found a positive and strong correlation between industrial agglomeration and wages for workers in the manufacturing sector. Similarly, Cardenas (2002) finds evidence of an asymmetric geographic location of the manufacturing industry, with a high concentration in the Northern Border States, concluding that northern states pay higher wages relative to the rest of the country. Furthermore, international empirical evidence indicates that areas with high industrial concentration levels generally exhibit higher wages and in general higher levels of per-capita income (Izraeli and Murphy 2003).

Now we turn the attention to analyze the evolution of regional average wage. As shown in Fig. 9.3, average wages are in general higher in Border states while the rest of regions are fluctuating at more less the same level. Before and after NAFTA, wages in states with traditionally high out-migration rates are below those of Border, with greater regional wage differentials between these two regions in the last period.

A cursory examination of Fig. 9.3 reveals that the Mexican economy's crisis significantly impacted wages in all regions, as they experienced deep declines. The South region showed the largest declines in wages while the opposite was found for the Border states. In contrast, Traditional Migrant states have showed declines in average wages after the enactment of NAFTA, with a slightly recovery from 1999 onwards. The lowest average wage was reached in 1996 by North Central states; however this group ended with the second-highest average wages in 2008. In general, the persistence of wage differentials across regions, particularly comparing

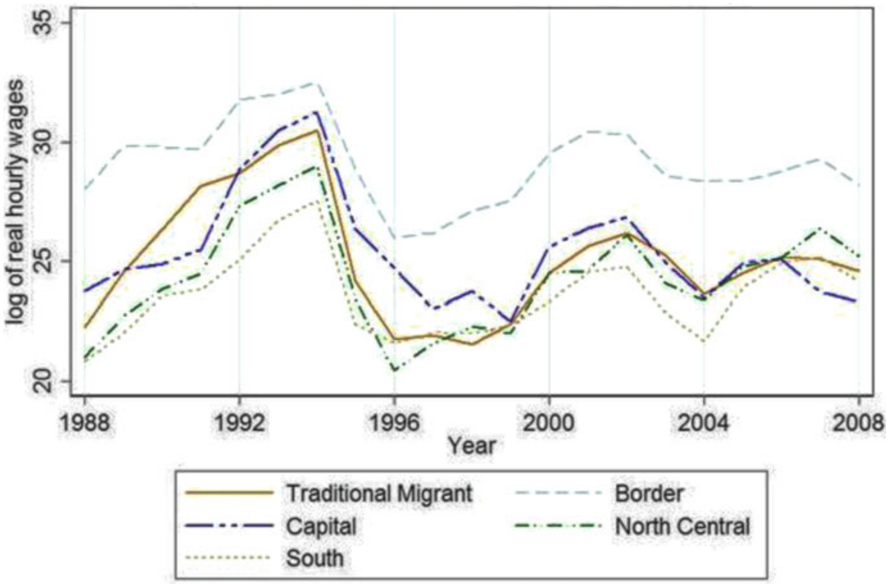

Fig. 9.3 Evolution of average wages by region

the Border with other regions, is notable. Moreover, the crisis at the end of 1994 had two main implications: all regions showed a severe drop in real average wages; nonetheless, some regions could recuperate faster than others. Therefore, not only the currency crisis but also the changes in the internal economy after implementation of NAFTA could be associated with the increasing out-migration from regions traditionally sending migrants to other areas of Mexico and the U. S. after 1994.

Conclusions and Discussion

Several major conclusions can be addressed from the above analysis: First, our analysis of the industrial sector concentration before and after NAFTA revealed that manufacturing became concentrated along the border between the U.S. and Mexico after NAFTA, while the financial services sector became concentrated in Central Mexico around Mexico City after NAFTA. In regards the region identified with long migratory tradition to the U.S., before and after it has kept relative concentration in the agriculture sector.

Second, the analysis also indicates that the employment concentration across geographic areas exhibited a major shift away from the central region of Mexico to the regions along the border between the U.S. and Mexico, a finding which corresponds to the sector concentration in the first conclusion above. However, the Border region experienced an 18.5% increase in employment volatility from the

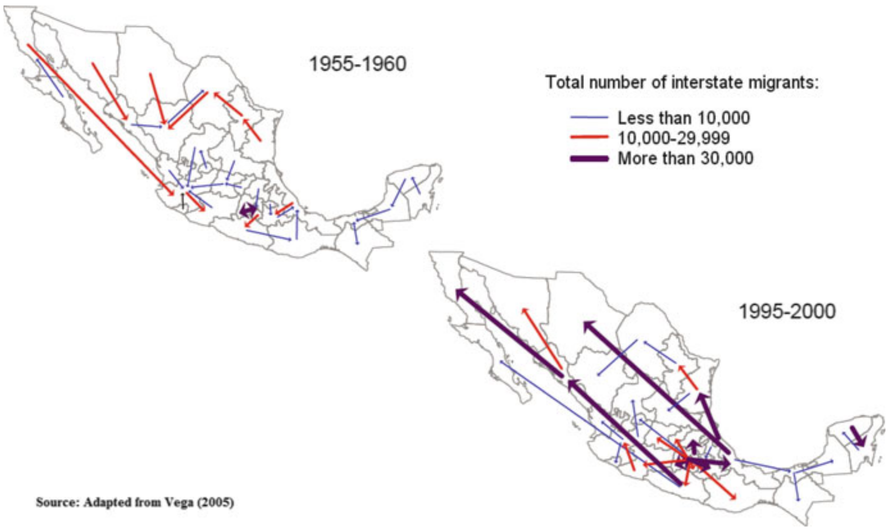

Fig. 9.4 Main interstate migration flows streams, 1995–2000 (Source: Adapted from Vega 2005)

period before to the period after NAFTA, while the central region (traditional U.S. migration region) experienced a reduction of 1.6% over the same period. Both the Capital Region, at a 7.2% increase, and the Southern region at a 5.7% increase, demonstrated significant increases in employment volatility after NAFTA.

Third, wages by region were also differentially higher in the Border region than in other regions after the enactment of NAFTA.

As explained before, higher levels of regional industrial concentration are expected to be associated with increasing economic liberalization. This in turn can be related to higher levels of wages and increasing levels of employment volatility. Nonetheless, the shifts in industry concentration patterns have not occurred evenly across regions in Mexico.

The reason of considering regions in the analysis has to do with the fact that the migratory phenomenon is not a random process unevenly distributed across the Mexican territory. There are some regions with a long migration tradition to the U.S. that theoretically should experience strong social capital formation and institutionalized migration networks. In this sense, wages in traditional migrant states to the U.S. are below other regions within the country. And a comparison of wage differentials between Mexico-U.S. would lead to a much higher wage gap.

There are also regions with particular dynamics in terms of internal migration. As shown in Fig. 9.4, contemporary internal migration flows have marked a well-established pattern towards northern states, contrasting with the patterns in late 1960s in which internal movements were in the direction to central Mexico. Hence, the Border region seems to be a good alternative for potential internal migrants. The extent to which this region retains them or serves as a platform for international migration is an open question that is left for further research.

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Part III
Business Demography

Chapter 10
Alcohol Buying Behaviour of Australian Households*

Farhat Yusuf and Julian de Meyrick

Introduction

In common with many countries, alcohol consumption has played a significant part in the social history of modern Australia (Lewis 1992). The supply of rum in the early colony was so regular and predictable that, for a short time, it replaced the currency as the medium of exchange. Excessive alcohol consumption was widespread in the time of Gold Rush in the 1850s and became closely associated with the tradition of "mateship" among Australian males. A similar pattern has been observed in colonial and early independent America. Problems associated with excessive alcohol consumption have been reported through Europe and Scandinavia. In Australia, the main voices criticising alcohol consumption came from the temperance and some religious movements and became associated with anti-social "wowsers" or spoil-sports. In the United States, moves to address alcohol consumption were associated with the unsuccessful Prohibition initiatives. As a consequence, concerted campaigns to address alcohol use in the community were much slower to develop than those addressing other risky behaviours such as tobacco smoking. In campaigns that have included alcohol, for example social marketing and legislative campaigns to reduce the prevalence of driving while under the influence of alcohol, it is the driving behaviour that is the target, not the consumption of alcohol.

*This chapter is based on the revised version of a paper on the same topic that won the "Best Paper Award" in the Asia-Pacific Marketing Track at the UK Academy of Marketing Conference held in Aberdeen, Scotland, July 8–10, 2008 http://www2.rgu.ac.uk/am2008/prizes.htm.

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_10,

More recently, there is increasing recognition that, while there are benefits from a light-to-moderate consumption of alcohol, they are outweighed by the costs to the community of excessive alcohol consumption. Initiatives to reduce alcohol consumption have been comparatively low-impact and broad-brush. For example, alcohol marketers include the exhortation "Consume alcohol in moderation" in small print on the labels of some alcohol products, and the National Health and Medical Research Council (NHMRC) publishes guidelines setting out "safe" levels of alcohol consumption. None of these campaigns attempts to segment the target market as advised by marketing texts (*e.g.,* Kerin et al. 2008) or social marketers such as Andreasen (2002, 2006). The same message is used regardless of audience (it is the same message on all retail alcohol containers), and the guidelines differentiate between males and females but not on any other basis. Once target segments have been identified, appropriately tailored campaigns can be developed that are likely to be more effective than a standard, non-differentiated strategy aimed at all groups. This paper examines different demographic gradients in the reported household expenditure on alcohol to indicate potential higher priority market segments for which appropriate alcohol campaigns could be developed.

Literature Review

Many studies have sought to determine the burden alcohol consumption places on the community (*e.g.,* Konnopka and Konig 2007; Patra et al. 2007; Rehm et al. 2003; Room et al. 2003), and there is general agreement that the burden is significant. Alcohol impacts the community either directly, by increasing the incidence of diseases such as those attacking the liver (Gramenzi et al. 2006) or pancreas (Apte et al. 2006), or indirectly, in that as it impairs important cognitive and motor-skill functions, it increases the incidence and severity of motor vehicle accidents. Studies by Desapriya et al. (2006) and Zaloshnja and Miller (2006) estimate that if driving while under the influence of alcohol and driving without a seat-belt could be eliminated, U.S. employers would be saved USD15.2 billion per annum in reduced health insurance and sick-leave payments. Several studies reported that alcohol consumption was associated with half of the injuries treated in hospital emergency facilities (e.g., Salome et al. 2005; Tindale 2007; Vinson 2004). A study by Watt et al. (2006) found that the relationship was less clear-cut and not as strong. On the other hand, Borges et al. (2006) found that the risk of injury increased even from quite low levels of alcohol consumption.

Studies that have included demographic segmentation variables usually focus on the factors associated with unhealthy levels of consumption and alcohol dependence (*e.g.,* Degenhardt et al. 2005; Diala et al. 2004; Gillespie et al. 2007; Jian Li and El-Guebaly 2004; Selin 2005). A study by Selvanathan and Selvanathan (2004) found demographic gradients in alcohol demand in Australian communities. Similarly Arvanitidou et al. (2007) found demographic gradients in alcohol consumption in a large group of metropolitan Greeks, including the finding that parents' level of education was positively associated with alcohol consumption. A study by Soydemir and Bastida (2006) also found a relationship between income and alcohol consumption. Green et al. (2003) found differences in the reactions to alcohol-abuse prevention messages between different demographic groups. An electronic search of major databases did not reveal any other studies that examine demographic patterns in household expenditure on alcohol in the way that this study does.

Data and Methods

The Household Expenditure Survey (HES) carried out by the Australian Bureau of Statistics in 2003–2004 was the main source of data for this study. In this survey, a household was defined as "a person or group of people living together and having common provision for food and other essentials of living" (Australian Bureau of Statistics 2006). The scope of the survey included usual residents of private dwellings in Australia, except foreign diplomatic or defence force staff and people living in remote areas. The sample included 6,957 households throughout Australia. It was selected using a multistage, stratified probability sample design. Standard ABS weights were applied to the data to develop estimates for the total Australian household population.

In each household a person aged 15 or over was selected as the "reference person" if the person was the first person in the household to fulfill one of the following criteria: was a partner in a registered or *de facto* marriage, was a lone parent with one or more dependent children, was the person with the highest income, or was the eldest person. In this paper we have designated such reference persons as the "household head."

Personal interviews were conducted in the selected households to obtain data on characteristics of households and their members and various items of income and expenditure. In addition, identified spenders in the households were each issued with a diary to record expenditure on every item over the 2 weeks immediately after the interview. For the purposes of this research, all households were divided into two groups: those reporting no expenditure on alcoholic drinks, and those who did spend part of the household budget on alcohol. It is this second group of households that is the focus of this study. Information was available for each alcohol buying household as to the weekly amount spent on purchasing beer, wine, spirits, and other types of alcoholic drinks for consumption at licensed or off-license premises.

In the context of this study, household expenditure on alcohol was taken as a proxy to the level of consumption. Given that households vary in size from a single person to more than six persons, an attempt was made to calculate the per capita expenditure on alcohol. Unfortunately, the age distribution of household members was not available in detail. The only information available was persons aged 15 and over. This number was used to estimate per capita expenditure. Given that persons below 18 are not supposed to buy alcohol, the per capita estimates presented in this study are to be considered as under-estimates of the true figure.

Odds ratios based on binary logistic regression models were calculated to study the impact of selected demographic and socio-economic correlates of alcohol buying behaviour. Categories with an odds ratio of 1.00 were used as the “reference” for comparison purposes.

Findings

Characteristics of Households and Propensity to Purchase Alcohol

In 2003–2004, of the estimated 7.74 million households in Australia, 58.4% incurred expenditure on alcoholic drinks. Table 10.1 shows the proportion of households which bought alcohol and the odds ratios for selected characteristics of the households. It is apparent from the table that households in which the nominated head of the household was a male, which accounted for just over 64% of all households, had a significantly greater propensity to buy alcohol compared to those households in which the head was female.

The youngest age group was the most likely to buy alcohol and the oldest age group was least likely. Household heads who had higher educational qualifications and those engaged in occupations at the higher end of the socio-economic scale (*e.g.,* professionals, administrators/managers) were more likely to buy alcohol compared to those who were less educated and in occupations at the lower end of the socio-economic scale (*e.g.,* tradespersons, production or labourers). Migrants from mainly English speaking countries – such as the UK, USA, and New Zealand – had a somewhat higher propensity to buy alcohol, while those from other countries, a sizeable proportion of these were Asians, had the lowest propensity.

Income exhibited a strong positive relationship with the propensity to buy alcohol, with households in the fifth (highest income) quintile more than nine times as likely to purchase alcohol as those in the first (lowest income) quintile.

It appears that households in the capital cities (Sydney, Melbourne, Brisbane, Perth, Adelaide and Hobart) were marginally less likely to buy alcohol compared to those in the non-metropolitan and rural areas. The Australian Capital Territory (ACT), and the Northern Territory (NT) had the highest percentages of households purchasing alcohol. These two territories, although accounting for less than 2% of the total population according to the 2006 census, are quite unique in terms of their socio-economic conditions (ACT) and the high proportion of indigenous people (NT).

Type of Alcoholic Drinks

Table 10.2 shows that nearly half (49%) of all alcohol-purchasing households purchased only one type of drink: beer, wine, spirits, or others. The table also shows that beer and wine were the dominant forms of alcohol purchased by these households. One-fifth of households that purchased alcohol only purchased beer. A further 14.3% only purchased wine, and 13.1% purchased beer and wine only; thus,

Table 10.1 Percent of households that bought alcohol and odds ratios by selected characteristics: Australia, HES 2003–2004

Characteristics	% bought alcohol	Odds ratio
Gender of household head		
Male	64.4	1.000
Female	49.1	0.534
Age		
<35	64.5	1.000
35–44	60.6	0.848
45–54	63.0	0.938
55–64	61.0	0.861
65+	42.4	0.406
Education of household head		
Postgraduate	68.3	1.000
Graduate	67.1	0.949
Diploma	66.1	0.907
Certificate	62.1	0.761
No post-school	50.1	0.475
Occupation of household head		
Professionals	70.6	1.000
Admin./managers	69.3	0.944
Clerical/sales	63.4	0.724
Tradespersons	67.4	0.863
Production	65.3	0.785
Labourers	54.6	0.502
Others (inc. retired)	42.2	0.305
Country of birth of household head		
Australia	60.7	1.000
English-speaking	64.5	1.576
NES[a] countries	44.2	0.512
Household income from all sources		
First quintile (lowest 20%)	29.5	1.000
Second quintile	49.0	2.292
Third quintile	63.9	4.223
Fourth quintile	69.9	5.550
Fifth quintile (top 20%)	79.7	9.389
Location of household		
Capital cities	57.4	1.000
Other areas	59.3	1.083
ACT/NT[b]	68.8	1.634

[a]Non-English speaking countries
[b]Australian capital territory/northern territory

two-thirds of alcohol-purchasing households bought beer or wine either alone or in combination. In contrast, relatively few households purchased spirits either alone or in combination with other alcoholic drinks except beer. Hardly any households purchased a combination of alcoholic drinks that did not include beer.

Table 10.2 Type of alcoholic drinks bought by selected characteristics of households and their heads: Australia, HES 2003–2004

		Household head										Household	
			Age (%)			Education (%)		Occupation (%)		Country of birth (%)			
Type of alcoholic drink bought	% of all households buying alcohol	% female	<35	35–64	65+	Graduate or higher	No post-school	White collar[a]	Blue collar[b]	Australia	NES[c]	Mean income (in AUD)	% in capital cities
Beer only	**20.1**	27.6	26.0	57.6	16.4	18.1	45.5	30.8	25.8	76.2	13.5	1,103	58.4
Wine only	**13.8**	49.2	11.4	62.7	25.9	30.6	33.7	39.3	11.7	65.6	17.1	1,134	67.6
Spirits only	**6.3**	41.2	32.1	54.9	13.0	15.8	41.7	25.8	25.2	71.5	13.2	1,099	55.8
Others only	**7.0**	36.0	27.9	58.7	13.4	23.0	39.0	41.4	22.0	75.0	15.2	1,325	56.6
Beer and wine	**12.6**	25.9	19.7	65.3	15.0	33.3	27.7	48.4	16.2	71.8	12.5	1,392	61.4
Beer and spirits	**7.5**	28.4	40.9	52.6	6.5	16.0	40.1	30.4	35.3	78.4	13.8	1,277	57.5
Beer and others	**5.1**	28.3	24.3	65.4	10.3	18.7	40.3	30.8	28.3	82.4	9.3	1,326	54.7
Wine and spirits	**3.4**	42.5	18.6	64.1	17.3	30.1	37.2	43.9	15.0	78.3	9.0	1,298	63.9
Wine and others	**3.1**	33.0	14.5	64.1	21.4	44.1	23.6	50.9	13.1	77.6	10.7	1,650	64.1
Spirit and others	**2.3**	46.8	40.6	49.7	9.7	17.7	41.9	26.1	28.6	80.8	11.6	1,314	57.0
Beer, wine and spirits	**6.7**	27.1	29.4	62.4	8.2	19.0	38.8	42.6	24.1	78.3	9.0	1,545	61.9
Beer, wine and others	**4.2**	32.5	21.7	67.5	10.8	31.1	28.7	53.7	17.1	80.0	6.6	1,698	61.9
Beer, spirits and others	**3.0**	23.2	38.8	58.9	2.3	15.8	32.8	32.6	28.9	73.5	12.3	1,463	54.6
Wine, spirits and others	**1.3**	32.0	17.2	64.3	18.5	32.2	34.3	52.5	10.8	85.1	8.1	1,877	59.4
Beer, wine, spirit and others	**3.7**	30.7	27.2	68.3	4.5	25.2	36.0	41.5	23.0	79.7	10.0	1,941	59.8
All households buying alcohol	**100.0**	33.2	24.8	60.7	14.5	24.0	37.2	38.0	21.8	75.0	12.7	1,318	60.2

[a]Includes administrators and professionals
[b]Includes tradespersons, production and labourers
[c]Non-English speaking

Households with a female head were over-represented among those that purchased just wine. They were also more likely to purchase spirits, either alone or, more often, in combination with either other alcoholic drinks or wine.

Table 10.2 indicates that households with a head who was between 35 and 64 made up the largest group of households buying alcohol. Households where the head was less than 35 years of age made up a larger proportion of spirits purchasers, especially in combination with beer or other alcoholic drinks. The minimum age at which it is legal to purchase alcohol in Australia is 18. Generally, households with a head who is 65 years or older were less likely to purchase any of the alcohol types than households with younger heads, except for wine, either alone or in combination with other alcoholic drinks.

Although households where the head was a graduate or had postgraduate qualifications had the highest propensity to buy alcohol (Table 10.1), they constituted a smaller proportion of the total households buying alcohol compared to the households where the head had no post school qualification (Table 10.2). Among the former, wine and other drinks seemed to be bought somewhat more frequently than among the latter.

The smallest percentage among households with an Australian-born head was 65.5% (purchasing wine only) and the largest was 85.1% (purchasing wine, spirits, and others). The range among households in which the head was born in a non-English speaking country is much narrower and lower than the range among categories for Australian-born households. The range among households in which the head was born in a non-English speaking country is from 8.1% (purchasing wine, spirits and others – the most popular category among Australian born households) to 17.1% (purchase of wine only – the least popular category among Australian born households). Overall, there was some indication that the purchase of wine was relatively more popular among the non-English speaking households compared to the Australian-born.

In Australia, there is not as clear a link between income and the social status of an occupation that is found in some other countries, however, Table 10.2 indicates that there were marked differences between the higher status “white collar” occupations and the somewhat lower status “blue collar” occupations when it comes to alcohol purchases. A larger percentage of households in white collar occupations purchase all forms of alcoholic drinks than among households in blue collar occupations, except beer and spirits, and spirits and others combinations, where the reverse is true.

Table 10.2 did not reveal a strong income gradient, however it shows that as income increases, so does the range of alcoholic drinks purchased. Purchase of all four types of alcoholic drinks is associated with the highest mean income (AUD1,941 per week) and the purchase of wine only (AUD1,134), beer only (AUD1,103), and spirits only (AUD1,099) associated with the lowest.

More than half of the households in capital cities that purchased alcohol purchased in each of the categories. The most popular alcoholic drink purchase among these households was wine. They were less likely to purchase a combination of types of alcoholic drinks that did not include wine.

Place of Consumption

Table 10.3 focuses on the place of consumption of alcohol bought by households. Licensed premises are usually bars where alcohol is sold across the counter for consumption within the premises and restaurants that are licensed to sell alcohol for consumption in the restaurant with food sold by the restaurant. The alternative is to purchase alcohol for consumption away from the alcohol retailer's premises. In general, alcohol purchasing households are most likely to buy their alcohol for consumption in both licensed and off-license premises.

There was no great difference between the genders in their tendency to buy alcohol from licensed or off-license premises. Households with a male head were most likely to purchase alcohol from both licensed and off-license premises, whereas households with a female head were more likely to purchase alcohol from an off-license outlet for consumption at home, in a party, or some other place.

In all age groups, alcohol purchasing households were least likely to only purchase alcohol from licensed premises. In all but the oldest age group, households were more prone to purchasing from both licensed and off-license outlets.

There was a slight tendency for households with the lowest level of education to buy alcohol for consumption in off-license premises only. Household heads in "white collar" occupations we less likely to buy their alcoholic drinks at off-license premises only. While it was noted earlier (Table 10.1) that households with a head born in a non-English speaking country were less likely to purchase alcohol, Table 10.3 indicates that when these households do purchase alcohol, it is most likely purchased from an off-license outlet.

There was an income gradient associated with location of consumption. Households in the lowest income quintiles were most likely to purchase alcohol from off-licensed outlets while those in the highest quintiles were more likely to buy from both. There was no difference in the patterns of purchase among households in capital city or other areas, including the ACT and NT.

Type of Alcoholic Drinks and Place of Consumption

Table 10.4 provides some data on the type of alcoholic drink and place of consumption for those households that only bought one type of alcoholic drink. As noted earlier, such households accounted for just under half of all households purchasing alcohol. By limiting the analysis to those buying only one type of drink, the authors could identify households that bought alcohol for consumption in licensed premises only, those who bought alcohol for consumption at off-license premises only, and those who used both options. For households that bought two or more types of drinks, this analysis would have been very cumbersome and has thus not been included here. The table indicates that among households that only purchased one type of alcoholic drink, beer only buyers tended to purchase either from licensed or

Table 10.3 Percent of households that bought alcohol by place of consumption and by selected characteristics: Australia, HES 2003–2004

Characteristics	Licensed	Off-license	Both	Total
Gender				
Male	22.2	34.9	43.0	100.0
Female	23.7	40.1	36.2	100.0
Age				
<35	26.4	31.8	41.8	100.0
35–44	17.2	40.9	41.9	100.0
45–54	19.2	36.0	44.8	100.0
55–64	25.7	33.1	41.2	100.0
65+	26.9	42.8	30.2	100.0
Education				
Postgraduate	14.7	40.1	45.2	100.0
Graduate	24.8	31.7	43.5	100.0
Diploma	22.9	32.1	44.9	100.0
Certificate	20.0	37.4	42.6	100.0
No post-school	25.2	38.2	36.6	100.0
Occupation				
Professionals	23.3	31.9	44.8	100.0
Admin./managers	23.5	32.6	43.9	100.0
Clerical/sales	20.7	36.1	43.2	100.0
Tradespersons	19.6	35.7	44.7	100.0
Production	19.2	40.0	40.7	100.0
Labourers	22.4	39.5	38.1	100.0
Others (inc. retired)	25.1	42.8	32.0	100.0
Country of birth				
Australia	23.5	33.8	42.7	100.0
English-speaking	18.2	42.1	39.7	100.0
NES[a] countries	21.9	48.1	30.0	100.0
Income				
First quintile	26.1	45.6	28.3	100.0
Second quintile	24.1	43.4	32.5	100.0
Third quintile	22.6	39.8	37.6	100.0
Fourth quintile	21.6	36.0	42.4	100.0
Fifth quintile	21.1	26.0	52.9	100.0
Location				
Capital cities	21.0	36.7	42.4	100.0
Other areas	23.1	36.2	40.7	100.0
ACT/NT[b]	22.2	37.3	40.6	100.0

[a]Non-English speaking
[b]Australian capital territory/northern territory

Table 10.4 Percent of households buying only one type of drink and the number of female buyers per 100 male buyers by place of consumption: Australia, HES 2003–2004

	Beer	Wine	Spirits	Others
Licensed				
% of total	38.6	15.8	16.7	74.1
Females per 100 males	34	113	38	61
Off-license				
% of total	39.4	71.7	72.6	16.0
Females per 100 males	51	92	76	31
Both				
% of total	22.0	12.5	10.7	9.9
Females per 100 males	25	111	102	90
Total				
% of total	100.0	100.0	100.0	100.0
Females per 100 males	38	98	70	58

off-licensed outlets but were much less likely to patronize both. Households with a male head were predominant among beer purchasers. Beer only households with a female head were most likely to purchase their alcoholic drinks from off-license premises. Most wine only households purchased their wine from off-license outlets and households with a female head outnumbered those with a male head in purchases from licensed premises and from both types of premises. A similar pattern was found among the households that purchased spirits only.

Household Expenditure on Alcoholic Drinks

The 4.52 million households that reported expenditure on alcohol spent an average of AUD39.94 per week (or a total of AUD9.41 billion annually) in 2003–2004. This amount represented 3.8% of their total expenditure on goods and services.

Table 10.5 shows the corresponding statistics by the selected characteristics of households. It appears that female headed households, on the average, spent less on alcohol and that this expenditure accounted for a much smaller proportion of their total expenditure on goods and services compared to the male headed households. While the older household heads (those where the household head was 65 years or more) spent substantially less on alcohol, it represented about the same proportion of their total expenditure as the younger and middle aged household heads.

While the relationship between educational qualifications and alcohol expenditure was not clear cut, household heads in the higher education categories spent a much smaller proportion of their total expenditure on alcohol. This is likely to be due to the positive association between income and education. In the HES, households in which the heads had a degree or higher qualification had an average income that was 58% higher compared to those with no post-school education.

The average weekly alcohol expenditure was highest among the households in which the head was an administrator/manager followed by tradespersons and labourers. There was no consistent social status gradient found in the analysis of types of alcohol purchased. The labourer and tradesperson households spent a much larger proportion of their total expenditure on alcohol compared to the administrators/managers. This difference could be, at least partly, due to the income differentials at the two ends of the socio-economic spectrum.

Income showed a very clear and consistent relationship with the household expenditure on alcohol. It appears that the amount spent on alcohol increased with income but as a proportion of the total expenditure it decreased. Expenditure on alcohol represented a much greater proportion of the total household expenditure on goods and services for the poorer households (first quintile, 6.6%) compared to those in the highest income group (fifth quintile, 3.2%).

Migrant households from non-English speaking backgrounds spent substantially less on alcohol, and this expenditure constituted a much smaller proportion of their total expenditure. With the exception of those in the NT/ACT, households located in the five capital cities spent more on alcohol than those in other regions, but it accounted for a much smaller proportion of their total expenditure on goods and services.

Per Capita Expenditure by Type of Alcoholic Drinks

Table 10.6 provides information on the mean weekly per capita expenditure on alcohol by the type of drink, as well as its impact on the households' budget, taking into consideration selected characteristics of the households and their heads.

Overall, households that purchase alcohol spend AUD20.65 per adult person on alcohol per week, or 4% of their total expenditure on all goods and services. Households that only purchased one type of alcoholic drink seemed to spend less than this, and those that purchase a greater range of alcoholic drinks spend more, and it constitutes a larger proportion of their total weekly expenditure on all goods and services. In both male and female headed households, those who purchased all four types of alcoholic drinks spent approximately double the amount compared to those who bought a smaller range of alcoholic drinks.

As noted above, households with a female head typically spent less on alcohol and a smaller percentage of their total expenditure on all goods and services. Their expenditure on alcohol is focused mainly on the purchase of spirits in combination with wine, and with beer and wine.

Table 10.5 Mean weekly household expenditure (in AUD) on alcohol and as a percent of the total expenditure on goods and services by selected characteristics: Australia, HES 2003–2004

	Weekly household expenditure on alcohol	
Characteristics	Mean per household (AUD)	As a % of the total[a]
Gender		
Male	\$43.35	4.0
Female	\$33.09	3.4
Age		
<35	\$40.87	3.9
35–44	\$39.00	3.3
45–54	\$47.79	3.8
55–64	\$41.81	4.2
65+	\$25.97	4.0
Education		
Postgraduate	\$37.66	3.0
Graduate	\$43.43	3.3
Diploma	\$44.48	3.9
Certificate	\$39.52	4.0
No post-school	\$38.03	4.1
Occupation		
Professionals	\$42.44	3.4
Admin./managers	\$51.76	3.5
Clerical/sales	\$38.45	3.7
Tradespersons	\$48.25	4.6
Production	\$44.16	4.3
Labourers	\$45.38	5.1
Others (inc. retired)	\$28.26	4.0
Country of birth		
Australia	\$41.04	3.9
English-speaking	\$41.81	3.9
NES[b] countries	\$31.56	2.9
Income		
First quintile	\$18.59	6.6
Second quintile	\$27.36	5.4
Third quintile	\$33.70	4.4
Fourth quintile	\$41.27	3.8
Fifth quintile	\$59.41	3.2
Location		
Capital cities	\$40.78	3.6
Other areas	\$38.46	4.1
ACT/NT[c]	\$41.44	3.5

[a]Weekly expenditure on all goods and services
[b]Non-English speaking
[c]Australian capital territory/northern territory

Table 10.6 Mean weekly per capita expenditure (in AUD) on alcohol by the type of alcoholic drinks bought and as a percent of the mean weekly per capita expenditure on all goods and services by selected characteristics of households and their heads: Australia, HES 2003–2004

		Weekly per capita expenditure on alcohol as a % of the weekly per capita expenditure on all goods and services														
			Household head										Household			
			Gender		Age		Education		Occupation		Country of birth		Income		Location	
Type of alcoholic drink bought	Mean per capita alcohol expend (AUD)	All households	Male	Female	<35	65+	Graduate or higher	No post-school	White collar[a]	Blue collar[b]	Australia	NES[c]	First quintile	Fifth quintile	Capital cities	Other areas
Beer only	14.08	3.0	3.3	2.4	2.7	4.0	2.0	3.5	2.3	3.7	3.3	1.7	5.0	1.6	2.9	3.3
Wine only	10.13	2.0	1.9	2.1	1.5	2.0	2.0	2.3	2.0	1.4	1.9	1.5	2.2	2.1	2.1	1.8
Spirits only	11.17	2.3	2.4	2.2	2.4	3.8	2.0	2.6	1.9	2.0	2.3	2.2	2.7	2.3	2.3	2.3
Others only	9.59	1.8	1.9	1.8	2.2	2.7	1.2	2.1	1.4	2.0	1.8	1.5	2.4	1.6	1.5	2.3
Beer and wine	25.24	4.6	4.9	3.6	3.8	5.9	4.3	5.2	4.3	4.7	4.4	5.3	6.7	3.7	4.7	4.6
Beer and spirits	23.36	4.5	4.9	3.5	4.6	7.0	3.7	4.7	3.6	6.0	4.8	2.8	5.3	3.9	4.0	5.3
Beer and others	23.66	4.8	5.4	3.3	4.1	4.4	3.1	5.1	3.7	7.7	5.0	2.3	6.8	3.5	3.9	6.1
Wine and spirits	27.28	5.3	4.7	6.0	3.2	8.8	4.6	6.1	4.4	3.8	5.5	5.4	5.5	3.4	5.4	5.4
Wine and others	17.35	2.9	2.8	2.9	2.3	2.2	2.5	3.2	2.7	2.9	2.8	1.8	4.3	2.4	2.9	2.9
Spirit and others	22.12	5.0	5.9	4.0	4.8	5.6	4.6	5.0	4.9	6.5	4.9	6.0	8.0	3.1	5.0	5.0
Beer, wine and spirits	35.33	6.1	6.4	5.2	5.8	10.4	5.1	6.6	5.3	8.5	5.9	7.9	8.7	5.3	5.9	6.6
Beer, Wine and others	36.41	6.3	6.9	5.2	6.9	6.3	6.1	6.8	6.5	7.4	6.2	7.8	6.9	6.3	6.3	6.5
Beer, spirits and others	33.41	6.3	7.0	4.5	7.6	8.7	7.6	6.0	5.4	8.4	6.9	4.3	5.8	6.5	5.5	7.6
Wine, spirits and others	28.61	5.0	5.1	4.8	5.2	8.8	4.6	5.2	4.5	6.9	5.1	2.1	6.9	4.0	4.6	5.7
Beer, wine, spirit and others	45.84	8.0	8.1	7.7	10.0	6.5	5.5	8.4	6.2	12.3	7.9	8.9	13.7	6.4	8.0	8.1
All households buying alcohol	20.65	4.0	4.3	3.4	4.0	4.3	3.3	4.4	3.5	5.2	4.1	3.2	4.8	3.6	4.1	4.3

[a]Includes admin. and professionals
[b]Includes tradespersons, production and labourers
[c]Non-English speaking

Among the younger household heads, the largest proportion of expenditure went on all four types of alcoholic drink, whereas among households with older heads, a greater proportion of expenditure was spent on beer, wine and spirits, and similar combinations. There was no clear pattern when educational qualifications were taken into consideration. Both those with graduate degrees or higher and those with no post-school qualification tended to spend a greater proportion of their total expenditure on combinations for beer and wine and wine and spirits.

Households in which the head had a blue collar occupation spent 12% of their total expenditure on goods and services on the purchase of all four types of alcohol. In households where the head was engaged in white collar occupations, there was a greater than average expenditure on a combination of all four types, but it was not as pronounced as it was among blue collar households. Among white collar households, there was a relatively greater concentration on beer, wine, and others.

Apart from the above findings that households whose heads were born in a non-English speaking country tended to spend less and that a smaller percentage of their total expenditure was spent on alcoholic drinks, there was no major difference between the patterns of expenditure across different types of alcohol.

It was noted earlier that higher income households spent a smaller proportion of their total expenditure on alcohol than lower income households. The difference is particularly noticeable in the purchase of beer, both alone and in combination with the other types of alcoholic drinks. This finding is in contrast with location of the household, for which there is no discernable difference in patterns of expenditure between city households and others.

Per Capita Expenditure by Place of Consumption

The correlation between the expenditure on all goods and services and current weekly disposable income was quite high ($r = +0.612$). This finding is shown most clearly in Table 10.7 where mean expenditure on goods and services increased steadily with income quartile. Table 10.7 shows that, in general, most alcohol-purchasing households bought their alcohol from both licensed and off-license outlets. As noted earlier, households with a female head were less likely to purchase alcohol for consumption on licensed premises and they spent a slightly smaller percentage of their total expenditure on alcohol. It was also noted earlier that the amount spent on alcohol was likely to remain the same across age groups, occupation status, and income quintiles. In all age groups, a greater percentage of expenditure was directed through off-license outlets than for consumption on licensed premises although the difference was most pronounced in the oldest group. The percentage of total expenditure spent on alcohol also decreased with increases in education, occupation status and income quintiles. There were no significant differences by the location of households.

Table 10.7 Mean weekly per capita expenditure (in AUD) on all goods and services and alcohol expenditure as a percent of this by place of consumption and by selected characteristics of households and their heads: Australia, HES 2003–2004

Characteristics	Mean expenditure on G&S[a]	Alcohol expenditure as a % of expenditure on G&S[a]		
		Licensed	Off-license	Both
Gender				
Male	$998	1.3	1.6	3.3
Female	$914	1.0	1.6	2.8
Age				
<35	$996	1.4	1.6	3.3
35–44	$1,167	1.0	1.3	2.7
45–54	$1,155	0.8	1.3	2.5
55–64	$911	1.1	1.7	3.5
65+	$576	1.7	2.6	4.0
Education				
Postgraduate	$1,147	0.5	1.3	2.5
Graduate	$1,228	0.9	1.4	2.6
Diploma	$1,157	1.0	1.4	3.0
Certificate	$876	1.4	1.9	3.1
No post-school	$838	1.4	1.7	3.7
Occupation				
Professionals	$1,190	1.0	1.3	2.6
Admin./managers	$1,281	0.8	1.5	2.5
Clerical/sales	$1,047	1.0	1.4	2.6
Tradespersons	$908	1.5	2.2	3.8
Production	$849	2.1	1.5	3.9
Labourers	$879	1.5	1.3	4.6
Others (inc. retired)	$644	1.5	2.2	4.1
Country of birth				
Australia	$941	1.3	1.7	3.3
English-speaking	$988	1.3	1.6	2.9
NES[b] countries	$1,126	0.6	1.0	2.3
Income				
First quintile	$488	2.4	3.1	6.8
Second quintile	$646	1.8	2.3	4.7
Third quintile	$889	1.7	1.8	3.7
Fourth quintile	$1,089	0.9	1.3	2.6
Fifth quintile	$1,448	0.7	1.2	2.1
Location				
Capital cities	$1,072	0.9	1.7	3.0
Other areas	$1,044	1.1	1.5	2.9
ACT/NT[c]	$834	1.4	1.8	3.6

[a]Goods and services
[b]Non-English speaking countries
[c]Australian capital territory/northern territory

Table 10.8 Mean weekly per capita expenditure (in AUD) on alcohol and as a percent of the total expenditure on goods and services for households buying only one type of drink by place of consumption and gender of the household head: Australia, HES 2003–2004

	Beer	Wine	Spirits	Others
Licensed				
Mean per capita expenditure on alcohol	\$11.45	\$6.07	\$6.35	\$8.4
As a % of total expenditure on goods and services				
All households	2.6	1.1	1.2	1.6
Male headed households	2.9	0.6	1.2	1.7
Female headed households	1.5	1.5	1.2	1.5
Off-license				
Mean per capita expenditure on alcohol	\$11.13	\$9.95	\$11.21	\$10.03
As a % of total expenditure on goods and services				
All households	2.5	2.0	2.4	2.3
Male headed households	2.5	1.9	2.2	2.4
Female headed households	2.4	2.1	2.4	1.6
Both				
Mean per capita expenditure on alcohol	\$24.31	\$16.49	\$18.33	\$19.98
As a % of total expenditure on goods and services				
All households	4.6	3.0	3.6	3.2
Male headed households	4.8	3.0	3.0	2.9
Female headed households	3.9	3.0	3.6	3.2

Per Capita Expenditure by Type of Alcoholic Drinks and Place of Consumption

Table 10.8 shows that among households that purchased alcohol, those who bought for consumption at both licensed and off-license premises spent a larger percentage of their total expenditure than those who only bought from one or other type of outlet. Among households who only purchased beer, the amount of expenditure through licensed and off-license premises was approximately the same, and that expenditure through both types of locations was twice the size of either of the types alone. Male headed households spent a much larger percentage of their total expenditure through licensed premises than households whose head was a female. In off-license outlets, the percentages were the same, and in households that bought from both sorts of outlets, male headed households spent a larger percentage of their total expenditure than households with a female head. Among wine only purchasers, the pattern was different in households with a female head spending a larger percentage of their total expenditure on wine consumed on licensed premises than households with a male head. Wine only purchasers also tended to spend a greater percentage of their total expenditure in off-license outlets than licensed premises. The gender of the household head did not appear to be a factor in the pattern of expenditure in spirits only households.

Conclusion

Our analysis indicates that expenditure on alcohol was having a different impact across different demographic segments in the Australian market. Households with a male head not only spent more on alcohol, but they also spent a larger percentage of their total expenditure for goods and services on alcohol. This finding indicates that it is more important for a potential campaign to be salient and relevant for male headed households. Income quintile was often a less useful segmentation variable because of the more egalitarian distribution of income across the Australian population. Similarly, level of education was not a strong differentiator. The most important differentiator in this population was found to be the occupation status. The clear status gradient indicates that priority should be given to lower social status occupation groups.

Other factors to take into account when developing media and message strategies that will be appropriate to the segments identified here include the different patterns in the types of alcohol purchased and the locations in which they are consumed across gender, age, and other demographic groups. For example, our analysis indicates that messages aimed at helping households with female heads to avoid over expenditure and over consumption of alcohol could include a focus on wine and another on spirits and be directed through off-license premises, showing wine being consumed in situations other than on licensed premises. Our analysis indicates how campaigns could be developed for families with male heads, older heads, and those with other socio-demographic characteristics. Knowledge of the characteristics of the target audience and an understanding of aspects of their alcohol purchasing behaviour can help direct the content of the strategy, the language and the imagery used, and the communication channels selected to reach the target.

The data examined here indicate that, in general, campaigns could be effectively delivered in English, saving the need, at least in the first instance, for translation into other languages. Geographically, campaigns should include the more populous states but the NT should be included because of the greater impact of alcohol expenditure and the absence of a bias towards upper social status occupations that is found, for example, in the ACT.

The next step for alcohol policymakers might be to identify priority targets such as younger, blue collar households that are spending more than 10% of their total household expenditures on goods and services on a wide range of alcoholic drinks. Campaigns could then be developed to appeal directly to this group of households. Marketing research would be needed to refine the selection of channels used to carry the messages, but our findings indicate that such groups purchase a significant proportion of their alcohol from off-license premises. The data also suggest that it might be important to enlist the cooperation of the owners of these outlets to help convey the message. In Australia, as in many other countries, the various arms of the alcohol industry are keen to be seen to be acting as good corporate citizens and promoting the responsible consumption of alcohol. Our analysis could provide valuable assistance in the development of such a campaign.

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Chapter 11
Demographic Cohorts and Marketing Research

Alison Yacyshyn

Introduction

In a Globe and Mail article entitled "By Definition: Boom, bust, X and why" (Pearce 2006) the question asked, "who exactly is a baby boomer?" demonstrates the interest of cohort terminology in everyday life. "Baby boomers" is a demographic term that identifies not only a population's compositional structure, but also a cohort to which an individual belongs. Belonging to a cohort effects markets in many ways, and other common cohort terms include: baby bust, Generation X, Generation Y, and millennial. Which cohort an individual belongs to also might suggest which group marketers focus on, as "population segments that are increasing in size represent new and expanding opportunities while those segments experiencing population decline offer challenges for existing businesses" (Pol 1987, pp. 151–152). In fact,

> Retailers paid little attention to demographic details before the mid-1970s, focusing instead on the overall rise or gain in population and income. The baby-boom generation changed that. The demographic roller coaster caused by the baby boom forced businesses to look beyond total population and examine the shifting age structure behind it (Myers 1988, p. 53)

In this paper, the field of demography is related to business, whereby segmentation of the population into cohorts is examined and the application of cohort (demographics) to marketing is explored. Demographers offer a different perspective to business (Morrison 1991), and the analysis of research focusing on cohorts demonstrates the contemporary academic interest and the importance of terminologies used.

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_11, © Springer Science+Business Media B.V. 2012

Demography and Marketing

The compositional structure of a population is of interest to demographers and marketers since population segments represents the potential expanding or contracting businesses opportunities and decisions (Pol and Thomas 1997). Demographers can distinguish between age and cohort effects (Morrison 1991) and the perspective also allows a unique outlook to a variety of business situations. “Business demography,” is a relatively new field of demographic analysis and it

> concerns itself with the manner in which such variables as age, income, and occupation influence the business-related behavior of individuals and organizations, and how aggregate characteristics such as the age, income, and occupational structures affect the business environment of markets (Pol and Thomas 1997, p. 1).

Business demography is also a part of the demography subset labeled “applied demography.” Applied demography is the “branch of the discipline that is directed toward the production, dissemination, and analysis of demographic and closely related socioeconomic information for quite specific purposes of planning and reporting” (Rives and Serow 1984, pp. 9–10). Business demography is used in specific marketing purposes. “When marketers think like demographers, they gain an understanding of how things work that can help them increase market size, deepen market penetration, and carve out market share” (Exter 1988, p. 20).

Simply using demographics to understand a market is insufficient, yet demographic information appeals to marketers as the information is easily accessible and affordable, describes aggregate purchase behaviors, may be used in trend analysis, and provides appropriate market evaluation (Nesbit and Weinstein 1988). Marketers typically do not focus on cohorts (Pol and Thomas 1997) even though aggregate data describing period and cohort effects are available. However, using demographic information with specific marketing data can be very informative in describing purchasing behaviors to even a small specialty retailer. For example, the “data can tell a food retailer or bakery firm who buys whole wheat bread, how much of it they buy, how many potential buyers there are now, and how many there will be in the future” (Francese 1988, p. 12). Similarly, where products are located in a grocery store, for example, at the end of aisles where people expect to find “sale” products, and the cheapest product line at the lowest shelf while the expensive product is at eye level, are important business decisions. With the increasing demands of marketplaces (Brown and Orsborn 2006), detailed (demographic) information representing select segments of the population are needed and are essential to business success.

Segmenting the Population

Highly industrialized countries, like Canada or the United States, share similar population age structures. “The shape of the distribution deviates somewhat from that of a true (population) pyramid in the geometric sense” (Trovato 2009, p. 97), particularly as the population(s) are experiencing increasing numbers of older individuals (Kalbach and McVey 1979) represented by the infamous baby boom cohort. Historically, cohort terminology was used to refer to a group of warriors and soldiers (Glenn 2005; Mason and Fienberg 1985). Today, cohorts aggregate individuals into unique groups sharing life course events.

Generational marketing differs from cohorts, as a generation is:

> defined by its years of birth. For example, a generation is usually 20 to 25 years in length, or roughly the time it takes a person to grow up and have children. But a cohort can be as long or short as the external events that defines it. The cohort defined by World War II, for example, is only 6 years long (Schewe et al. 2000, p. 48).

Segmenting the population by select demographic characteristics can also include variables such as "gender, age, income, geography, or their different needs" (Hague et al. 2004, p. 95). With the aggregation of individuals by select characteristics, a cohort is created. Therefore, a cohort does not represent individual histories, but it is rather a representation of the unique circumstances the group experiences together (Ryder 1985). "Cohorts are highly influenced by the external events that were happening when they were 'coming of age' (generally between the years 17–23)" (Schewe et al. 2000, p. 48). Defining moments that group individuals in cohorts together are traumatic events, like war (Ryder 1985). By understanding what individuals have experienced over their life course, marketers can learn about whom their customers are (Pol 1987) and this information can aid in targeting key characteristics, often used in marketing strategies.

Cohorts vary from one another due to demographic effects of mortality and migration. "The movement of the cohort, within the politico-spatial boundaries defining the society, is a flow of person-years from time of birth to the death of the last survivor" (Ryder 1985, p. 12) and this includes all the events that happen between birth and death. Education, peer-group socialization, and historical events affect individuals (Ryder 1985). Age-period-cohort effects (Osmond and Gardner 1989) also characterize cohorts. For example, "the catch phrase for the 1990s when it comes to discussing population is Generation 'X'. GenX, the generation getting McJobs and being paid McMoney" (Cheung 1995, p. 1).

The largest cohort in Canada and United States populations are represented by the "baby boom." Although the other contemporary cohorts may not be as large in size, they are also recognized and include: the "baby bust" (also referred to as Generation X, or Gen X) and "millennials" (also known as Generation Y, or Gen Y). Table 11.1 compares the cohorts of the Canadian and United States populations.

As cohort years vary by country histories, when various countries are compared, the differences should be noted. "The population spike was shorter in the United States, much shorter in Europe and the United Kingdom, and longer but less pronounced in Australia" (Pearce 2006). No matter the length of the cohorts, certain patterns are established; "following each baby boom is a baby bust. In the 1920s, this generation was called the 'Lost Generation'. In the 1990s, this generation is called 'Generation X'" (Cheung 1995, p. 8). In Canada, an examination of the 2006 population pyramid demonstrates five different cohorts: the parents of the baby

Table 11.1 Cohorts of the Canadian and United States populations

Cohort	Canada	United States
Baby boom	1946–1965	1946–1965
Baby bust (echo boom, Generation X, Gen X)	1966–1974	1965–1976
Baby boomlet (Generation Y, Gen Y, millennial)	1975–1995	1977–present

Sources: Data are adapted from Statistics Canada (2007) for Canada data and Wickham (1988) for United States data

boomers (individuals born between 1922 and 1938), the Second World War cohort (those born between 1939 and 1945), the large baby boom cohort (birth years between 1946 and 1964), the baby bust cohort (individuals born between 1966 and 1974), and finally the children of the baby boom cohort (those born between 1975 and 1995).[1]

Applying Cohort Information to Marketing

Obviously major life course events affect an individual (like a birth, marriage, divorce, death), when a collective group of individuals as large as that of the baby boom cohort go through life experiences together, it is hard not to notice. Pol and Thomas (1997, p. 206) refer to the emergence of the large baby boom cohort as "the major demographic event of the second half of the twentieth century in American." Although the baby boomers are historically unique, every cohort has some distinctive features. "The smaller and less vocal "Silent Generation," (in the United States) also known as the "Ikes" named after one of their major influencers, the Eisenhower presidency" (Brown and Orsborn 2006, p. 16). Although historical, political, economic, and social trends and characteristics as well as influential brands can be affiliated by cohort (Generation X, Trailing-Edge Boomers, Leading-Edge Boomers, and Ikes/Silents), Fig. 11.1 highlights historical and political events that relate to the United States.[2]

Each cohort experiences varying life influences, as Fig. 11.1 demonstrates. In marketing research, if cohort analysis is carried out, characteristics must be clearly identified.

[1]For figurative comparisons between Canada (see Statistics Canada 2006) and United States (see Brown and Orsborn 2006, p. 18) data, population pyramids can graphically demonstrate the size of various cohorts.

[2]The additional societal influences on United States cohorts besides the historical/political ones presented in Fig. 11.1 (i.e. economic and social trends, characteristics, and influential brands) can be viewed in Brown and Orsborn (2006, p. 42).

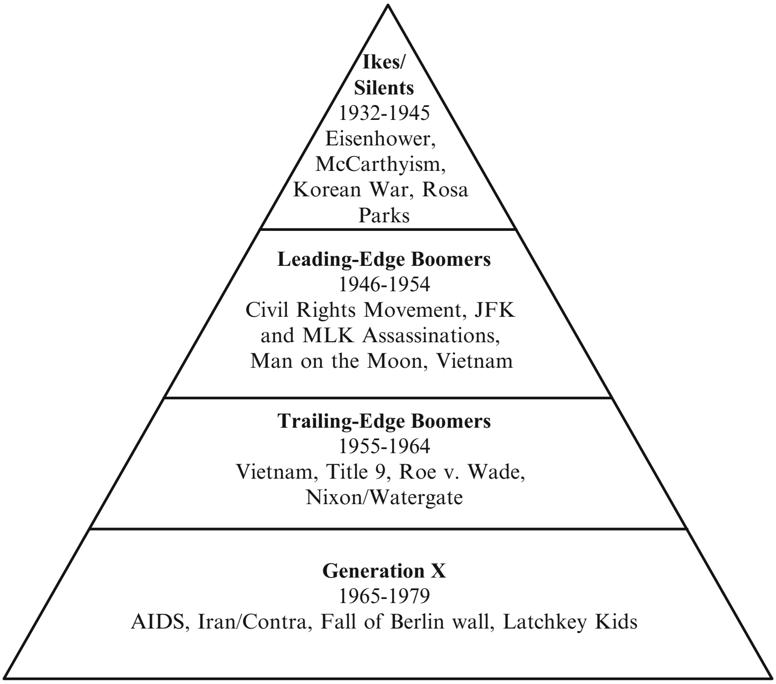

Fig. 11.1 United States historical and political cohort influences (Source: Adapted from Brown and Orsborn (2006, p. 42))

Methodology

As a means to measure the degree of cohort terminology used in scholarly (peer reviewed) marketing journals, a terminometric analysis (Quirion 2003) is conducted. First, a more general Boolean search including two terms like "baby *and* boomer" together, for example, initiates the more general investigation. The academic search engine EBSCO is accessed through the University of Alberta site license. "EBSCO Information Services provides e-journal, e-book, and e-journal package and print subscriptions, e-resource management tools, full-text and secondary databases, and related services for all types of libraries, research organizations and corporations" (EBSCO 2009). Using EBSCO as host, the search is limited to the Business Source Complete database, academic journals, and magazines for the years 2004 through 2009, and a historical search including the years between 1983 and 2003 is conducted. A more specific search is completed using archives of JSTOR (2009) including five marketing journals (Marketing Science, Journal of Marketing, Journal of Consumer Research, and the Journal of Public Policy and Marketing). The terms used in the searches include: baby boom, baby boomers, baby boomer, Generation X, Gen X, baby bust, Generation Y, Gen Y, Millenials, and Millenial.

Table 11.2 General search of cohort terms using EBSCO host between 2004 and 2009

	Baby boom	Baby boomers	Baby boomer	Generation X	Gen X	Baby bust	Generation Y	Gen Y	Millennials	Millennial
Articles	352	277	98	93	15	7	140	33	70	70
Magazines	8	7	3	4	0	0	3	0	6	6

Table 11.3 General search of cohort terms using EBSCO host between 1983 and 2003

	Baby boom	Baby boomers	Baby boomer	Generation X	Gen X	Baby bust	Generation Y	Gen Y	Millennials	Millennial
Articles	337	207	46	102	3	25	163	1	114	41
Magazines	20	7	3	4	2	6	3	0	22	16

Results

The general search of cohort terms using the EBSCO host engine is presented in Tables 11.2 and 11.3. The results indicate that the terminology (keywords) used to describe population related cohorts does affect the number of associated articles/magazines that exist.

In the time between 2004 and 2009 (Table 11.2) and 1983 through 2003 (Table 11.3), terms used in journal articles and magazines have varied. It is noted that more recent articles have included terms focusing on individuals belonging to the millennial cohort. As the millennial cohort contains younger aged individuals than older cohorts (like the baby boomers and Generation X), the mere time to research aspects of this cohort has not been long. Even without as long a historical existence, interest in this young population exists in business academic literature.

In a more academic literature search, using JSTOR as a search engine, Table 11.4 demonstrates that few articles actually focus on cohort terminology. The terms used to search for specific cohort related articles also influences the number of articles that are presented. Baby boom, baby boomers, generation X, generation Y are better terms than baby boomer, Gen X, baby bust, Gen Y, millennials, and millennial.

Discussion

The findings suggest that cohorts indeed are of limited interest to researchers publishing in academic marketing journals. Cohort segmentation does seem to provide a method for separating consumer markets, which has been demonstrated previously (see Schewe et al. 2000). Schewe et al. (2000, p. 53) note that, “cohort segmentation is particularly appropriate for food, music, apparel, automotive, financial and insurance, as well as entertainment products.” Therefore, demographic information is important as it provides valuable information for market management; no matter how big or small the geographic focus is (Francese 1988).

Table 11.4 Specific search of cohort terms in academic journals using JSTOR for articles between 1983 and 2003

	Baby boom	Baby boomers	Baby boomer	Generation X	Gen X	Baby bust	Generation Y	Gen Y	Millennials	Millennial
Marketing Science (j100726) 1982–2004	0	2	0	1	1	0	0	0	0	0
Journal of Marketing (j101361 and j101362 and j100012) 1936–2003	5	3	0	0	0	0	0	0	0	0
Journal of Marketing Research (j100233) 1964–2003	4	1	1	1	0	0	0	0	0	0
Journal of Consumer Research (j100492) 1974–2003	6	9	4	5	0	0	0	0	0	2
Journal of Public Policy and Marketing (j50000000 and j50000001) 1983–2003	3	5	0	0	0	1	1	0	0	0
5 Journals together	46	52	5	7	1	2	1	0	0	2

Note: Literature reviews, reviews and books received were excluded from the counts

As industrialized countries experience population aging, the large number of baby boomers garners vast amounts of attention. The baby boom cohort spans roughly 19 years, whereas the smaller baby bust spans only 8 years, and the difference in years results in uneven cohort sizes. Brown and Orsborn (2006) view the large number of boomers as a tidal wave rolling across America and with such large numbers of individuals experiencing various life course events collectively, it is hard not to focus on the boomer cohort. The number of individuals in the baby boom cohort is also notable as the millions of individuals affect the population composition. As the baby boomers increase in age, it would seem women should become of more focus as females have longer life expectancies (Brown and Orsborn 2006). Women have also increased their role in the labour market, and with higher income levels than ever before, women have more influence in the retail market than ever before. Specific characteristics cohorts (like being an older female) have allowed marketers to address unique characteristics, and the integration of psychographics has become commonplace in market research focusing on consumption behaviors (Townsend 1988).

Indeed demographics play an important role in data estimation and projection as applied to marketing and even more generally to business applications (Swanson and Pol 2005). Understanding the terminologies used to refer to cohorts demonstrates the importance of demographics in marketing research.

Conclusions

The cohort to which an individual belongs is important. Marketing research tends to focus on specific cohorts because of interest in researching individuals who belong to respective cohorts. In business, “since these cohorts can be described by the ages of their constituents, they offer an especially efficient vehicle for direct marketing campaigns” (Schewe et al. 2000, p. 48). Therefore, understanding characteristics that reflect baby boomers, Generation X, and Generation Y also allow one cohort to be separated from another. As new cohorts enter the marketplace, organizations need to keep apprised of their changing value structures (Schewe et al. 2000, p. 53). Quoting David Foot, “we don’t control when we’re born, but it can have a major implication on our life and life experiences” (Pearce 2006). Understanding who exactly belongs to which cohort demonstrates the interest of cohort terminology in academia and in everyday life.

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Chapter 12
Effects of Corporate Form and Financials on Executive Backdating of Stock Options at the Turn of the Century: An Analysis of Pair-Matched Corporations

Don R. Warren, Mary Zey, and John Garza

Introduction

An executive stock option (ESO) is an option to buy common stock of a company, generally issued as a form of non-cash compensation. In the 1980s, the main purpose for corporations to issue stock options to its executives was to align executives' interests with those of the company's shareholders. Financial economists held that agents or managers are effort-adverse (Jensen and Meckling 1976; Jensen and Murphy 1990), and rewards, such as stock options tied to performance, are required to provide executives the incentive to supply effort, but more specifically, to supply effort which is consistent with the interest of stockholders.

Option holders (including managers) should experience a direct and equal increase in the price of their option shares, linking top managements' interests to that of the stock holders.

However, such a linkage also provides a direct incentive to top executives of a firm to report news that will increase the firm's stock price regardless of its relationship with corporate profits. This step is often taken to avoid potential losses not only to the companies but also to their vested top ESO holders. Decisions related to executive stock options and their transactions (including the amount, relationship to profits, and timing) are touted by normative managerial theory to be at *arm's-length* between the board (including its compensation committee) and top executives. Throughout the 1990s to the present, stock options, grants, and timing, like most major decisions in private corporations, have increasingly come under the control of the Chief Executive Officer (CEO) and the board of directors. Moreover, throughout the 1980s to the present, CEOs, Chief Financial Officers (CFOs), Chief Operating Officers (COOs), Chief Accounting Officers (CAOs), and board members have

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_12,

received extraordinary compensation through backdated stock option bonus packages, as well as through regularly scheduled compensation packages. Consequently, there is now a disconnect between company and stockholder profits, and the CEO and executive interests have replaced stockholder interests as paramount.

Backdating Defined

The value of a stock option is determined by its strike price, usually the market price of the stock on the grant date, as reported to the Securities and Exchange Commission (SEC). The term, *backdating* an ESO, is defined as retrospectively choosing a different option grant date, so that on that date, the stock is already "in-the-money,"[1] thereby enhancing its value. Executives backdate to obtain options at a lower strike price. The executive effectively retains earnings equal to the difference between the amount of the strike price on the retrospective lock-in date and the presumably higher market price that the executive receives as a function of reporting an altered grant date to the SEC. The practice of backdating stock options has been likened "to letting executives bet on a game when they already know the final score."

Prior to the enactment of Sarbanes-Oxley (SOX)[2] 2002, the grant date could be moved by as much as ±30 days, to when its price was lower, causing an increase in its value. Under SOX, executives could have multiple ESOs granted on different dates and at different strike prices over this 60-day period, regardless of the actual exercise date on which they received the compensation. Moreover, the corporation did not have to report executives stock option grants to the public until the end of the fiscal year, often months after the award. When reported, the corporation did not have to define the number of shares, only the cash value at the time the grant was reported.

Since the enforcement of SOX in 2004, the difference between the initial and subsequent grant dates can be *no more than* 2 days. We find, as do Heron and Lie (2007),[3] that the reduced 2-day window has reduced backdating. The timing of ESO grants can still be unscheduled and vary in the number of times made per year and can vary from

[1] Stock options with the exercise price equal to the prevailing stock price are called "at-the-money options." If the exercise price is lower or greater than the stock price, the options are called, respectively, "in-the-money" or "out-of-the money" options.

[2] Our final list of backdating firms after 2002 documents our findings that the Sarbanes-Oxley Act (SOX) of 2002 has not been successful in eliminating ESO backdating.

[3] Heron and Lie (2007) estimated that, before the new 2-day filing requirement took effect, the rate of backdating was 23.0%, and after, the rate was 10.0%. Overall from January 1, 1996, to December 1, 2005, they estimated that 13.6% of all individual stock option grants to top executives were backdated or manipulated. In order to generate these findings, they assumed "that in the absence of backdating or other types of grant date manipulation, the distribution of stock returns during the month before and after grant dates should be the same, that is, that the distribution of return difference should be centered on zero." They then inferred "that the fraction of grants that must have been backdated or otherwise manipulated by contrasting the distribution of the observed return differences with what the distribution should be in the absence of grant timing" (2007, p. 2).

1 year to the next. If the company chooses not to grant the option at-the-money, the incentive to backdate is muted. Furthermore, if grants are scheduled (occurring on the same date every year), the opportunity for backdating is absent.[4]

For more than a decade, evidence that the practice of backdating could be substantiated has existed in the academic literature. However, management's timing of options was accounted for as the result of "superior managerial knowledge" of corporate functioning of when stock prices would be low, and thus stock options *should* be issued to incentivize executive performance. Professor Erik Lie (2005) of the University of Iowa was the first to define such superior managerial knowledge as a function of retrospectively choosing the grant date. It was not until 2006 that the *Wall Street Journal (WSJ)* published its report that executives of six companies had backdated their stock options (Forelle and Bandler 2006).

Consequences of Backdating

Because investors are often unaware of the values of the options granted, the practice of backdating stock options has adverse effects for the following reasons. First, stockholders are paying executives higher amounts of compensation than they have agreed to pay. Second, stockholders believe that management's interests are aligned with their interests through future stock price increases, when in fact this alignment has been diluted. Third, stock options granted at-the-money may require fewer expenses for the company than do in-the-money options. Thus, the stockholders are deceived with respect to the amount of executive compensation granted and also with respect to the validity of the corporate statement relative to the Generally Accepted Accounting Principles (GAAP). These deceptions are often in violation of SEC statutes and more recently the SOX. Moreover, they lessen the confidence that investors have in their corporate executives.

Backdating stock options results in three major structural changes in the relationships between corporate finance and parties of interest: (1) it increases the already decoupled pay for performance incentive structures, resulting in the exploitation of stockholder value by executive managers, (2) it devalues stock prices, and (3) it lowers the confidence of both the stockholders and the public in the U.S. corporate capital system.

Although managerial analysts have been slow to acknowledge and accept these changes, there is evidence that academics are beginning to recognize the executive-serving nature of the existing system (see, for example, the work of Bebchuk and Fried 2004).[5] We and others have argued that recently top executives have captured the compensation process and have weakened the sensitivity of pay for performance

[4]Former studies of stock option grants have generally pooled options to identify outlying grants as "backed" (Heron and Lie 2007).

[5]Bebchuk and associates question the arms-length model and suggest that the compensation process has been captured by the executives being compensation while alternatively theorizing from a "Power" perspective. For a critique of the arms-length assumption, see Bebchuk and Fried (2004). For a critique of this perspective, see Murphy and Kevin (2002).

relationships. This decoupling of executive pay and performance has been augmented not only by ESO, but also by cash and bonus compensation, deferred compensation benefits, executive interest-free grants (i.e., unreimbursed loans), and the lack of retraction of such compensation benefits when performance is low or negative. In fact, *pay for non-performance* has become the norm as executives receive multi-million dollar golden parachutes for being sacked as their corporations do not perform and file for bankruptcy. Backdating is simply another way to reduce the link between pay and performance and to ensure gains in compensation when performance and stock option price do not increase.

A more direct, and in the longer term, more detrimental macro-level effect of backdating ESOs is the associated overstatement of the firm's value through inflated earnings reports that, when unacknowledged for an extended time, could bankrupt a company. To illustrate, Enron had to restate 5 years, and within the year it filed for bankruptcy. Thus, the costs of backdating to the firm may be insolvency, as was the case with Enron. Misaligned incentives encourage executives to misallocate corporate resources, which sometimes results in extraordinary losses in corporate capital value.

"Expensing stock options" means that corporate income statements must reflect the fact that the backdated options were granted in-the-money, requiring that the intrinsic value of the option also be treated as corporate compensation expense. This modification lowers the reported corporate income and decreases the stockholders' equity. If financial analysts assumed no backdating on the part of a corporation that actually had backdated, this assumption would cause them to inaccurately devalue the ESO grants.

Prior to 2003, corporations did not have to expense stock options. In 2003, the Federal Accounting Standards Board (FASB) reversed its stance and unanimously voted to recommend expensing the fair market value of the options at the time of the grant. Due to continued opposition, FASB did not achieve the release of FASB 123R until December of 2004 (FASB 2004). After still further delay by the SEC, the accounting rule of FASB 123R did not become effective until the fiscal year starting December 15, 2005. Not until 2006 did corporate earnings reports reflect the cost of executive stock options to the corporate bottom line with the price of each share and the shares granted to each executive, enabling the public to calculate how many shares of the company's stock were being granted to its executives and at what cost to shareholders. Thus, even after backdating was exposed after 2002, with few exceptions, corporate executives continued to misrepresent the corporations' bottom line to their stockholders and the public by refusing to expense stock options and adjust the corporate bottom line accordingly. The CFO now, after 2006, finding that the company has in reality issued options of greater value to the executives is required to lower the corporate value and thus all stock prices.

Political-Legal and Economic Historical Context

In response to the declining profits, the high corporate debt, and the economic pressures of weak internal cash flow caused by the back-to-back recessions of the early 1980s, managers had the incentive to reduce capital dependency on external debt.

In response, corporations turned to high risk strategies such as mergers and acquisitions to create internal capital flow between the corporation and its subsidiaries. In some cases, large parts of corporations were acquired and, in other cases, entire corporations were acquired through the sale of high-risk subordinate debt to fund the restructuring of their holdings into more flexible, loosely coupled enterprises that could be easily disassembled and reorganized with less legal and financial cost (for a comprehensive discussion of this era see Zey 1993). Such mergers and acquisitions required high levels of capital that often could not be obtained by the acquiring corporation except at high interest rates through selling subordinate debt. High levels of non-investment-quality debt places the corporation at great risk of bankruptcy. In order to survive under the threats of high debt and ever increasing capital dependency of such acquisitions, corporations organized politically (for example, see Zey 1993). In 1985, a political coalition of over 300 institutional investors, financial investment firms, and corporations, led by the Committee for Capital Access, had overcome opposition and pressured Congress to pass the Tax Reform Act of 1986, which eliminated the long standing New-Deal-era tax on capital transfers from subsidiary corporations to parent companies (Zey and Swensen 2001). Throughout the late 1980s and early 1990s, a majority of the largest *Fortune* 500 companies changed their corporate form from the multi-divisional to the multi-subsidiary form (Zey and Camp 1996; Zey and Swensen 1998, 1999, 2001). They restructured their existing divisions and newly acquired entities into holding companies and controlled them financially from small, often remote, headquarters operated by a small team of a dozen or more top (chief) executive managers – including the CEO, CFO, COO, and CAO. These four executives and the chair of the board receive the largest portion of ESOs.

Changes in Reporting and Disclosure Laws

Historical changes in ESO reporting and disclosure laws are important to understanding the lack of enforcement of illegal backdating, our sample period from 1998 to 2006, and the timing of reporting our findings. First, we briefly review the historical context of the time of changes in the legal status of disclosing executive stock options as they relate to financial statement reporting.

Until the mid-1990s, options reporting for financial purposes were controlled under the guidelines established by the Accounting Principles Board (APB) Opinion 25. Before the mid-1990s, whether ESOs were granted in-the-money or out-of-the-money had no impact on the corporate financial statement. However, if the options were granted in-the-money, the difference between the grant date stock price and the exercise price (called the intrinsic value of the option) had to be treated as an expense and deducted from corporate income. The intrinsic value aggregated over all options grants was amortized as a compensation expense and distributed evenly over the vesting period. Note that as the stock rose or fell in price, the compensation expense was not adjusted for subsequent changes in the market price of the underlying stock (IRC §409A Supp. IV 2005). This law had financial consequences for corporations which backdated: first it deferred tax assets due to compensation expenses because no actual tax was paid at the time of the grant, meaning that a deferred tax asset was created; second it offset increases in shareholder equity.

In 1993, the Financial Accounting Standard Board (FASB) proposed expensing employee stock options at their fair market value at the time of the grant. Subsequently, in 1994, the U.S. Senate, under pressure from corporate lobbyists, proposed legislation that blocked the FASB from implementing the expensing of stock options. The Senate retaliated by proposing a resolution that condemned the FASB proposal and threatened to revoke the FASB's independent status to make and enforce accounting rules. The FASB rescinded its proposal and required only that the fair market value of the options be disclosed in a footnote to the financial statement.

In 1995, the FASB issued the final Statements of Financial Accounting Standard No 123 (SFAS 123) that asked corporations to treat the fair market value as expense at the time of the grant but allowed corporations to report under APB 25 as long as the footnote contained a pro forma presentation of earnings. All corporations choose to report under this less transparent rule APB 25.

The Multi-subsidiary Form and Special Purpose Entities (Private Partnerships)

The *multisubsidiary form* (MSF) has a parent company or holding company at the top of the corporate hierarchy that operates as the financial management unit for the entire enterprise, which consists of this unit and two or more levels of legally separate and independent subsidiary companies. The parent company owns first-level subsidiaries, and one or more first-level subsidiaries own second-level subsidiaries. Thus, through their ownership of the first-level subsidiary, the parent company owns and controls all lower levels. The parent company benefits financially from the assets of all these corporations, yet holds limited legal responsibility for them. (See Zey and Camp 1996; Zey and Swensen 1998, 1999, 2001; Hogun et al. 2009).

The MSF differs from the multidivisional form in many ways as described in the works cited above; however, for the purposes of this article, the legal independence of subsidiary holdings enabled executive management to reduce their debt dependency by financing only 51% of a subsidiary's asset value in stock while retaining managerial control over that first-level subsidiary and its subsidiary holdings, including management compensation policies (which include ESOs). At the same time, as this corporate form became more flexible and decoupled, few changes were made by the federal government to oversee or regulate the political-legal context in which the MSFs operated. Changes that did occur were directed toward deregulation. For example, the Tax Reform Acts of 1986 and 1987 (TRA86 and TRA87) eliminated the capital transfer taxes on dividends, which broke the coupling between the Internal Revenue Service and corporations because corporations no longer had to report such capital transfers. Giant mergers and acquisitions transactions were tax free.

Transfer prices "are the prices [financially] related companies, such as a parent corporations and their subsidiaries charge . . . for inter-corporate transactions" (U.S. Government Accountability Office (GAO) 2008 [bracket material added by author]). Transfer prices are critical components of the corporate tax system because they affect the distribution of profits, and therefore, taxable income. Hypothetically, transfer pricing is at-arms-length: the same as the prices that occur between two legally and financially unrelated entities. However, as learned with Enron and after, this is seldom the case. The GAO has difficulty interpreting transfer pricing data, when and if, they obtain such data from the corporation (GAO 2008, p. 5). The SEC is unable to identify and define their nature. Consequently, the SEC is unable to establish the tax bases to determine why most large domestic parent companies paid no taxes throughout much of the late 1980s and 1990s.

With corporate decoupling of owned entities, there is a decoupling of critical parts of the regulatory system. First, the dominant MSF is decoupled from the political-legal structure and regulatory structure in which it operates, creating "structural holes" (Burt 1992) that provide opportunities for top executives of the parent or holding company to transfer capital among corporate entities in secrecy – without transparency to investors, regulators, and often middle and lower level managers. These "structural holes" and consequential lack of transparency creates the ideal condition for corporate crime (Zey 1998a, b, 1999). Second, and more importantly, there are multiple accounting rules within the two Accounting Board systems under which U.S. corporations report transactions. The rules are not the same between the two systems. This difference creates ambiguity in the laws, resulting in multiple interpretations of the accounting rules under which reported financial transactions between the parent corporation and its entities and among (average of more than 100 networked) its subsidiaries may take place.

Third, and most important for the public and the investor, the lack of public and investor transparency created by these structural holes, the context of political-legal secrecy, and the environmental support for corporate crime provided opportunity and facilitated backdating throughout the 1990s and into 2000s. These changes allowed corporations, without impunity, to create, structure, and restructure, and then unwind complex private-financial-partnerships, so-called off-balance-sheet "*special purpose entities*" *(s.p.e.s.),*, which were not reported on the parent's consolidated financial statement. Often the only references to such private partnerships appeared in the small print of brief footnotes.[6] Prior to this study, the extent to which parent firms used their subsidiaries and s.p.e.s to execute crimes was unknown, except for antidotal evidence.

In sum, corporations, first, changed from the multidivisional form to the multi-subsidiary form in the mid-1980s largely to reduce their dependency on external corporate debt from commercial banks and investment banks that charged extraordinary fees for their service (Zey 1993). Corporations reduced their bank dependency

[6] Enron's special purpose entities and private financial partnerships were so numerous that a full list has not yet appeared in print.

by issuing stock in their legally independent but financially dependent subsidiary holdings, creating a rash of initial public offerings (IPOs) in the 1990s. Second, reducing bank dependency and debt dependency through internal transfers of capital from its financially controlled subsidiaries to the parent corporation increased the parent corporation's access to capital at inter-corporate low transfer prices. Third, not only could the parent company make invisible capital transfers to its subsidiaries, but it also could access and transfer capital from its subsidiaries to the parent to meet balance sheet needs, which created the appearance of healthy capitalization for its investors. Fourth, the number and level of subsidiaries (average held 42, highest held nearly 300) held within eight or more hierarchical structural levels not only creates unimaginable complexity, but many *structural holes* so that neither corporate executives nor middle-level managers, and certainly not regulatory agencies, can fully know the operations of the corporation. Fifth, because subsidiaries are legally independent, but financially dependent on the parent company, and because a single individual can simultaneously serve as the CFO or COO of the parent company and the CEO of one of its subsidiaries, single individuals can control a string of subsidiaries in the interest of the parent company or in their own interest.[7] Thus, they receive stock option grants not only from the parent company, but also from its subsidiary holdings. Sixth, many times executives not only received stock options from subsidiary holdings, but also received management fees from the private partnerships or s.p.e.s (e.g., Andrew Fastow, CFO of Enron received stock options from subsidiary holdings of Enron and management fees from private partnerships, which he operated from his CFO and later CEO office in Houston).

Hypotheses

In the context of deregulation, this political-legal corporate environment, ambiguous and unenforced accounting rules, and management-controlled boards increased the opportunity for backdating stock options. Complex, multi-subsidiary corporations create opportunities for managers to be compensated through stock options by the parent company and its holdings. The structural holes that immerged between these entities reduced investor and regulator transparency and permitted backdating.

H1: Parent corporations that are organized as the multi-subsidiary form are more likely than others to backdate executive stock options.

This first hypothesis was tested separately because the measure of MSF had to be obtained manually for the end year of our range as compared to obtaining it from the WRDS proprietary database across 9 years. Table 12.1 shows the backdating and multi-subsidiary-form (MSF) status of the 248 corporations that make up the

[7]Enron's CEO and CFO both served as CEO of Enron subsidiaries and managed private partnerships from Enron's parent company office in Houston.

Table 12.1 MSF corporations

	Corporate form is multi-subsidiary		
Back-dated	No	Yes	Total
Yes	31	93	124
No	47	77	124
	78	170	248

analytic data set (see below for details). To summarize, the 124 corporations that backdated were all U.S. corporations that did so during the time period of this study. The 124 corporations that did not backdate were optimally pair-matched (using propensity scores) to the backdating corporations for the purpose of statistical comparison. Thus, the design is of the case-referent (or, equivalently, a case-control or retrospective) type.

The relevant statistic is the relative risk of backdating given that the corporate form is MSF as compared to non-MSF. This statistic would show how much more probable backdating was among MSF corporations as compared to non-MSF corporations. However, because the design fixed the backdating marginal distribution instead of allowing it to be determined empirically, it is not sensible to directly calculate this statistic. Because backdating is, in general, rare, meaning that the probability of backdating is quite small, the odds ratio can fortunately be used to indirectly estimate the relative risk. The odds-ratio-based estimate of the relative risk was 1.83, meaning that backdating among MSF corporations is 83% more probable than among non-MSF corporations. The 95% confidence interval was 1.06–3.16; because this interval does not contain 1, the value of the odds ratio under the null hypothesis, this relationship is significant statistically. Thus, the multi-subsidiary form contributes to backdating.

The remaining five hypotheses test the central tenet that shareholders' conception of value increases opportunistic behavior. Increasing corporate net sales increases the intrinsic value of executive stock options; however, when recent net sales are falling, executives are expected to be more likely to backdate stock options to increase their return from stock options.

H2: Corporations whose recent net sales decline are more likely to backdate executive stock options.

Likewise, when the liquidation value of preferred stock is declining, executives are expected to be more likely to backdate their stock option holdings. Debt, especially debt that is incentivized with the option of conversion to equity (common stock), generally means the corporation could not find bond issuers without the conversion component.

H3: Corporations whose preferred stock-liquidating value decreases are more likely to backdate executive stock options.

The U.S. economic downturn and intense multi-national competition, which pressured U.S. corporations to globalize in the 1980s, decreased profits and increased corporate capital shortages in the midst of unprecedented increases in interest rates that reached record high levels, leading to a series of recessionary periods. As addressed above, to reduce their dependency on expensive external capital financing, many corporations throughout the 1980s and into the 1990s changed their corporate form to the MSF and issued stocks and bonds through their subsidiary holdings. The shift from debt to equity financing resulted in a sharp decline in corporate debt markets; that is, the sharp decline was from 20.5% commercial bank debt funding from 1980 through 1986 to 14.5% commercial bank debt funding on non-mortgage related debt in non-financial corporations (James and Houston 1996, p. 11). This shift also increased the competition among banks for corporate debt while, at the same time, orienting corporations toward raising capital from institutional investors such as TIAA-CREF and CALpers. To illustrate, an Enron private partner was funded through CALpers and operated by Andrew Fastow of Enron from his Enron office. This shift from debt to equity financing did not eliminate capital dependency, nor did it eliminate debt dependency for the most risk-prone corporate managers. It merely replaced one form of capital dependency with another, and made U.S. corporations dependent on institutional investors such as large private funds and private investment companies such as Kohlberg, Kravis, Roberts.

In 1992, the Securities and Exchange Act of 1934 was revised to permit direct communication between investors and top executives (see Krier 2005), and FASB all but abolished its rules governing communication between investors and top executives. In response, corporations instituted quarterly "*conference calls*" between their CEO and CFO and their investors and established investor relations departments. These changes allowed corporations and their top executives to institutionalize their previous informal communications with their community of investors. The establishment of national news networks that publish these calls to the public has further facilitated the communication of management to their investors of their actions to increase stock prices. Because corporate managers are dependent on capital from fund managers and private corporations, they engage in communications that raise shareholder value, which increases their own stock option values.

New sources of capital brought new vulnerability to these corporations because private investment companies and funds are not satisfied, as banks are, with corporations just meeting their debt payments. In contrast, these investors prefer that managers pursue goals that directly affect the value of the stock in their portfolios. Therefore, they pressure corporate managers to maximize shareholder value (Useem 1993, 1996), which in turn increases the relative importance of a manager's stock option holdings and increases the pressure on managers to backdate their stock options. Long-term debt does not expire until more than 1 year after the time of filing the financial statement. Thus large quantities of long term debt present a corporation with considerable risk. We hypothesize that:

H4: Corporations with long-term debt are more likely to backdate executive stock options.

"*Subordinate debt*" is debt (corporate bonds) of low quality, and its value is not recoverable in case of bankruptcy until investment quality debt holders are paid off. Corporations that cannot find a market for their corporate bonds may make them more attractive by attaching to them an equity conversion, making them convertible under some condition or in a defined amount of time. Subordinate debt is often used to cover bridge loans during mergers and acquisitions. For example, during the mergers and acquisitions movement of the 1980s, Michael Milken often financed bridge loans with third-level subordinate debt through issuing junk bonds (non-investment quality bonds, below BBB+rating or unrated) on the target corporation (Zey 1993). This practice has continued throughout the 1990s to the present. The market for subordinate debt is a good measure of the quality of the debt of a corporation. As subordinate debt increases, the corporation's debt rating decreases; thus, as subordinate debt increases, corporate risk increases, and corporate executives are more likely to backdate their stock options to increase their personal outcomes.

H5: corporations whose subordinate debt is convertible and long-term are more likely to backdate executive stock options.

Cash and "*short term investment*" accounts contain any investments that a company has made that will expire within 1 year. For the most part, these accounts contain stocks and bonds that can be liquidated fairly quickly for the purpose of mergers and acquisitions. For example, Microsoft has always held a strong short-term cash position for acquisitions. In 2005, it held $32 billion in cash and short-term investments.

The high-risk or "speculative management" behaviors "oriented toward securities markets with the intention of influencing the price of corporate stock" (Krier 2005, p. 22), which prevailed through the late 1980s, 1990s, and until 2005, are characteristics of the development of the MSF, which is dependent on internal capital markets. Generally, these high risk behaviors included spin-offs of low-profit entities, split-offs into IPOs (held as subsidiaries) of high-profit entities, and mergers and acquisitions that eliminate redundant employees and are defined by the market as increasing profits and thus often raise stock prices. Krier (2005, pp. 151–152) notes that teams of "very senior managers and very large owners" who have an interest in "higher equity values" possess both corporate authority and capital power to financially restructure corporations and report events that are characterized by short term equity values. However, these pressures to report high profits have a negative effect on managers because they strain the corporation's cash flow, and thus create incentives for managers to conceal losses in order to attract investors. This formulation is consistent with *strain theory* of Clinard and Yeager (1980). McIntosh and Zey-Ferrell (1986) and Zey-Ferrell and McIntosh (1987) found that "asset growth" was a significant predictor of corporate losses due to fraud during the saving and loan crisis in the 1980s (Tillman and Pontell 1995).

H6: Corporations with cash and short-term investments are more likely to backdate executive stock options.

Sample and Methods

In this section, we define the measures, sample, and statistical methods.

Sample

The corporation is clearly the unit of analysis, not the CEO's ESO grants or grants to any employee of a private enterprise company. Thus, stock options that were backdated in any entity by any position holder in the firms are included in our definition of backdating, as is any company that had one or more of its executives – CEO, CFO, COO, general counsel, or a member of its board of directors – backdating. The advantage of this operational definition is that it eliminates multiple enumerations of the same firm because all of its employees backdated. In addition to eliminating multiple enumerations of the same firm and not biasing upward the number of firms backdating, which occurs in other studies, our sample also has the advantage of avoiding the counting of X-dividend issued stock as backdating.

Three federal government agencies have investigated corporate backdating: the Securities Exchange Commission, the Justice Department, and the Internal Revenue Service. State attorneys general have also investigated corporations with home offices in their jurisdictions. Using these sources the *Wall Street Journal* compiled a nearly complete online list of corporations that have been reported by one of the above agencies or have self-reported involvement in executive backdating. This list is called the "Options Scorecard."[8] In most cases, the decisions related to the guilt or innocence of each corporate case had not been reported before the "options scorecard" was discontinued in 2007.

Thus, in order to determine whether a company had backdated, we tracked each corporation individually until the final legal decision of guilt was made. Thus, we continued tracking these cases until December 2008; that is, for 2 years after December 2006, which was the last date on which new firms could be added to our sample. Not all corporations on the options scorecard were subsequently found guilty of backdating, nor were all firms that had been charged with backdating on the "options scorecard."

List of Backdating Corporations

As introduced, we specified the corporation as the unit of analysis. Actually, any of a range of corporation-related entities can be involved in backdating, such as the corporation itself, or separately the CEO, the COO, the CFO, or the General Counsel. Previous researchers have often used these entities in a mix-or-match manner. Instead, we specifically identified only corporations as having been involved in backdating if one or more of their subsidiaries had backdated, as defined below.

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[8]See the *Wall Street Journal* online at http://online.wsj.com/public/resources/documents/info-optionscard06.full.html (last visited in 2007). Also see *The New York Times.* Eric Dash, *IRS Reviewing Companies in Options Inquiries.* N.Y. Times, July 28, 2006, at C1.

To make this determination (as introduced above), we reviewed listings of corporations that had been identified as being involved in backdating from the SEC, the DOJ, or the *WSJ*. By involvement, we mean any of a set of activities that range from the less serious, such as publicly volunteering that they were checking into the possibility of involvement, to the more serious, such as being convicted of one or more backdating violations. This review identified corporations that had backdated or were suspected of having done so, identified by one of more of these three organizations or, in a few cases, self-identified by the corporation. The list was then unduplicated to produce a list of unique corporations. This process identified 158 corporations, of which back dating was confirmed (for our purpose) for 131 corporations by their guilty plea, no-contest plea, or payment of a fine. The remaining 27 corporations were exonerated by the absence of a plea or fine. To code this result, we created a backdating variable coded "1" for confirmed corporations or "0" for exonerated corporations. To this list, we added (for the nine calendar years of 1998 through 2006) a wide range of variables, the corporation-specific values of which we believed had the best chance of predicting which corporations had been found in violation or not in violation of federal backdating statutes.

Construction of Matched Pairs and Propensity Scores

The methodological "gold standard" would have been to conduct an experiment to randomly and prospectively assign the thousands of corporations to a range of different corporate-condition and corporate-governance categories, wait for the assigned conditions to be implemented and to take effect on the corporations, and then analyze the effects of these conditions to see if they had an influence on the statistical ability to predict which corporations would engage in stock-option backdating. Such a research attempt would be infeasible in the extreme for a number of reasons, not the least of which is that corporate laws and regulations are usually implemented for all corporations at the same time.

Nevertheless, to be able to draw legitimate conclusions as to which combinations of corporate conditions predict backdating, reasonable research needs statistical comparisons, in this case, between corporations that engaged in backdating and equivalent corporations that did not. The key word in the previous sentence is "equivalent" and the corresponding issue is how to construct an equivalent comparison group of corporations. As mentioned in the previous paragraph, the best way to achieve this would have been to randomly assign corporations to either a treatment group or to a control group. Barring that and since there was no pre-existing comparison group, we produced one using the next best alternative, a technique called propensity scoring, developed by Rosenbaum and Rubin and their associates (e.g. Rosenbaum and Rubin 1984). Thus, instead of statistically analyzing just the data set of backdating entities, we found for each backdating corporation a pair-matched comparison corporation that had not been involved in backdating. This produced a comparison group, not the full functional equivalent of an experimental control group, but nevertheless an approximation.

Table 12.2 Variables used to estimate the propensity score

Variable	Estimate	SE	Wald Chi-square	Probability > Chi-square
Intercept	1.5435	0.3147	24.05	<.0001
Inventories – total	0.0030	0.0024	1.54	0.2146
Depreciation and amortization	–0.0110	0.0052	4.51	0.0338
EPS (basic) – exclude extra. items	–0.0006	0.0004	1.65	0.1983
Liabilities – other	0.0219	0.0112	3.83	0.0504
Debt – subordinated	–0.0062	0.0030	4.24	0.0396
Deferred taxes (statement of CF)	–0.0471	0.0207	5.19	0.0227
Preferred stock – redeemable	0.0383	0.0527	0.53	0.4676
Earnings per share from operations	0.6891	0.4186	2.71	0.0997

Development of a Statistical Model as the Basis of the Propensity Score

The propensity scoring method seeks to provide a basis of statistically comparing the members of the list of backdating corporations with a comparison group of corporations not on the list that are otherwise optimally matched. This was done using the set of 158 corporations, 131 of which were confirmed as having backdated (coded as 1) and 27 of which were exonerated (coded as 0). The fact that there was a yes/no mix regarding backdating gave us a basis for developing a statistical model to estimate for each corporation a propensity score, the conditional probability of backdating. Because of missing values within a particular corporation across the 9 years of data, for each variable we calculated means across the 9 years. To identify which of these variables predicted backdating, we conducted a logistic regression using the above category as the dependent variable.

As the decision rule to determine which of the variables to use (see Table 12.2), the best-subset logistic regression used the Furnival and Wilson (1974) branch-and-bound (highest likelihood score) algorithm to identify the eight best-subset variables as predictors of backdating, producing for each corporation an estimated propensity score, the conditional probability of backdating. Note that the approach that we took was not to determine only estimates for which the associated type-1-error probability was less than the traditional significance level of 0.05; notice, for example, that this probability for the "preferred stock – redeemable" variable was about 0.47. Instead, we took the Furnival and Wilson approach mentioned above; for example, if we had excluded the "preferred stock – redeemable" variable, then the model, instead of explaining about 30% of the variance, would have explained 24% of the variance.

Pair Matching

Before pair matching, for each of the 131 corporations for which backdating was confirmed, the following operations were performed: (a) we established that the

Table 12.3 NAICS sectors for backdating corporations

		Sector	Label
1		11	Agriculture, forestry, fishing and hunting
2	√	21	Mining
3		22	Utilities
4	√	23	Construction
5	√	31–33	Manufacturing
6	√	42	Wholesale trade
7	√	44–45	Retail trade
8		48–49	Transportation and warehousing
9	√	51	Information
10	√	52	Finance and insurance
11	√	53	Real estate, rental, and leasing
12	√	54	Professional, scientific, and technical services
13		55	Management of companies and enterprises
14	□	56	Admin. support, waste management, and remediation services
15	√	61	Education services
16	√	62	Health care and social services
17		71	Arts, entertainment, and recreation
18	√	72	Accommodation and food services
19		81	Other services (except public admin.)
20		92	Public administration

corporation operated within the U.S. (this reduced the number of corporations from 131 to 124), and (b) the NAICS sector was determined from the NAICS (North American Industry Classification System) code. To determine the NAICS sector, we extracted the first two digits from the NAICS code and then collapsed a subset of these initial digits into sectors; for example, if the first two digits of a corporate NAICS code had been 32, then that corporation was assigned to standard NAICS sector "31–33" because 32 falls within that range. Of the 20 NAICS sectors, the 124 backdating corporations occurred in the 13 sectors that show a checkmark in Table 12.3.

Members of the set of 9,454 U.S. corporations were potential comparisons for the 124 backdating US corporations because they were not involved in backdating. Of the 20 NAICS sectors, these 9,454 corporations occurred in 13 NAICS sectors. A comparison of the 124 backdating and the 9,454 non-backdating corporations is shown in Fig. 12.1. In terms of NAICS sector membership, the backdating corporations did not differ statistically from the non-backdating corporations.

Adapting the tradition for corporate research, we performed the pair matching within NAICS sector. We used a SAS linear programming procedure (PROC LP) by minimizing the integer objective function between the two groups of corporations, producing a pair-matched data set of size 248. The pair matching was not "greedy" matching – that would have caused substantial distortion in this matching – but was instead 1:1 optimal matching (Ming and Rosenbaum 2001).

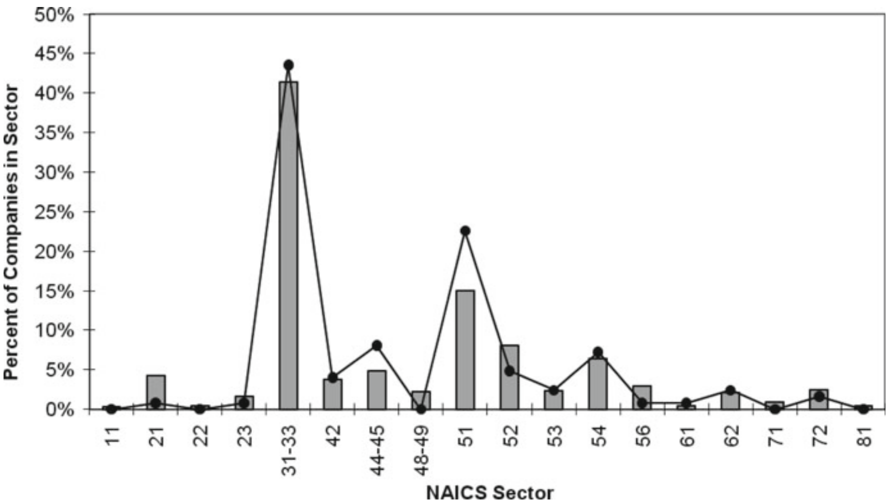

Fig. 12.1 Comparison of distributions of backdating U.S. corporations (*line*) with all other corporations (*bar*)

Statistical Analysis Findings

Given that each corporation that engaged in backdating was associated with a matched comparison corporation, the design was of the case-referent (also known as case-control or retrospective) type of design. Thus, the statistical method that was used was conditional logistic regression, using the SAS PROC PHREG procedure (see Allison 1999).

Before the analysis was run, we had to establish our set of potential independent variables. First, we selected those variables that simultaneously were not used to estimate propensity scores, were of theoretical interest, and were structurally basic to corporations. Second, we had to adjust our analytic strategy to the situation that the statistical routine performs case-wise deletion for missing values and our data set of means across 9 years still had missing values for some observations. For this reason, we further limited our set of potential independent variables to those that had no missing values.

The conditional logistic regression selected the five variables that appear in Table 12.6. The overall model (or the global) fit of these variables (see Table 12.5) produced a remarkable drop in the log-likelihood criterion and the information criteria, indicating an exceptionally good-fitting model.

The test of the global null hypothesis (see Table 12.6) was significant statistically by all tests.

Note in Table 12.6 that all of the variables that were included in the model were significant statistically. The hazard ratios are all close to zero due largely to scaling

Table 12.4 Model fit statistics

Criterion	Without covariates	With covariates
−2 Log L	171.901	61.025
AIC	171.901	71.025
SBC	171.901	88.593

Table 12.5 Testing global null hypotheses: β = 0

Test	Chi-square	df	Probability > Chi-square
Likelihood ratio	110.8751	5	<.0001
Score	26.9343	5	<.0001
Wald	322.5827	5	<.0001

Table 12.6 Analysis of maximum likelihood estimates

Parameter	df	Parameter estimate	Standard error	Chi-square	Probability > Chi-square	Hazard ratio
Sales (net)	1	−0.0005	0.0001	33.19	<.0001	0.9995
Long-term debt – other	1	0.0190	0.0051	13.90	0.0002	1.0192
Cash and short-term Investments	1	0.0179	0.0010	317.43	<.0001	1.0181
Preferred stock – liquidating Value	1	−0.0324	0.0091	12.63	0.0004	0.9681
Debt – subordinated convertible	1	0.0549	0.0272	4.09	0.0433	1.0565

considerations; that is, because the dependent variables had a range of one and the independent variables are in the unit of millions of dollars.

To summarize*, hypotheses H2 through H6 were supported statistically by the data*. For a given corporation, the predictors of backdating were <u>decreases</u> in either net sales or the liquidating value of preferred stock, or <u>increases</u> in any of the following: the “other” category of long-term debt, cash and short-term investments, or subordinated convertible debt.

Conclusions and Discussion

Controlling for industry-sector effects through matched pairs, corporate size through statistical analysis, and corporate form, we analyze the financial characteristics of backdating firms. First, we find that corporate MSF is related to executive backdating. We can draw several strong conclusions from our analysis as well as several general conclusions regarding backdating. Second, our analysis demonstrates that there is a definite well-defined financial structure of corporations in which illegally backdating executive stock options occurs. Backdating firms are smaller, that is, they have lower net sales than corporations in which executives do not backdate stock options. Thus, we support the finding of Heron and Lie (2007) that backdating firms are financially smaller than the average U.S. firm. In firms in which executives backdate their stock options, the liquidation value of the firms’ preferred stock is lower, thus increasing the likelihood that executives will backdate stock options to increase their stock value. Corporations in which executives backdate their stock options carry more debt than those firms that do not backdate their stock options. Both their long-term-debt and their subordinate convertible bonds debt are higher than in firms in which executives do not backdate stock options. Firms in which executives backdate stock options hold larger pools of cash and short-term investment than those in which executives do not backdate. Holding cash creates flexibility to buy and sell entities that later become subsidiaries of the parent company's multi-subsidiary holdings. It also allows corporations to easily transfer capital to and from the parent company, from its subsidiaries, and between its subsidiaries.

Significantly, the liquidity crisis and collapse of Enron, WorldCom, Adephia, Tyco, and several other major corporations in the first decade of the twenty-first Century, where backdating stock options took place, implicates the effects of executive decision making in U.S. corporations on stock holders and the public. The liquidity crisis has spread to investment banks (Bear Stearns, the fifth largest, and then, in September 2008, Lehman Brothers), the home mortgage industry where some companies were bailed out with taxpayer capital by the government (Fannie Mae and Freddie Mac, which owned and guaranteed $5 of the $12 trillion in U.S. home mortgages) and to others that were not bailed out (Countrywide Financial Corporation and IndyMac), and then to the economy in general.

On March 14, 2008, the Federal Reserve Bank, with consent of the Treasury Department, bailed out the largest banking conglomerate in the world, JPMorgan Chase & Company, with $29 billion in government guaranteed loans. Again, executives received extraordinary stock options. Within the month, the Federal Reserve Board provided emergency loans to the non-government insured investment banks. By July 2008, one-third of the 6,919 banks in the U.S. that report to the Federal Deposit Insurance Corporation (FDIC) exceeded 100% of their risk-based capital and were automatically on the government "watch list for bank failure" in the largest "illiquidity crises since the Great Depression". Later in 2008, as a result of the illiquidity of the two largest remaining investment banking firms, Goldman Sachs and Morgan Stanley, the Federal Reserve Bank of New York permitted them to restructure as commercial bank holding companies, which gave them access to the Federal Reserve Bank's lending and guarantees.

When the liquidity crisis reached its height in September 2008, the federal government made $200 billion available to financial firms. On September 17, the federal government committed $85 billion to bail out American International Group (AIG), the third largest U.S. insurance company. When it became obvious that the government could not solve the liquidity problems of all U.S. corporations, the Secretary of Treasury, Henry Paulson, obtained Presidential authority to stabilize the recession with $50 billion from the New Deal Treasury Department's emergency Exchange Stabilization Fund. The cost to the taxpayer of the $700 billion government intervention is on top of the $600 billion that the government has spent bailing out individual firms. Paulson later finally acknowledged that the "root cause" of the financial crisis is the "rot on corporate balance sheets." However, no explanation is given of why regulators were unaware of the liquidity problem of the largest U.S. corporations.

Since our research was completed, two of the largest U.S. industrial automobile corporations, General Motors and Chrysler Corporation, have filed for bankruptcy protection and received large bailouts, including a national program from the federal government to buy any "clunker" for $4,500 that could be towed to an automobile sales floor – a program costing the government approximately $2.9 billion (United States Department of Transportation 2009). It is evident that the liquidity problem is spreading from financial to industrial corporate America. Our research bridges the gap between those who would explain this crisis as deception of corporate executives and those who would explain it as the general characteristics of rotten balance sheets.

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Part IV
Health Demography

Chapter 13
The Health Transition in Estonia: Breaking Away from the Soviet Legacy*

Luule Sakkeus and Kati Karelson

Introduction

Estonia, with a total population of slightly more than 1.3 million in 2010, offers an interesting opportunity to investigate the health transition and its determinants. On one hand, Estonia has been among the forerunners of the demographic transition (Coale et al. 1979; Katus 1994). This implies that the so-called epidemiological transition follows the trends of that of Northern and Western Europe (Omran 1971; Caselli 1995). However, the occupation of Estonia by the Soviet Union, which began in the 1940s and lasted for almost 50 years, introduced other systems, one of which pertained to health care. Estonia was brought into this new system that aimed to tackle the challenges of the second and third stages of the epidemiological transition. These challenges had already been overcome by Estonia by the beginning of the occupation. The Soviet Union on the whole was still in the previously mentioned stages. Most of the measures introduced took into account the overall situation in which the diversity of the population was substantial. Therefore, the approach of this past regime and health policy ignored regional variations and was ill suited to the small population of Estonia. Estonia had by that time reached the threshold of the later phase of health transition, as defined by Vallin (2005).

* The preparation of the article has been supported by the Estonian Ministry of Education and Research target funded project Nos 0132703s05 and 0130018s11 and Estonian Science Foundation grants Nos 7619, 8325 and 8904.

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_13, © Springer Science+Business Media B.V. 2012

The impact of the Soviet health care system, vaunted as a means of conquering all diseases, suppressed any initiative on the part of the population itself and neglected preventive programs. Such programs as existed were mostly oriented toward combating infectious diseases rather than advocating for a healthy lifestyle and early detection (Hertrich and Meslé 1999; Meslé 2004; Cockerham et al. 2002). The results of this approach are clearly manifested in mortality stagnation, starting at the beginning of the 1960s and lasting for almost 40 years in Estonia (Katus and Puur 1997). The deterioration of health in Estonia during the economic transition in the early 1990s, after the restoration of independence, is the continuation of this long-term stagnation. Since the end of the 1990s life expectancy gradually increased and recent years' findings support our conviction that Estonia is the first country to break away from the Soviet legacy of population health development.

Significant changes in life expectancy (LE) and the nature of the causes of death that have occurred in the last few years lead us to focus on two main health challenges in the Estonian population: until recently, an ever-widening gender gap in LE, comprising one of the highest proportions of male excess mortality in Europe, and a persistent gap in LE between the immigrant and native populations. Another macro-level indicator, healthy life years (HLY), displays one of the lowest values in Europe (Eurostat 2010). Such indicators lead to the hypothesis that despite the changes in mortality, the population of Estonia is entering a phase of longer life with more restrictions, which was the characteristic of the developed world in the 1980s (van de Water 1997; Crimmins 1990; Crimmins and Ingegneri 1993). As some research has shown, in the beginning of a period when one enters a new phase of the transition, divergent trends can be seen among different population groups. Thus we should expect to see inequality between different population groups (Vallin and Meslé 2005). In order to understand better what has caused the low HLY values, we will analyze the indicator that is used in the formula for calculating HLY in European Union countries. In those countries HLY trend estimations are derived from the survey[1] question: "For at least the past 6 months, to what extent have you been limited because of a health problem in activities people usually do? Would you say you have been (1) severely limited (2) limited but not severely or (3) not limited at all?" This question is part of the Minimum European Health Module (MEHM), which contains two more questions in addition to the one mentioned above. The survey responses are linked to the relevant mortality patterns in the country, and healthy life years (HLY) are calculated using Sullivan's method (Eurostat 2007).

This analysis is based on the Estonian Health Interview Survey (EstHIS), which is part of the European Health Interview Survey (EHIS), carried out in 2006–2007. The EstHIS incorporates, in addition to the MEHM questions, a variety of background characteristics, information on physical and mental well-being, the onset and prevalence of chronic conditions, main lifestyle characteristics, health care utilization characteristics, as well as some major life careers (Oja et al. 2008; Eurostat 2007).

We are testing two main hypotheses:

1. In assessing the wide gender gap in LE and HLY, manifested in limitations on one's daily activities, we hypothesize that the probability of being limited in one's daily activities differs between men and women due to men's less favorable health

lifestyle factors and social disposition. In the case of men, chronic conditions that are mainly responsible for activity limitations are related to diseases that reflect excessive alcohol consumption and lifetime smoking habits.

2. Restrictions on daily activities are more prevalent among the native population. In the case of Estonia, due to excess mortality of the immigrant population, the surviving population is selective and might not be as likely to be restricted in their daily activities because of health problems as compared to the native population.

The use of the question on limitations on daily activities in assessing the probability of being disabled in the future is motivated by several reasons. In assessing trends in disability, it has long been stressed that disability is a social process. It arises from the loss or reduction of ability to perform activities pertinent to any social role due to a prolonged deterioration of health (Haber 1990; Verbrugge and Jette 1994). Thus, we will assess the main determinants and chronic conditions responsible for restricted ability to participate in society, which has significant implications for increasing the burden on households and society as a whole.

Multiple initiatives have been targeted at finding valid indicators that would reveal the factors connected with better quality of life at the national level. Gold et al. (1996) found that the Health Utility Index they developed is a useful indicator in predicting better health outcomes among those who obtain the highest scores in self-reported health. Erickson (1998) constructed the Health and Activity Limitation Index as a measure of health-related quality of life. It was initially designed for quality-adjusted years of life. He concludes that self-perceived health and activity limitation indicators measure different concepts of health. The latter characterizes a functional ability to cope with life.

Although self-perceived health has been reported in multiple studies to be a good predictor of subsequent mortality, it has some wider social connotations. Therefore, this indicator might measure not the health status but rather the overall perceptions of a society, in particular those in the process of radical transformation. Thus, based on the evidence from a series of cross-sectional studies developed for Finland and the Baltic countries, it has been found that other factors than health behavior patterns might have an impact on self-assessed health in the Baltic countries (Helasoja et al. 2007). These research outcomes motivated us to use the above-mentioned single question on restriction of daily activities. We have taken this as a proxy for more objective measures of a person's health status and his or her ability to function as a full member of society. In addition, this indicator provides a good means of evaluating which chronic conditions contribute most to restrictions in one's daily activities.

Background

The following analysis is based on the health transition concept, which has supplemented the concept of a purely epidemiologic transition by including broader societal responses like social conditions, behavioral changes, health policies, etc.,

Fig. 13.1 Life expectancy in Estonia, males and females 1897–2008; Estonians and Non-Estonians 1959, 1970, 1979, 1989, 1998, 2005–2010; Russia 1959–2009 (Sources: Katus and Puur (1992), Katus (2004) (up to 1959); Estonian Statistics database (2011), Human Mortality Database (2011). For earlier census years estimations on Estonians-Non-Estonians: Katus and Puur (1992)

aimed at bringing about significant improvements, i.e. transition (Caselli 1995; Vallin and Meslé 2005; Vallin 2005). During the last decades, research in the field of population health has focused on identifying a wider context that will aid in understanding the societal consequences of the inevitable ageing process that takes place in the developed world. As the population ages, the tension between “living longer” and health-related quality of life has become increasingly significant. During the transition, fatal diseases are replaced by non-fatal conditions that delay death, thus leaving societies to cope with an increasing proportion of disabled among the population.

Estonia entered the first health transition phase quite unmistakably at the end of the nineteenth century when life expectancy exceeded 40 years (Fig. 13.1, Katus and Puur 1997). The next 40 years brought about significant gains in life expectancy, comprising an annual average gain of more than 0.3 years in peacetime. By the beginning of the 1940s this period of calm had raised the life expectancy for males to 55 years and for females to more than 61 years. World War II and, for Estonia in particular, events related to the Soviet occupation and deportations had an impact on life expectancy. In 1950, average life expectancy decreased to a lower figure than at the beginning of the 1940s. However, the following decade was characterized by the fastest gains in life expectancy in its history. By 1960 male life expectancy had reached 64.7 and 73.0 years for women. With overall life expectancy at 69.3 years, Estonia was one of the European countries in the advanced first phase of health transition. For almost 40 years thereafter, the indicator fluctuated around that level (see Katus and Puur 1997). Only in the last few years, starting in 2005, has the life expectancy for males increased for the first time in almost 50 years. For females the increase in life expectancy beginning in 1996 accounted for 3.7 years in a 13-year time period.

Another feature of Estonian society is that it is characterized by one of the largest and oldest immigrant populations in Europe (Katus et al. 2003). Estonian immigration occurred in several waves and the immigrant population that remains in Estonia originates almost equally from each decade since World War II (Sakkeus 2007). According to the 2000 census, the foreign-born population comprised more than 18% and, together with the second generation, accounted for almost 30% of the population of Estonia (Statistics Estonia 2002). This immigrant population comes from various countries but mostly from former territories of the Soviet Union. However, almost 95% identify themselves as being of Russian ethnicity. From the wider demographic perspective the immigrant population has been characterized by significantly different trends and patterns. This is owing to the fact that it originates from countries that entered the demographic transition later and were experiencing phases of the health transition that had already occurred in Estonia (Coale et al. 1979; Katus 1994; Vishnevski 2006; Caselli 1995; Riley 2005).

In order to define the population of immigrant origin we have expressed cultural differentiation from the majority population by means of self-identification and place of birth. The immigrant population includes people whose parents were born outside the country of residence (see also Haug 2000). However, for macro-level health indicators, the calculations are derived only from differentiation according to the self-identification variable. Therefore, in life expectancy, standardized mortality rates, and years of healthy life, we distinguish between Estonian and non-Estonian populations. We acknowledge, however, that about 4% of the latter group can be described as a long-established national Russian minority. Their behavior patterns differ from Russians of immigrant origin (see Katus et al. 2000).

To account for the main developments in the immigrant population, life expectancy calculations are presented at several points over five decades. We are comparing them to the same indicator in Russia (Fig. 13.1). Life expectancy for the Estonian and non-Estonian populations over the last 50 years has gone through several phases. At the beginning of the 1960s the life expectancy of Estonian men was almost 3 years higher compared with the relevant non-Estonian population. This gap was reduced to almost equal values in the two subsequent decades, i.e. the convergence occurred in an unfavorable direction for the native population. Average life expectancy for the immigrant male population remained at the same level throughout these decades. The native male population lost 1.3 years life expectancy during the 1970s while the life expectancy of the immigrant male population did not change. The Soviet period was more favorable for the native female population than for its immigrant counterpart in terms of the development of life expectancy[1]. The period

[1]For comparative purposes, we have used the data from 1959–1989.

of economic transition had a more unfavorable effect on the immigrant male population, with a loss of more than 3 years LE in the 1990s. In the last decade the gain for both male populations has been similar, while somewhat favoring the immigrant population. Among women, the native population has made gains equal to immigrant males (almost 4.5 years between 1998 and 2008). It should be noted that over the 50-year period the gain for both male populations has been almost identical (5.3 years), i.e. the speed of transition has occurred at the same rate. The native female population has gained 9 years life expectancy during the past half century, as compared to 6 years for the immigrant population. Almost half of that gain has resulted from processes in the last decade. But as Vallin and Meslé (2005) point out, with higher levels of mortality, or with a younger age structure, the same rate of decrease in mortality produces a higher increase in life expectancy. It should be noted that the Estonian population has an older age structure.

In addition to the trends in general life expectancy, an underlying trend is that the male population in Estonia has diverged significantly from its female counterpart during the health transition. The widening gap in their life expectancies, now almost 11 years, predicts that the female population might be entering the next stage of the health transition, while the male population has not yet come through the initial stage. Nevertheless, the last decade has brought about a change for the male population as well, as the annual gain in life expectancy has for the first time since the 1950s been greater for males than for females, accounting for an average of 0.38 years annually from 2000 to 2008. Bearing in mind the considerable difference in LE of the genders, one of the aims of the present analysis is to understand what is responsible for the substantial gender difference in the health of the population of Estonia.

Developments in the life expectancy of the native and immigrant populations compared with the same findings for Russia reveal the fact that although the immigrant population of Estonia is reflecting similar trends to those of its country of origin, the periods of crisis have not resulted in levels among the immigrant population lower than in their country of origin. Although recently similar trends have become visible also in Russia, life expectancy among the immigrant population in Estonia has increased significantly. That fact has led to the hypothesis that the selectivity of the immigrant population of Estonia, in particular their higher levels of educational attainment, which often is associated with better health outcomes, is mediating the positive effect (Shkolnikov et al. 2006).

It has been suggested that despite the radical change in the diseases that occurs during the health transition, and the risk factors that are presumed to explain them, the association between socio-economic status and mortality has persisted over time, thus elevating the position of socio-economic status to that of a 'fundamental cause' for persisting inequalities in population health (Phelan et al. 2004; McDonough and Berglund 2003; Cornia and Menchini 2006). As mentioned above, socio-economic differences as evidenced by the widening gap in educational levels have been found to explain the major dissimilarities in life expectancy patterns for Estonia (Shkolnikov et al. 2006). Recent studies of health inequalities in 22 Western and Eastern European countries suggest, however, that 'although inequalities in health associated with socioeconomic status are present everywhere, their magnitude is highly variable, particularly for inequalities in mortality.' (Mackenbach et al. 2008). The authors believe that such an outcome provides hope that the situation is amenable to improvement. Recent studies have shown that the effect of socio-economic status might not be as straightforward and differences could be attributed rather to methodological problems of data collection (as concerns socio-economic status after the person is dead) (Shkolnikov et al. 2007). For our analysis the reverse connotations of the value of education and occupational status, pertaining to a section of the population from the Soviet period, provide room for interpretation.

A new phase in the health transition is often accompanied by structural changes in the causes of death (Caselli 1995; Vallin and Meslé 2005; McMichel et al. 2004). The phase in which mortality due to circulatory diseases is dominant is followed in the next phase by higher proportions of mortality due to cancer and other diseases such as those of the respiratory or digestive systems (Caselli 1995; Vallin and Meslé 2005; Vallin 2005). In the following three figures (Figs. 13.2, 13.3, 13.4) we illustrate the development of the three main causes of death in the population of Estonia compared to the average indicator in 27 member states of the European Union (EU27).

One of the main differences between other European countries and Estonia is the high incidence of circulatory diseases in the latter, which even in recent years comprises almost half of all causes of death. Although the standardized mortality rates due to circulatory diseases have been diminishing in Estonia over the last decades, the rates remain nearly twice as high for both men and women compared with the average of the 27 countries of the European Union. Similarly, standardized rates for Estonians and Non-Estonians confirm the decreasing mortality trend for both population groups; however, for the Non-Estonian male population the difference is even greater (Fig. 13.2).

The second main cause of death – mortality due to malignant neoplasms – is fluctuating at around 30% higher rates among the male population compared with the EU27 average; a clear downward trend has been manifested only in recent years. For the female population the standardized mortality rates due to this cause are very similar in Estonia and Europe. There is a difference of 5–6% in mortality rates between the immigrant and native populations in favor of the latter (Fig. 13.3).

One of the reasons for excess mortality in the Estonian population compared with its European counterparts, aside from the high incidence of circulatory diseases, has been high mortality rates due to external causes. For the male population, the rates are still more than three times the EU27 average, despite the fact that from 1997 to 2008 there has been a decrease of over 40%. At that rate, mortality due to external causes is decreasing twice as fast as in Europe on average. The same is true for the female population; however, the Estonian rates are still twice as high. Another favorable trend is the diminishing difference in mortality between the native and immigrant populations over the last few years due to the change in external causes (Fig. 13.4).

To summarize, one could say that the recent trends in the structure and level of causes of death in the Estonian population indicate an improvement. In particular, avoidable deaths in the 0–64 age group from all these causes show a substantial decrease in recent years (WHO Health-for-All Database 2010). Standardized mortality

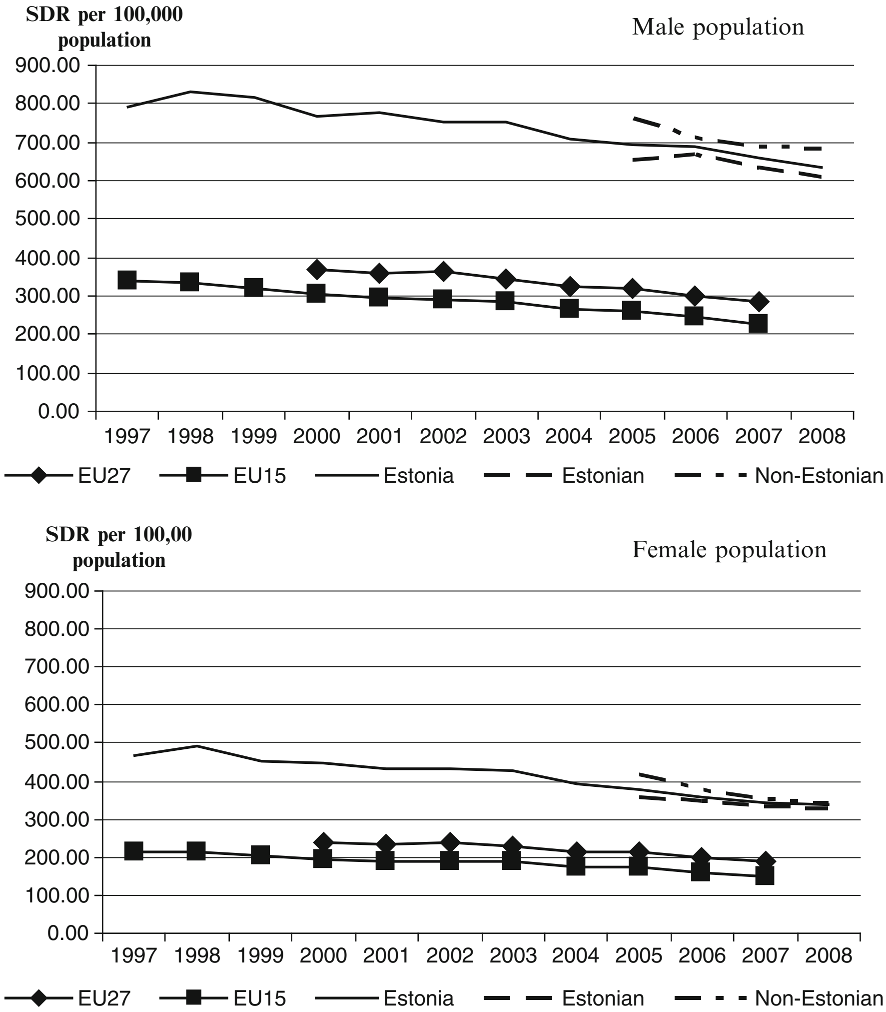

Fig. 13.2 Standardized mortality rates due to circulatory diseases by gender, Estonia, EU27, EU15 for 1997–2007; Estonians and Non-Estonians 2005–2008 (Source: Eurostat (2010))

rates from circulatory diseases in the 0–64 age group for the female population of Estonia have fallen to the EU27 average during the last 4 years. Due to advances in knowledge about health and the main risk factors affecting quality of life, the health care system is also responding better. Thus, previously under-diagnosed diseases of the respiratory system, diabetes, and diseases of the endocrine system are showing increasing trends and reaching the levels of the EU27 average (Meren et al. 2005; WHO Health-for-All Database 2010). On the other hand, Estonia is also characterized by an increase in diseases related to long-term alcohol consumption. Therefore,

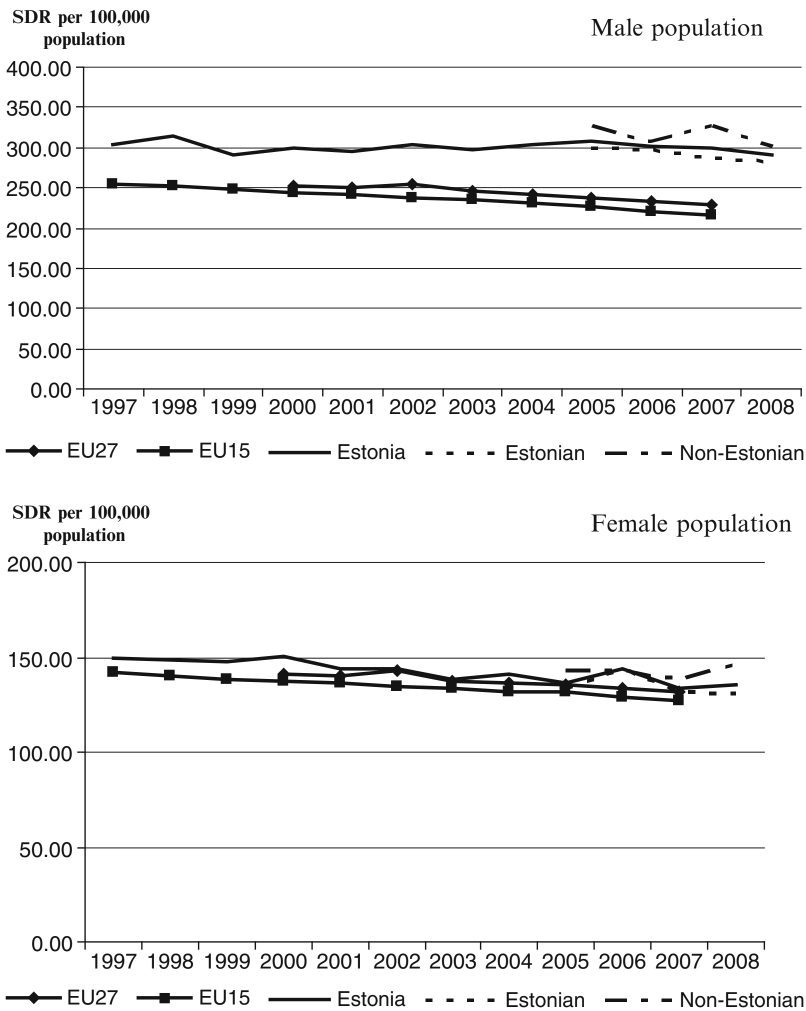

Fig. 13.3 Standardized mortality rates due to malignant neoplasms by gender, Estonia, EU27, EU15 for 1997–2007; Estonians and Non-Estonians 2005–2008 (Source: Eurostat (2010). Unpublished estimations of Estonian Statistics 2005–2009)

mortality due to mental and behavioral disorders due to the use of alcohol and alcoholic cirrhosis of the liver have shown increasing trends for both men and women in recent years, substantially exceeding the EU27 average (Sakkeus 2008). Although alcohol-related causes of death can be affected by diagnostic procedural practices (Ramstedt 2002), this trend clearly indicates that health outcomes are still very much related to lifestyle and health behaviors in Estonia.

Despite the conflicting trends in causes of death described above, increased life expectancy has become a trend in Estonia. In these circumstances the question to be

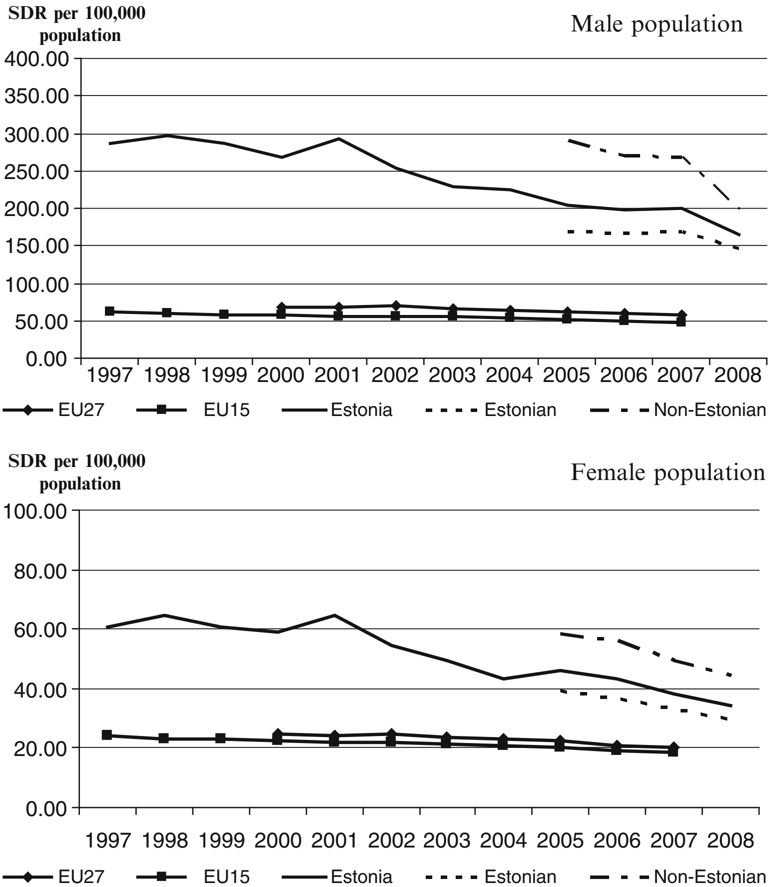

Fig. 13.4 Standardized mortality rates due to external causes by gender, Estonia, EU27, EU15 for 1997–2007; Estonians and Non-Estonians 2005–2008 (Source: Eurostat (2010). Unpublished estimations of Estonian Statistics 2005–2009)

asked is whether the years gained are spent actively and in good health or whether they result in a longer period in inactivity with diminished quality of life. Since the 1960s researchers have grappled with these questions trying to find measures combining morbidity and disability that would better describe a person's health status (Sanders 1964; van de Water 1997; Cambois and Robine 1999; Robine et al. 2007).

In 2004, the European Commission incorporated a measure of disability-free life expectancy – healthy life years – into the EU-wide Survey on Income and Living Conditions (SILC) as one of the main structural indicators for measuring the comparative health status of populations across nations (Eurostat 2010). By this indicator, Estonia is one of the European countries with the lowest levels for both men and women (Fig. 13.5). Although the wide gender gap of about 10 years in life expectancy is reduced to 4 years in terms of healthy life years, the divergence of Estonia

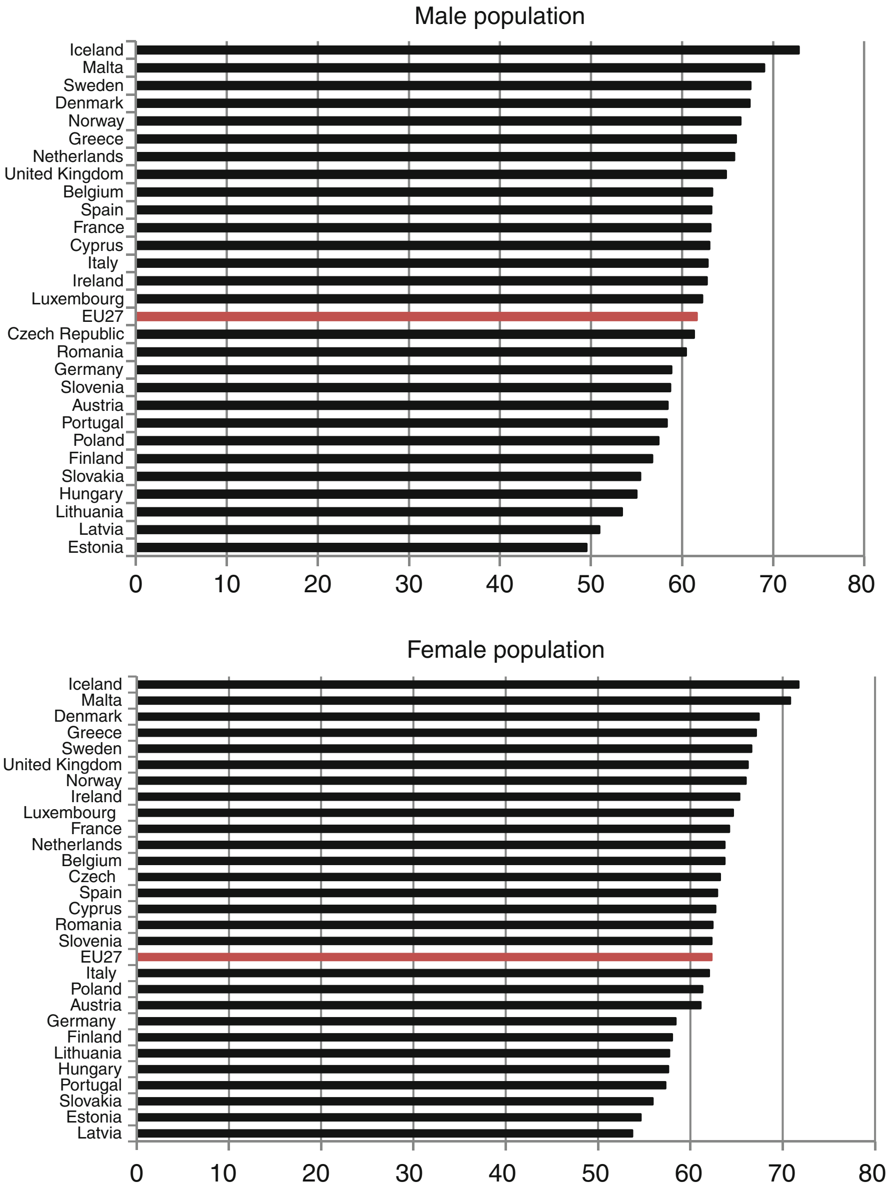

Fig. 13.5 Healthy life expectancy in EU countries by gender, 2007 (Source: Eurostat (2010))

from other European countries has increased. The 6-year difference in male life expectancy between Estonia and the European average has increased to a 12-year discrepancy in healthy life years (HLY), and for females the 3-year difference in life expectancy has increased to 8 years according to HLY (Eurostat 2010). This suggests that the female population of Estonia has to spend more than twice as long as its European counterparts in a health status that limits their everyday activities.

The recent comparative study of healthy life years at age 50 for 25 European countries showed a greater variability among countries than did life expectancy, and generally speaking, the ten countries that have most recently joined the EU had fewer HLYs (Jagger et al. 2008). According to the authors, the findings indicate that Estonia belongs to the lowest group. They also note that the fact that the age to which men can expect to live without limitations on their activities in these countries (including Estonia) is much less than 65 years, thus challenging the overall European target to increase the participation of older people in the labor force (Jagger et al. 2008). However, this assumption contradicts the reality in the case of Estonia: according to Eurostat estimates the average age of exit from the labor force has been more than one year higher during the last 9 years, except for 2003, than the European average (Eurostat 2010), equaling 62.1 years in 2007. Similarly, the employment rate among the 55–64 year age group was 59.1% in 2007, whereas the EU27 average was 44.7% and the OECD average was 53.7% (OECD Factbook 2009). Thus, Estonia also presents an interesting opportunity to study how high labor force participation at older ages with such low quality of life as expressed in HLYs is maintained in the population.

Refinements in survey methodology in the field of population health in the 1970s have enabled researchers to examine the relationship between self-perceptions, risk factors, functional limitations, and more objective chronic conditions and to study the disparities among different population groups with respect to their quality of life. It has been well established that self-perceived health status has been a good predictor of several health outcome indicators, mortality in particular. However, this powerful measure has not been as useful in determining the status and quality of life before it terminates. For that reason, the research community has sought indicators that would better encompass functional limitations and the ability to perform (see Gold et al. 1996; Erickson 1998; van de Water 1997). Health expectancies were developed to bring a quality-of-life dimension to life expectancy and to establish whether the yearly increases in life expectancy are accompanied by decreases in unhealthy life years (known as the compression of morbidity hypothesis) or increases in unhealthy life years (expansion of morbidity), or whether there are intermediate scenarios such as dynamic equilibrium in which the increases in years spent in poor health are offset by a decrease in the mean level of severity of the prevalent disability (Sanders 1964; Fries 1980; Manton 1982; Robine et al. 2008). Therefore, if future increases in life expectancy are due to better behaviors, they could also be accompanied by larger increases in disability-free life expectancy leading to a compression of disability.

In order to measure this process, disability-free life expectancies were introduced. However, in most countries these have been developed on the basis of different estimates. In Europe this discrepancy was meant to be overcome by the pre-harmonized survey questions in SILC and EHIS. The Estonian HIS offers one of the first possibilities to study the main determinants of quality of life at the national level in a way that would be comparable with future studies, based on similar survey instruments.

After the developed world entered the so-called cardiovascular transition, it became clear that quite often the main determinants of ill health and lower levels of quality of life lie in our own actions and behavior patterns. The impacts of the main health determinants related to one's lifestyle have been widely studied (Verbrugge 1985; Shields and Shooshtari 2001). However, they have been mainly examined from the viewpoint of individual characteristics. On the basis of a survey that monitors the principal health behavior indicators in Estonia, the health lifestyle does not in general show much improvement (Tekkel et al. 2009). Concerning smoking habits, trends among daily smokers from 1990 to 2008 show a small reduction for men (from 44% to 38%), whereas the trend for women (among whom the percentage of smokers is half that of men) shows no clear direction, except for the fact that in the last few years there are fewer smokers in the younger age groups. Alcohol consumption and binge drinking are major health behavior concerns in Estonia; those who engage in binge drinking (more than 6 units at a time) at least once a month comprise 44% of men and 12% of women in 2008. Some studies of drinking patterns suggest that several campaigns initiated in Estonia to increase the population's knowledge about such bad habits have not yet had much effect and that the behavior is becoming more prevalent among young adults and women in all the North Eastern countries of Europe (Helasoja et al. 2007). The studies have also found that no major changes have emerged in daily smoking, consumption of strong alcoholic beverages, and leisure-time physical exercise (Puska et al. 2003). This suggests that in addition to health behavior patterns we have to look for other variables underlying possible improvements in health outcomes in order to understand their impact on one's quality of life.

Relying on Sewell's (1992) concept that mutually sustaining schemas and resources empower or constrain social action and tend to be reproduced by that social action, Cockerham (2005) has tried to develop a wider context encompassing health lifestyle. He identifies a particularly passive approach to health lifestyles as one of the determinants of a totalitarian system (which he defines as one characterized by Communist ideology) (Cockerham et al. 2002). Cockerham (2005, p. 61) comments: "The influence of exterior social structures and conditions are incorporated into the habitus, as well as the individual's own inclinations, preferences, and interpretations. The dispositions that result not only reflect established normative patterns of social behavior, but they also encompass action that is habitual and even intuitive. Through selective perception the habitus molds aspirations and expectations into 'categories of the probable' that impose perceptual boundaries on dispositions and the potential for action." In our analysis we try to determine the impact of such a social disposition, which we think might have a greater effect on health outcomes than actual behavior patterns.

The nature of the main diseases associated with mortality leads to the hypothesis that health lifestyle factors such as heavy alcohol consumption and binge drinking, a high incidence of smoking, and reduced physical activity in the later working ages are primarily responsible for the inferior health of the male population, especially the population of immigrant origin. All of these factors tend to contribute to mortality from man-made diseases, thereby preventing the emergence of a new phase of the health transition. However, the difference in HLY between the native and immigrant populations persists and the answer is to be found in the differentials.

Women tend to be less affected by man-made diseases. Is the wide gender gap – a manifestation of better health behaviors among the female population – pointing to an impending cardiovascular revolution in Estonia? Although the gap between the native and immigrant female populations is less than that in the male population, the main determinants of the differential are being sought. There have been several studies on the topic of sex differentials. In surveys in which subjective health indicators are used, it has often been found that women tend to report less severe conditions more readily and thus self-reporting tends to overstate the poor health of women, despite the fact that these conditions are not resulting in higher mortality (Spiers et al. 2003; Idler 2003). Case and Paxson have found that the difference in self-assessed health between women and men can be entirely explained by differences in the distribution of health conditions. Although women have, on average, poorer self-rated health than men, women and men with the same chronic conditions have identical self-rated health (Case and Paxson 2005, p. 191). That finding has motivated us to include the most important chronic conditions in our analysis.

In conclusion, we are attempting to identify the main determinants of higher HLY, thus enabling public policies to focus on measures promoting a general increase in life expectancy and enhancing quality of life while life expectancy is improving.

Data and Methods

Our analysis is based on data from the 2006 Estonian Health Interview Survey (Estonian HIS) – a representative survey of the population conducted by the National Institute for Health Development. The Estonian HIS incorporates the European Health Interview Survey (EHIS) modules. EHIS is included in the European Statistical Program administered by Eurostat.

The sample frame of the survey was taken from the Population Registry. The sample consists of individuals aged 15–84 years. The selection procedure comprised two stages. First, the sample was selected by the stratified systematic sampling method in which place of residence and the age of the individual were taken into account. Second, random sampling was carried out independently in each stratum. Within the Estonian survey, 6,434 respondents were interviewed face-to-face using the PAPI method. The response rate was 60.2%. Interviews were conducted over a 12-month period to even out seasonal factors. Data were weighted according to the size of the target population and the sample in each stratum in order to be nationally representative (see Oja et al. 2008).

In addition to EHIS modules, the Estonian HIS covers a range of topics related to changes in the respondent's socio-economic status (employment and education), health and its determinants (chronic diseases, health behavior, health care utilization), social activity, and childhood home characteristics, as well as attitudes toward life. The survey completely or partially covers some of the main life events (partnerships, pregnancy, employment, residential mobility) and provides the basis for richer exploration in the future. In the current analysis we restrict ourselves mainly to cross-sectional analysis; however, some of the selected covariates are characterized by persistent behavior patterns over one's lifetime.

Dependent Variable

Our main research question is related to limitations in daily activities as the proxy for disability. Limitations in daily activities were calculated on the basis of the third question in MEHM that asks about the existence of limitations in usual activities because of any health problem. The limitations should have lasted for at least the past 6 months. The response categories were "no limitations", "limitations that are not significant," and "significant limitations". In our analysis, the population without any limitations forms a reference group compared with those who are limited in their everyday activities.

Independent Variables

Demographic Characteristics

The demographic characteristics of the model include age, gender, nativity, and cohabitation status. Age was calculated for each respondent in full years as of January 1, 2006. The nativity variable divides the population into two groups – immigrants and natives. The native population includes people born in Estonia or who have at least one parent born in Estonia. The married or cohabiting population comprises those living with a partner irrespective of legal marital status. This variable partly accounts for existing social networks.

Table 13.1 presents the means and standard deviations for all population groups under examination. According to the survey data, men in the population are approximately 1 year younger than women. The immigrant population in Estonia is older than the native population by more than 1.5 years. The immigrant population accounts for more than 30% of the total population and is almost equally distributed across gender. As concerns partnership status, men and the immigrant population are much more likely to be in a partnership. It should be noted that the native and immigrant populations differ to a great extent in partnership behavior, cohabitation being much more prevalent in the native population, although the immigrant population displays a somewhat higher proportion of individuals in partnerships (at the expense of those who are married). We would expect to find that partnership is significant in the immigrant and male populations.

Education and main lifetime occupation are used for measuring socio-economic status. Level of education was determined by educational level last attained and coded according to UNESCO's International Standard Classification of Education (ISCED-97) into three categories: basic education or lower, secondary education (levels 3–4), and higher education (from level 5 upwards). The main lifetime occupation variable was formulated using the International Standard Classification of Occupations (ISCO-88). White-collar occupations include those that represent occupational groups 0–5 and the rest are classified as blue-collar. In cases where the

Table 13.1 Means and Standard Deviations of Covariates

	Total population		Native population		Immigrant population		Men		Women	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Limited in everyday activities										
Demographics										
Age	50.30	20.36	49.87	20.63	51.25	19.71	49.83	20.70	50.74	20.02
Age squared	2944.59	2026.18	2912.85	2045.95	3014.52	1980.65	2911.96	2044.24	2975.14	2008.96
Gender (female=1)	0.52	0.50	0.51	0.50	0.52	0.50	–	–	–	–
Nativity (immigrant=1)	0.31	0.46	–	–	–	–	0.31	0.46	0.32	0.47
Married or cohabiting (married or cohabiting=1)	0.59	0.49	0.58	0.49	0.60	0.49	0.68	0.47	0.50	0.50
Socio-economic Status										
Education (comp=basic)										
secondary education	0.45	0.50	0.45	0.50	0.46	0.50	0.48	0.50	0.43	0.49
higher education	0.31	0.46	0.30	0.46	0.32	0.47	0.28	0.45	0.34	0.47
White collar (white collar=1)	0.51	0.50	0.53	0.50	0.46	0.50	0.37	0.48	0.64	0.48
Accessibility										
Urban residence (urban=1)	0.78	0.41	0.70	0.46	0.96	0.20	0.77	0.42	0.79	0.41
Health insurance (yes=1)	0.03	0.17	0.03	0.16	0.04	0.20	0.04	0.20	0.02	0.14
Health Behaviours										
Has ever been binge drinker (yes=1)	0.34	0.47	0.37	0.48	0.29	0.45	0.43	0.50	0.26	0.44
Has ever been regular smoker (yes=1)	0.42	0.49	0.42	0.49	0.42	0.49	0.62	0.48	0.23	0.42
Poor BMI results (under and overweight=1)	0.55	0.50	0.54	0.50	0.56	0.50	0.55	0.50	0.54	0.50
Poor nutrition (yes=1)	0.18	0.38	0.18	0.38	0.17	0.37	0.21	0.41	0.14	0.35
Physically inactive (yes=1)	0.17	0.37	0.15	0.36	0.20	0.40	0.16	0.37	0.18	0.38
Illegal drug user (yes=1)	0.08	0.27	0.08	0.28	0.07	0.26	0.13	0.33	0.03	0.18
Risky sexual behaviour (yes=1)	0.07	0.26	0.07	0.25	0.08	0.27	0.11	0.32	0.03	0.17

Social Disposition										
Internal locus of control (yes=1)	0.43	0.50	0.43	0.50	0.43	0.50	0.47	0.50	0.40	0.49
External locus of control (yes=1)	0.08	0.27	0.06	0.23	0.12	0.33	0.07	0.25	0.09	0.28
Loneliness (severe and very severe=1)	0.07	0.26	0.05	0.23	0.12	0.32	0.07	0.25	0.08	0.27
Chronic conditions										
Has ever had an injury (yes=1)	0.26	0.44	0.25	0.43	0.28	0.45	0.30	0.46	0.22	0.41
Has ever had an episode of depression (yes=1)	0.29	0.45	0.29	0.45	0.30	0.46	0.21	0.41	0.37	0.48
Has heart disease (yes=1)	0.09	0.28	0.07	0.26	0.11	0.31	0.08	0.27	0.09	0.29
Has diabetes (yes=1)	0.04	0.20	0.04	0.19	0.06	0.24	0.04	0.19	0.05	0.21
Has high blood pressure (yes=1)	0.22	0.42	0.22	0.41	0.24	0.43	0.19	0.39	0.25	0.44
Has cancer (yes=1)	0.02	0.14	0.02	0.13	0.02	0.14	0.02	0.14	0.02	0.14
Has respiratory diseases (yes=1)	0.04	0.20	0.03	0.18	0.07	0.25	0.04	0.19	0.05	0.22
Has thyroid disorders (yes=1)	0.03	0.17	0.03	0.16	0.03	0.18	0.00	0.06	0.05	0.23
Has diseases of the digestive system (yes=1)	0.10	0.30	0.08	0.27	0.15	0.36	0.09	0.28	0.11	0.32
Has diseases of the musculosceletal system (yes=1)	0.20	0.40	0.20	0.40	0.21	0.41	0.18	0.38	0.22	0.42
Has eye diseases (yes=1)	0.05	0.22	0.05	0.21	0.06	0.24	0.05	0.21	0.05	0.22
	N=6434		N=4425		N=2009		N=3111		N=3323	

Source: EstHIS 2006

main lifetime job was not specified by a respondent, the most recent job was used for coding purposes. In our analysis, those who have not yet had a working career or who have never worked (who constitute a small group) are included with those with blue-collar occupations in the reference group.

Compulsory secondary education was instituted in the early 1970s during Soviet times in Estonia. However, it should be noted that education was not an important indication of socio-economic status during the Soviet period. Blue-collar workers earned higher incomes in accordance with Soviet ideology. A significant increase in the prevalence of higher education in the last 20 years has not been accompanied by a corresponding increase in income distribution. Because of the high turnover in the immigrant population over the decades (only every fifth within the turnover remained in Estonia), that population has become more educated than the native population (Sakkeus 2007). In the survey population (aged 15–84) 78% of the immigrant population versus 75% of the native population possess a higher than basic education. However, blue-collar jobs predominate as the main lifetime job of immigrants. Differences in socio-economic status between men and women are much greater than between the previously described subpopulations. Men are much more likely to have only a secondary education while women are more likely to have higher education; however, the proportion with lower levels of education is similar across gender. In occupational distribution there is a 1.7 times higher proportion of women in white-collar occupations (mostly engaged in the service sector) than men. Therefore in our analysis we expect occupation to be related to health differentials both for gender and nativity.

Characteristics of Area of Residence and Availability of Health Insurance

The ‘insurance’ variable describes whether a person has health insurance regardless of whether it is private (voluntary) or public (compulsory). Area of residence was classified as urban or rural according to a population density of 100 people per square kilometer, taking into account the generally low population density in Estonia (32 persons per sq km). The percentage of uninsured is low (3.1%); however, the variable is 1.5 times higher for the immigrant population and more than two times higher for men than women. As expected, the immigrant population is predominantly urban, whereas 30% of the native population resides in low-density rural areas. Both variables are expected to show the impact of access to the health care system; however, for the immigrant population these two variables might counteract each other.

Characteristics of Health Behavior

Health behavior is determined by regular smoking, binge drinking, physical activity, nutrition, body mass index (BMI), drug usage, and risky sexual behavior. The variable accounting for smoking habits includes those who have ever been regular smokers, i.e. had smoked daily or almost daily for at least 1 year in their lifetimes. Binge drinking is defined by whether a person had ever consumed at least five units of alcohol at once in his or her lifetime. The physically inactive population has never engaged in sports nor done any light, moderate, or heavy physical activity in the 4 weeks previous to the interview. Unhealthy nutrition habits are ascribed to those who always add salt to their food, mainly use animal fat for cooking and do not eat vegetables or fruits regularly. Problems with BMI encompass both underweight (BMI < 18.5) and overweight (BMI > 25) individuals. Drug usage applies to the population that has ever used any illegal drug. In most cases people had consumed cannabis and its byproducts. The use of cannabis is prevalent among the native and male populations. However, among the immigrant population, there are more people who have become addicted to strong drugs but never tried cannabis (EMCDDA 2009). These subgroups are not well populated enough to be described by the sample size of the referenced survey. Risky sexual behavior comprises several variables: whether one has had sexually transmitted diseases during the past 12 months, has ever been paid for sexual intercourse, has had several partners in the past 12 months and did not use always a condom with those partners, or thinks that he or she might get HIV during his or her lifetime. Additionally, men who have ever had sexual intercourse with other men were coded as belonging to the population with risky sexual behavior. The last two variables are included in order to account for new risky health behaviors among young adults, because drug users are the main group at risk for contracting HIV in Estonia.

The distribution of these variables in the survey population displays high percentages for almost all indicators; only the newer health behaviors related to the younger generation such as drug usage and risky sexual behavior are lower than 10%. With almost all types of health behavior, risky behavior is more prevalent in men, with regular smoking (62%), unfavorable BMI (55%), binge drinking (43%) and unhealthy eating habits (21%) at the top of the list. Among women the sequence of the behaviors, although they are less prevalent, is similar to that of men, except that the fourth place is occupied by physical non-activity (18%); on this indicator women score lower than men. The sequence of poor lifestyle habits is similar between the native and immigrant populations, again except for physical non-activity, which is more prevalent in the immigrant population.

Characteristics of Social Disposition

Social disposition is described by locus of control and loneliness variables. Internal locus of control characterizes a psychological tendency to perceive oneself as being in control of one's life. A person with external locus of control believes that his or her life is guided by external forces. The variable is based on the respondent's answers to three pairs of questions that had different sets of possible responses. Loneliness is attributed to those who report feelings of severe or very severe loneliness. These categories are calculated on the basis of the Loneliness Scale (de Jong Gierveld and van Tilburg 1999).

Internal locus of control is prevalent in more than 43% of the survey population, including more than 47% of men. We expect that this factor will counteract several other health behaviors and that it will be significant in reducing the number of years a person will live with activity limitations. Although the proportion of those who rely mostly on others is less than 10%, the fact that the incidence of external locus of control is almost twice as high among the immigrant population might more negatively affect their future health outcomes as compared with the native population. The fact that women rely more on others, although to a lesser extent than the immigrant population, might also have an unfavourable impact on their health outcomes. Loneliness as a variable indicating fragile social networks has been found to be significantly associated with health outcomes (Dykstra et al. 2005). Severe and very severe loneliness, which is twice as prevalent among the immigrant population, might affect their health outcomes to a greater extent, whereas gender differences are not as significant.

Characteristics of Chronic Conditions

Most of the indicators of chronic conditions relate to diagnoses that have ever been confirmed by physicians and have also persisted over the past 12 months. Some variables comprise a group of diagnoses, e.g. diseases of the heart (myocardial infarction, cardiac ischemia, stroke), respiratory system (asthma, allergy, chronic obstructive lung disease or emphysema, lung tuberculosis), digestive system (gastric or duodenal ulcer, gastric or duodenal inflammation, hepatitis, inflammation of the gallbladder and/or gallstones, nephritis), eyes (cataract, glaucoma) and musculoskeletal system (radiculopathy or back pain, rheumatoid arthritis, osteoporosis). Incidence of injury means that at least one event has caused an individual to withdraw from usual activities for at least 4 weeks in his or her lifetime. An episode of depression is determined on the basis of information about whether for a minimum of a 2-week period (according to the M.I.N.I structured diagnostic psychiatric interview, see Sheehan et al. 1998) the individual has ever felt less interest in most things, less capable of being happy about things that have usually pleased him or her, or ever felt depressed or down-hearted every day for a period of 2 weeks in his or her lifetime.

The most prevalent diseases that can affect one's ability to cope with everyday activities are depression (29%), serious injuries (26%), high blood pressure (22%), and musculoskeletal diseases (20%). The prevalence of all other diseases in the total population remains around 10% or lower. The order of the diseases by prevalence is the same between the native and immigrant populations; however, all conditions are more prevalent in the latter population. Diseases of the respiratory and digestive systems are more than two times more prevalent among the immigrant population, with diseases of the digestive system amounting to 15%. These last observations conflict somewhat with the variables describing lifestyle habits, according to which smoking and binge drinking are more prevalent in the native population. It might be that the immigrant population gives the "expected" answers to the questions related to the variables describing health behaviors, and for that reason the answers should not be taken at face value. As one might predict, serious injuries are more prevalent in men's lifetimes (30%), followed by depression, high blood pressure, and problems related to the musculoskeletal system. Among women the most prevalent are the episodes of lifetime depression (37%), followed by high blood pressure, musculoskeletal diseases, and injuries. All chronic conditions accounted for are comparatively more prevalent among women, except for injuries.

Methods

Multivariate analysis was performed by binary logistic regression using SPSS (16.0). The aim was to determine the predictors of limitations in daily activities due to health problems. Five different models with six steps each were formulated to test the predictive power of the determinants of health status. Covariates were included in stages. The first components of the model are the demographic characteristics, followed by the socio-economic, residential, and insurance information, health behavior, and social disposition variables. The final model includes chronic conditions in addition to the previously mentioned indicators. In the first phase, four separate models were constructed for the different population subgroups. The impact of the health determinants on the activity limitations of the immigrant and native, as well as the male and female, populations was assessed in separate models. The coefficients were compared and their significance assessed to examine which determinants have more predictive power in the case of a particular subpopulation. Next, the models were combined for the total population to analyze how the selected covariates operate across the sample and whether the significant differences across investigated sub-populations remain when controlled for the main risk factors.

Results

In assessing the main determinants behind the wide gender gap in both life expectancy and healthy life years, it becomes evident that different factors determine the quality of life of men and women. If controlled for the main socio-demographic, socio-economic, health lifestyle, and social disposition variables, the diseases that contribute to the probability of men being limited in their everyday activities are significantly different from those that are more prevalent in the descriptives of the population (Table 13.1). If the small group with thyroid disorders, which increase the probability of activity limitations more than 12 times, is disregarded, the most challenging chronic conditions resulting in activity limitations for men are heart diseases (7.4 times), diseases of the musculoskeletal system (6 times), diabetes and the small group with cancer (more than 4.5 times), followed by diseases of the respiratory and digestive systems (around 3.5 times) (Table 13.2). Among women, disregarding the small group with cancer, which contributes to activity limitations by 8.1 times, heart diseases (5.1) and diseases of the musculoskeletal system (4.4)

Table 13.2 Binary logistic regression of limited in daily activities across gender and nativity

	Men	Women	Native population	Immigrant population
Demographics				
Age	1.033	1.036*	1.038*	1.017
Age squared	1	1	1	1
Gender (female = 1)			1.109	0.991
Nativity (immigrant = 1)	1.299*	1.193		
Married or cohabiting (married or cohabiting = 1)	0.993	1.085	0.975	1.417*
Socioeconomic Status				
Education (comp = basic)				
secondary education	0.868	0.642***	0.793*	0.596**
higher education	0.738	0.576***	0.683**	0.615*
White collar (white collar = 1)	0.941	0.858	0.797*	1.094
Accessibility				
Urban residence (urban = 1)	0.804	0.984	0.916	0.787
Health insurance (yes = 1)	1.282	0.997	1.062	1.261
Health Behaviors				
Has ever been binge drinker (yes = 1)	1.233*	0.978	1.096	1.229
Has ever been regular smoker (yes = 1)	1.128	0.974	1.08	1.018
Poor BMI results (under and overweight = 1)	1.121	1.28*	1.302**	0.925
Poor nutrition (yes = 1)	1.011	0.988	1.025	1.049
Physically inactive (yes = 1)	1.367*	1.209	1.487*	0.919
Illegal drug user (yes = 1)	1.259	1.287	1.327	1.054
Risky sexual behaviour (yes = 1)	0.95	0.828	0.849	0.906
Social Disposition				
Internal locus of control (yes = 1)	0.819	0.766**	0.899	0.604***
External locus of control (yes = 1)	2.476***	2.009***	2.267***	2.078***
Loneliness (severe and very severe = 1)	1.685**	1.676**	1.647**	1.767**
Chronic conditions				
Has ever had an injury (yes = 1)	1.353**	1.208	1.226*	1.337*
Has ever had an episode of depression (yes = 1)	1.839***	1.557***	1.685***	1.67**
Has heart disease (yes = 1)	7.361***	5.131***	6.495***	5.54**
Has diabetes (yes = 1)	4.818***	1.989**	2.449***	5.011**
Has high blood pressure (yes = 1)	2.666***	2.374***	2.053***	4.504**
Has cancer (yes = 1)	4.648***	8.117***	8.863***	3.233*
Has respiratory diseases (yes = 1)	3.537***	2.676***	2.611***	3.772***
Has thyroid disorders (yes = 1)	12.152*	1.457	1.842*	1.128
Has diseases of the digestive system (yes = 1)	3.459***	2.72***	2.551***	4.234***
Has diseases of the musculosceletal system (yes = 1)	6.044***	4.433***	5.024***	5.172***
Has eye diseases (yes = 1)	2.284**	1.349	2.051***	0.961

*p<.05 **p<.01 ***p<.001
Source: EstHIS 2006

are followed by diseases of the digestive and respiratory systems (2.7). In general, all 11 chronic conditions significantly raise the probability that men will be limited in their everyday activities; for females, eye and thyroid disorders and the incidence of injury in their lifetimes do not play a significant role. It should be noted that the diseases display much higher significance for men than for women in determining the probability of activity limitations when assessed in separate models.

As health status is a phenomenon very much related to age and to the fact that, when controlled for the main chronic conditions, health deteriorates non-linearly at older ages, we still find that limitations in the daily activities due to health problems tend to increase with age for women. Among the male population, socio-demographic variables increase the probability of those of immigrant origin being limited in their everyday activities by 30%, whereas for women nativity is not significant.

Socio-economic differences whether assessed by level of education attained or by the principal lifetime occupation tend to have no effect for men after controlling for the main health behavior and social disposition characteristics. For the female population both secondary and higher education increase by approximately 40% at a high level of significance the ability to cope with everyday life as compared with women with basic and lower education. Thus when assessed in separate models, educational characteristics are one of the important variables for explaining the variance in activity limitations for the female population. The type of principal lifetime job does not play a role for women.

If an individual is limited in his or her daily activities, risky health behaviors have probably already contributed to the onset of chronic conditions. The main diseases that account for increased probability of being limited in one's activities are an accumulation of a set of factors, among which risky health behaviors have played an important part. In the case of Estonia, chronic conditions might also reflect the effects of malnutrition in childhood and various childhood infections, the effect of injuries and life-long nutritional habits, and also the accumulated effect of the past health care system, not accounted for in our variables (see Costa 2005). Nevertheless, after controlling for chronic diseases, men who have ever engaged in binge drinking experience increased probability of activity limitations by more than 23%. Physical inactivity contributes even more to activity limitations in men, raising the probability by 37%. After controlling for chronic conditions, unhealthy body mass increases for women the probability of being limited in their everyday activities by 28%.

As we expected, the social disposition variables remain significant for increasing the probability of being limited in one's activities. In the case of women all three variables contribute to the level of activity limitations, while relying on one's own judgment decreases the probability of being limited in one's activities by more than 23%. Allowing things to happen rather than taking an active approach to life more than doubles the probability of being limited for both men and women. Similarly, the variable accounting for severe loneliness increases by 1.6 times the probability of activity limitations both for men and women when assessed in separate models.

Separate models predicting activity limitations for the native and immigrant populations reveal that chronic conditions different from those in the descriptive statistics of these populations predict limitations in their activity (Table 13.2).

The main chronic conditions that increase the probability of limitations for the native population, disregarding the small group with cancer (8.8 times), are heart diseases (6.5), diseases of the musculoskeletal system (5.0), diseases of the respiratory and digestive systems (2.6) and diabetes (2.5). Among the immigrant population heart diseases increase the probability of limitations by 5.5 times, diseases of the musculoskeletal system by 5.2 times, diabetes by 5 times, and high blood pressure by 4.5 times. All 11 chronic conditions contribute to activity limitations in the native population; injuries and thyroid disorders have less significance. Among the immigrant population, thyroid disorders and eye disease are not significant predictors of the probability of more serious limitations in one's activities.

After controlling for the main chronic conditions, age remains a predictor of limitations for the native population. Among both subpopulations gender does not play a significant role in predicting activity limitations when all the chronic conditions are controlled for.

Surprisingly, among the immigrant population, being married or cohabiting somewhat increases the probability of being limited in one's activities when chronic conditions are accounted for. Education and a lifetime job in a white-collar profession significantly decrease the probability of being limited for the native population; however, the latter variable is not significant for the immigrant population. Secondary education more than higher education decreases the probability of activity restrictions in the latter sub-population compared to those with basic and lower levels of education.

No risky health behaviors remain determinants of activity limitations for the immigrant population after controlling for chronic conditions. For the native population, unhealthy body mass as well as physical inactivity predict higher probabilities of activity limitations. Social disposition is a better predictor of activity limitations for the immigrant population, thus self-reliance reduces the probability of being limited by almost 40%, whereas reliance on others more than doubles the probability. The latter small group is also significant for the native population; loneliness as well contributes to increased probability of activity limitations for both population groups.

It has to be said that the variables in the model explain only about 50% of the variation in the outcome. The model functions better for assessing the variation in activity limitations for men (Nagelkerke R Square 50.5%) and for the immigrant population (54.3%); its predictive value is lower for women and the native population. The inclusion of chronic conditions raises the explanatory value of the model from 30% to 50%. It is noteworthy that in the final model of separate assessment across nativity, for the immigrant population, no health lifestyle characteristics are significant, but characteristics such as internal locus of control and secondary (and higher) education are fairly important contributors to reducing the probability of limitations on activity. Activity restrictions are more probable among immigrants who are in partnerships and who exhibit external locus of control and severe loneliness. Aside from the latter two variables, which are also significant among the native population in predicting limitations on activities, physical inactivity and problems with body mass as well as higher education also play a role.

In order to assess whether the inequalities between men and women and the native and immigrant populations revealed by separate models for each population group persist, we introduce a model for the total population with the same covariates, controlling for gender and nativity (Table 13.3). In the first model, when gender and nativity are controlled, we can assume that activity limitations have a 20% greater probability of increasing with age for women than for men and a 44% greater probability among the immigrant than among the native population. Living with a partner has no significant effect on the probability of activity limitations.

In the next step, a set of socio-economic variables, which are assumed to differ by gender and nativity, is added to the model. Higher education and having had a

Table 13.3 Binary Logistic Regression Models of Limited in Daily Activities for the Total Population

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Demographics						
Age	1.055***	1.072***	1.072***	1.067***	1.062***	1.031*
Age squared	1	1	1	1	1	1
Gender (female=1)	1.198**	1.291***	1.291***	1.438***	1.352***	1.079
Nativity (immigrant=1)	1.435***	1.43***	1.45***	1.461***	1.367***	1.248**
Married or cohabiting (married or cohabiting=1)	0.897	0.937	0.936	0.92	0.997	1.079
Socioeconomic Status						
Education (comp=basic)						
secondary education		0.731***	0.734***	0.748***	0.776**	0.747**
higher education		0.573***	0.576***	0.606***	0.664***	0.67***
White collar (white collar=1)		0.813**	0.815**	0.83**	0.88	0.882
Accessibility						
Urban residence (urban=1)			0.95	0.933	0.929	0.897
Health insurance (yes=1)			0.998	0.981	0.898	1.161
Health Behaviours						
Has ever been binge drinker (yes=1)				1.185**	1.174*	1.13
Has ever been regular smoker (yes=1)				1.162*	1.135	1.06
Poor BMI results (under and overweight=1)				1.388***	1.433***	1.184*
Poor nutrition (yes=1)				1.029	0.99	1.021
Physically inactive (yes=1)				1.537***	1.36***	1.298**
Illegal drug user (yes=1)				1.501**	1.503**	1.207
Risky sexual behaviour (yes=1)				0.857	0.85	0.884
Social Disposition						
Internal locus of control (yes=1)					0.691***	0.794***
External locus of control (yes=1)					2.196***	2.2***
Loneliness (severe and very severe=1)					2.031***	1.67***
Chronic Conditions						

(continued)

Table 13.3 (continued)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Has ever had an injury (yes=1)						1.285***
Has ever had an episode of depression (yes=1)						1.667***
Has heart disease (yes=1)						6.12***
Has diabetes (yes=1)						2.964***
Has high blood pressure (yes=1)						2.463***
Has cancer (yes=1)						6.453***
Has respiratory diseases (yes=1)						3.02***
Has thyroid disorders(yes=1)						1.557*
Has diseases of the digestive system (yes=1)						3.027***
Has diseases of the musculoscelettal system (yes=1)						4.982***
Has eye diseases (yes=1)						1.695**
* p<.05 **p<.01 ***p<.001						

Source: EstHIS 2006

white-collar profession as one's principal lifetime job reduce the probability of being limited in one's activities. However, when these differences are accounted for, women are almost 30% more likely to have increased limitations. For the immigrant population the socio-economic variables did not explain the variation in activity limitations, and the difference between the native and immigrant populations did not change.

In the next step, believing that urban residence and health insurance might affect access to health and social services, we control for these characteristics. Although, these variables do not account for differences in activity limitations, it should be noted that accounting for these characteristics somewhat raised the probability that the immigrant population would experience limitations in their activities.

Health behavior patterns are added to the model in the next step. In order to assess probable risky behaviors among the younger ages and to take into account the high incidence of HIV in this population, mostly characteristic of drug users and immigrants, we have included drug use and risky sexual behavior among the health behavior covariates in addition to the main risk factors like binge drinking, regular smoking, poor nutrition, body mass problems, and physical inactivity. All of these behavior patterns are significant, except for sexual behavior and unhealthy eating habits. Physical inactivity increases by 54% the probability of being limited in one's activities, the use of drugs 50%, poor BMI 39%, any history of binge drinking 19%, and ever having smoked regularly 17%, as compared with those without risky health behavior. As expected, accounting for health behavior patterns increases the probability that women are more prone to activity limitations, and somewhat unexpectedly increases the probability for the immigrant population as well. We will discuss this conflicting evidence in the following section.

The set of social disposition variables is highly significant in explaining the variation in activity limitations. People with high self-confidence and who rely mainly on their own judgment have 39% less probability of being limited in their activities, whereas reliance on others increases the probability by more than 2.2 times. Experiencing severe loneliness, which indicates fragility of social networks, has almost the same magnitude of effect as external locus of control. Social disposition characteristics also affect health behavior patterns, reducing the impact of physical inactivity, smoking, and binge drinking, but they have no effect on drug users. Social disposition variables decrease somewhat the probability that women and the immigrant population will be limited in their activities. Although the latter set of variables increased the predictive value of the model, they still account for only 30% of the variation in activity limitation.

To a great extent those with activity limitations have underlying chronic conditions that restrict their functioning in everyday life. The next set of variables accounts for the main chronic conditions. All 11 chronic conditions are significantly related to variations in activity limitations. However, for the total population the variation in activity limitations, disregarding the small group with cancer, is most powerfully explained by heart and musculoskeletal diseases. Both cancer and heart disease increase the probability of activity limitations by more than six times, musculoskeletal diseases increase it by five times. These conditions are followed according to their magnitude of impact by diseases of the digestive system, diseases of the respiratory system, and diabetes (each of which increases the probability of activity limitation by more than three times). Controlling for chronic diseases significantly alters the impact of other variables. Although the impact of the set of social disposition variables remains similar to the previous model, loneliness now contributes less to the increase in probability of activity limitations. Most risky health behavior variables become insignificant; poor BMI results and low physical activity alone contribute to the increase in probability of activity limitations. The education gradient still plays a role; however, lifetime principal job loses its significance.

The main outcome of the model is that when main chronic conditions are taken into account, no significant gender differences remain in predicting activity limitations. Immigrant origin, however, remains somewhat significant in predicting a 25% increase in activity limitations as compared with the native population. According to the Nagelkerke R Square coefficients, the variables in the model account for less than half the variation in activity limitation (48.7%), which suggests that in Estonia there are many other factors responsible for the variance in activity limitations and their impact on quality of life.

Discussion and Conclusions

Because Estonia is one of the countries that pioneered the demographic transition, it would be expected to follow similar trends in mortality and health as other North and West European countries. Up until the 1960s Estonia followed the same path and pace of health transition as most developed European countries. Judging by macro level indicators on life expectancy and main causes of death, after the 1960s the population of Estonia entered a period of stagnation, which lasted for almost 40 years and has only shown the first signs of a breakthrough in the last decade. Despite the favorable trends in increasing life expectancy and decreasing rates in avoidable deaths in recent years, the healthy life years indicator ranks Estonia among the European countries with least favorable health outcomes. The main public health concern is the existence of one of the widest gender gaps in Europe. The nearly 30-percent immigrant segment of the population of Estonia continues to have a negative impact on health outcomes despite the group's high level of education. The enormous gap between the Estonian and European HLY averages makes one question the extent to which a country with this kind of social capital can sustain its development in the future. This analysis provides insight into the main determinants responsible for the fact that the population of Estonia spends more than 20 years of its life with activity limitations.

In order to evaluate the main determinants of better quality of life, we use self-assessments of the extent to which the individual has been restricted in performing his or her everyday activities due to health problems for a minimum of the last 6 months. We use this question as a proxy for health-related quality of life. Because this question is also used to calculate healthy life years, we think that it better identifies the main determinants that prevent us from leading a higher quality and more active life. This indicator is also considered to be more 'objective'. Health outcomes are the result of a lifetime of experiences. In a cross-sectional survey one has to find variables that target characteristics that encompass this long-term impact.

From this point of view we think that self-perceived health is of a more cross-sectional nature than the indicator on activity limitations. Although, as mentioned above, these indicators measure different concepts of health, we also think that in quickly developing societies whose economic structures, values, and social classes are changing and insecurity prevails, subjective indicators measuring current perceptions are more affected by the debates taking place in the society and isolated unfavorable circumstances, which tend to lower self-assessments. These self-assessments might reflect the insecurity of the overall situation and a value system more characteristic of long-term low self-esteem rather than the object we are trying to measure. Thus, some studies have established that in the Baltic context self-perceived health is not closely related to health behaviors and might be influenced by other factors (Kasmel et al. 2004). Self-perceived health has also been found to be culturally sensitive (Angel et al. 2001; Jylha et al. 1998), and the use of different scales affects the comparability of results (Leinsalu 2005). The use of the indicator on activity limitations is also motivated by its direct relation to HLY in Europe. Thus, understanding the main determinants of activity limitations helps us to target public health policies toward raising HLY in Estonia.

One of our main aims was to investigate the causes of the wide gender gap in health indicators. Based on the knowledge obtained from the macro-level health indicators for Estonia, we assumed that such main determinants as socio-economic differentials and binge drinking and regular smoking in particular would explain the substantial differences across gender (Shkolnikov et al. 2006; Mackenbach et al.

2008). In a similar study 10 years earlier EstHIS 1996 (Leinsalu et al. 1998) Replace, education was found to have the greatest independent effect on health ratings, especially for women (Leinsalu 2002). Because health behavior patterns monitored over the last 18 years do not reveal significant improvements, we expected these factors to play an important role (Tekkel et al. 2009).

When activity restrictions among the male and female populations were assessed in separate models, socio-economic determinants did not have any significant effect for men; however, both secondary and higher education remained highly significant for restrictions on women's activity. Controlling for the main chronic conditions in these models reduced nearly all the effects of health behavior patterns, although any history of binge drinking and being physically inactive was revealed to be somewhat significant for men. For women, only unhealthy body mass and physical inactivity were initially shown to be of some importance. When controlled for the main chronic conditions, only unhealthy body mass remained somewhat significant. Chronic conditions displayed a great variance across gender. Aside from the small group of cancer, heart diseases and diseases of the musculoskeletal and digestive systems are the main contributors to activity limitations in women, whereas aside from the small group with thyroid disorders, heart diseases, diseases of the musculoskeletal system, and diabetes are the significant chronic conditions for men. The differences in chronic conditions between men and women pose interesting research questions to be explored in the future. The main research question should focus on childhood determinants and occupational careers, as well as on life-long nutrition and other health behavior patterns, in order to explain the difference in chronic conditions between genders. However, our main hypotheses of persistent gender inequalities in activity restrictions were not confirmed. In a model for the total population, after controlling for all the variables, the gender effect disappeared, indicating that the type of chronic conditions and their prevalence are behind the gender differentials in activity limitations.

When activity limitations among the native and immigrant population were assessed separately, different variables were found to contribute to the probability of the occurrence of these restrictions. After controlling for the main chronic conditions, higher education, physical inactivity, and external locus of control were found to be the main factors explaining the variance of activity limitations in the native population. Among the immigrant population, secondary education much more than higher education was significant in decreasing the probability of activity restrictions for the immigrant population compared to the reference of basic and lower education. Although a white-collar main lifetime job was found to be somewhat significant for the native population, it revealed a different pattern for the immigrant population. In attempting to describe this pattern, it was found that in general the immigrant population in Estonia is characterized by higher levels of education, but is more likely to be engaged in blue-collar occupations than the native population. Therefore, the immigrant population seems to have been, despite the level of education, disproportionately more engaged in blue-collar occupations during their lifetimes, albeit earning higher incomes, and for that reason white-collar occupations tended to have no positive effect on reducing activity limitations.

Somewhat surprisingly, no health behavior patterns explain the variance in activity limitations for the immigrant population. One explanation that would confirm our initial hypotheses is that those who have survived have a better health lifestyle. However, it might also be plausible that the immigrant population tends to give socially approved answers to surveys to a greater extent than the native population. All of the social disposition characteristics significantly influence the activity limitations of the immigrant population, which suggests that, due to the higher proportion initially found to have an external locus of control, the immigrant population is comprised of several different groups. Partnership status was found to be somewhat significantly related to activity restrictions only for the immigrant population among all of the separately studied population groups. As described above, the immigrant population is more likely to be married. As marital status increased the probability of activity restrictions among this population, particularly when controlled for chronic conditions, it might indicate that part of the immigrant population is more characterized by traditional family values and more reluctant to divorce.

Although our initial hypotheses were that higher mortality rates among the immigrant population have resulted in a population of selectively healthier survivors and thus nativity would be found to correlate with activity limitations (which were more likely to occur in the native population). The results of our analysis indicate the reverse. Although possessing somewhat less significance, the probability that the immigrant population will be restricted in their everyday activities is about 25% higher. Partnership status, significant for the immigrant population, does not explain the variance in activity limitations when nativity and other variables are controlled for. The most important factor for determining activity restriction in the population of Estonia remains the onset of chronic conditions, of which cancer (which increases the probability of being restricted by 6.5 times), heart diseases (6.1 times), and diseases of the musculoskeletal system (5 times) are of the greatest consequence. Another highly significant set of indicators for determining activity restrictions are those of social disposition, in particular external locus of control and loneliness, followed by a notably decreasing effect of higher as compared with basic or lower education.

Despite the fact that our initial suppositions about socio-economic inequalities were somewhat diminished, people with a basic education or less remain more at risk for being hampered by activity limitations. However, as Mackenbach et al. have noted in their 2008 research, although in most European countries health and socio-economic variables are associated, the rising trends in higher education among the younger cohorts might mean that mainly those who have from birth or childhood encountered health problems due to decreasing perinatal mortality will remain in such a population group. The results of our analysis of the total population reveal that compared with the population with basic and lower education, the decrease in probability of having activity limitations is 25% for those with secondary education and 33% for those with higher education, despite the fact that a considerable proportion of population acquired their education during the Soviet period, when higher education was somewhat of an obstacle to one's societal success.

Related to those results is the outcome that a white-collar as opposed to a blue-collar main lifetime job does not play a significant role in determining future activity limitations. This variable probably reveals the contradictory relationship between education and occupation in Estonia. As we have mentioned in the preceding pages, during the Soviet period, blue-collar occupations were associated with higher incomes. The Soviet ideology, in which the ruling class was comprised of industrial and agricultural workers, favored manual laborers in its income distribution. Because blue-collar occupations are often directly linked to negative health outcomes due to exposure to harsh working conditions, it is perhaps surprising to find that in Estonia occupational status has no significant effect on the probability of activity limitations when all variables are accounted for. However, that might be a consequence of the fact that individuals with higher levels of education are more likely to be found in blue-collar lifetime jobs. From our analysis we conclude that occupational status is not a straightforward indicator for societies with socialist origins, and socio-economic indicators can only be associated with health outcomes with caution.

Several earlier studies have indicated that the main contributors to long-term stagnation in health indicators might have been health lifestyle factors. The health lifestyle indicators were significant for the male population, but not as significant when assessing the main determinants of activity limitations among women or the native or immigrant populations. In particular, the impact of health behavior patterns on activity restrictions was lessened when controlled for social disposition factors. This led us to hypothesize that although the health lifestyle indicators are mostly constructed in our survey as a way to account for lifetime habits, the overall perception of one's position in society has a greater long-term impact on health outcomes.

We find that the greatest impact on health outcomes is displayed by accumulated long-term social stress from living in a society in which individuals had little choice, best characterized in our analysis by variables manifesting a pervasive reliance on others. In our final model all of the social disposition characteristics remained significant for the onset of activity restrictions in accordance with previous studies (Cockerham et al. 2002). They reduced the effect of most health behavior patterns (except unhealthy body mass and use of illegal drugs), gender and nativity effects, and somewhat the effect of educational characteristics. In the Estonian HIS, conducted 10 years earlier, no gender differences for self-assessed health ratings where found when controlled for locus of control (Leinsalu 2002). Thus we conclude that in transitional societies long-term social dispositions have had more of an impact on current health outcomes than almost 20 years of targeted public health programs.

Another way to look at the long-term impact of a society is through the set of chronic conditions that are mainly responsible for activity limitations. The lack of attention paid to preventive measures in the health care system, as revealed by the late diagnoses of terminal illnesses mainly observed in cancer survival patterns has been characteristic of Estonia (e.g. Sant et al. 2003). For several diseases, a lower rate of diagnosis as compared with West European countries has been reported (Pallasaho et al. 2002; Meren et al. 2005). The Estonian findings have generally confirmed studies of the habits of former Soviet Union physicians that indicated much less reliance on technological innovations and provision of preventive care (Remennick and Shtarkshall 1997; Bernstein and Shuval 1994). Thus the different structures of the chronic conditions that account for activity limitations among men and women, and among the native and immigrant populations, reveal the long-term cumulative effects of the system. These chronic conditions provide an opportunity for us to look for long-term behavioral confounders in an interaction with the health care system. Main chronic conditions like cancer, heart diseases, and diseases of the musculoskeletal, digestive and respiratory systems all point towards the long-term negligence on behalf of the system to raise the awareness of the population, to build a surveillance system attending to prevailing problems, and to address the problems with applications of new technologies that are responsible for the current high probability of disability in Estonia. Social disposition characteristics remaining highly significant after accounting for main chronic conditions indicate that these are the key determinants for future improvements in the population's quality of life.

One could conclude that raising the self-esteem of a population, as well as of that of its subpopulations, through better education and awareness of the possibilities to improve one's health lifestyle has to be supported by the entire society, including the health care system. Combating emerging behavior patterns in drug use and risky sexual behavior might improve the next cohorts' long-term possibilities for an active life. The current situation in Estonia, although analyzed from a cross-sectional perspective, leads us to conclude that improvements in health indicators at the macro level are not confirmed at the level that accounts for quality of life. Given the prevailing health patterns, although we are entering the phase of the health transition characterized by longer lives, we are also increasing the number of years in which we live with restrictions on our activities. For the immediate future, this means a greater burden on households, which could be alleviated by action at the societal level.

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Chapter 14
The Rural-Urban Gradient and Life Expectancy in the United States, 1970–1990*

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Introduction

Life expectancy is arguably the single most important indicator of the general health of a population (Lamb and Siegel 2004) and it has long been documented that variations in life expectancy exist among the broad geographic divisions within the United States, as well as among individual states (Dublin et al. 1949; Glover 1921; James and Cossman 2006; Oosse 2003).[1] However, until the work of Swanson and Stockwell (1986), virtually nothing was known about sub-state variations.[2]

*An earlier version of this paper was presented at the Applied Demography Conference, San Antonio, Texas: January 10–12, 2010.

[1] Through this paper we use the term 'life expectancy' to refer to 'life expectancy at birth.'

[2] In 2008, Ezzati et al. constructed sex-specific life expectancies for counties for every year from 1961 to 1999. However, they were forced to combine the 3,141 counties into 2,068 units because of the lack of data needed to avoid unstable death rates. This represents about two-thirds (66%) of the total counties. They merged smaller counties with adjacent counties to form units with a total population of at least 10,000 males and 10,000 females. In the study reported here, only counties with less than 50 deaths were excluded. For the 537 counties used in this study this limitation resulted in the exclusion of 48 counties in 1990, leaving 91% available for analysis. Had the excluded counties been merged with adjacent ones, there would have been virtually no reduction.

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_14,

Using regression analysis, Swanson and Stockwell (1986) examined life expectancy in 1930 and 1980 in Ohio and found that while differences narrowed between 1930 and 1980, significant geographic variations in life expectancy persisted. Subsequent work by Swanson et al. (2009) found significant variations for the U.S. as a whole.

Not surprisingly, it also has long been documented that differences in life expectancy, among other population health outcome measures, exist between rural and urban areas (Aday et al. 2001; Washington Department of Health 2009). Various reasons have been posited for these differences, along with a range of analytical frameworks (Aday et al. 2001; James and Cossman 2006; Public Health Agency of Canada 2009; Ricketts 2000). However, in this paper, our primary aim is to examine trends and any rural-urban differences rather than to provide explanations of them. Having said this, we do discuss some of the issues that are likely to be generating the trends and differences we find.

The years 1970 and 1990 are selected for this study because they represent what may be regarded as the "bookends" of a pivotal social policy period in the U. S. Where federal support of social welfare programs was at a high point circa 1970 (via the New Deal under Roosevelt and the War on Poverty under Johnson, among other programs), by 1990 (shortly after the end of the Reagan era) federal support was significantly smaller (Reese 2005; Stockwell et al. 2005).

Materials and Methods

Using the four-category rural-urban classification scheme developed by Calvin Beale and his colleagues at the U.S. Department of Agriculture (Butler and Beale 1994), county populations are grouped into two sets for 1970 and 1990: (1) the most urban set (metropolitan central city counties); and (2) the most rural set (non-metropolitan nonadjacent counties). The data represent 1,798 (of the approximately 3,100) county and county equivalents, of which 519 are classified as being in the "most urban" set, and 1,279 as being in the "most rural" set.[3]

A regression-based technique is used to estimate life expectancy at birth (Swanson 1989), an earlier version of which was used by Swanson and Stockwell (1986).

All of this is not to say that the regression method is in competition with a complete (abridged) life table. Clearly, a life table provides much more information than does life expectancy alone, even when, as is the case in the study by Ezzati et al. (2008), only three of the 39 years for which they constructed life tables had census quality population data in the denominators (the remaining years had estimated age-sex specific data). However, where neither is it desirable to merge counties nor is there the need to maintain a high number of them for analysis, then the regression estimation method may be preferable.

[3]This is not the only classification system used to distinguish rural and urban areas. For a comprehensive description of different systems that includes the strengths and weaknesses of them see Ricketts et al. (1998).

Until the advent of this method for estimating life expectancy, there was no reliable way to examine life expectancy for small populations. This is due to the fact that life expectancy is calculated through the construction of a life table, which has rigorous data requirements that are difficult to meet for small populations (Kintner 2004). The model used here was tested by Swanson (1989) and found to be sufficiently accurate for its use here. The model is defined as:

$$e_o = \{82.276 - (4.24 * CDR) + (3.02 * Ln(P65+)) + (.0267 * CDR^2) + (.1773 * Ln(P65+)^2) + .8707 * [(CDR) * (Ln(P65+))]\}$$

where:

e_o	is life expectancy at birth
CDR	is the Crude Death Rate (expressed as deaths per 1,000 population)
Ln(P65+)	is the natural base logarithm of the percent of the population 65 years of age and over

While this model was found to work well for small populations, it has two conditions under which it can produce unreliable estimates: (1) a substantial "special" population, such as is found in a retirement community (population 65 years of age and older); and (2) a small population with very few deaths, such that the crude death rate can fluctuate substantially from year to year. In terms of the former condition, a very high difference between the percent aged 65 and over at the state level and for a given county warrants further examination. In terms of the second, it is advisable to not use the model if the number of deaths is much less than 50. None of the counties in this study was found to have a life expectancy that was severely affected by the presence of large retirement populations. However, there are counties and county-equivalents that otherwise would have been included in the analysis but were excluded because the number of deaths was below 50 in one or both of the 2 years. A list of all counties with inclusion/exclusion status is available from the authors.

The analytical unit consists of a county population. Thus, this study is an "ecological" design because the population characteristic of life expectancy is being examined rather than the individual (Swanson and Stephan 2004, p. 764). Moreover, no attempt is made to cross the "group-level/individual-level" boundary, so the analysis itself is not subject to the "ecological fallacy" (Freedman 2002).

Mortality data needed to estimate 1970 and 1990 life expectancy values are taken from 1970 to 1990 vital statistics reports produced by the U. S. National Center for Health Statistics (1974, 1994), respectively. Population data for 1970 and 1990 are taken from reports for the 1970 and 1990 censuses (U. S. Bureau of the Census 1973, 1992, respectively). To measure change in life expectancy between 1970 and 1990, a dummy variable regression model was constructed for each of the two SES populations by state:

$$e_o = a + b(YR)$$

Where:

e_o is life expectancy in 1970 and 1990 for a given SES population as found from the equation shown above
a is the intercept (1970 mean life expectancy for the same SES population)
b is the change in mean life expectancy between 1970 and 1990 for the SES population in question
YR is a dummy variable for year (YR = 0, in 1970; YR = 1, in 1990)

The one-tailed test ($p = .05$) is applied to the slope coefficient, b, in each of the two equations to determine if there is a statistically significant change in life expectancy for the county population in question. Because there is a positive correlation between life expectancy for each county population in 1970 and 1990, the standard error is diminished. However, this should not be a major problem, given the large samples to begin with. The null hypothesis is that there is no change (i.e., $b = 0$); and the alternative hypothesis is that there is positive change (i.e., $b > 0$). This "one-tailed" test structure is appropriate because there is evidence to indicate that, on average, life expectancy increased between 1970 and 1990 (Swanson 1992; U. S. Department of Health and Human Services 2000).

Results

According to our analysis, change in life expectancy has not been distributed evenly throughout the nation. In some parts of the nation, life expectancy has grown rapidly, in some, it has grown slowly, and in others, it has declined. As shown in Fig. 14.1, only 5 out of 489 metropolitan central city counties experienced loss in life expectancy. Pueblo County, Colorado, lost the most years of life expectancy, followed by Rankin County, Mississippi. Life expectancy for Pueblo County declined from 79.18 years in 1970 to 75.52 years in 1990, a decrease of 3.66 years or 4.62%. Life expectancy for Rankin County, Mississippi, declined from 76.97 years in 1970 to 74.73 years in 1990, a decrease of 2.24 years or 2.91%. Among the urban metropolitan central city counties, Johnson County, Iowa, gained the most years of life expectancy, followed by Prince George County, Virginia. Life expectancy for Johnson County, Iowa, increased from 49.21 years in 1970 to 78.46 years in 1990, an increase of 29.25 years or 59.44%. Life expectancy for Prince George County, Virginia, increased from 50.35 in 1970 to 77.31 years in 1990, an increase of 26.96 years or 53.55%.

Fifty-five out of 1,086 non-metropolitan non-adjacent counties experienced loss in life expectancy. Ringgold County, Iowa, lost the most years in life expectancy followed by Palo Alto County, also in Iowa. Life expectancy for Ringgold County declined from 81.95 years in 1970 to 76.74 years in 1990, a decrease of 5.21 years or 6.36%. Life expectancy for Palo Alto County declined from 79.11 years in 1970 to 75.86 years in 1990, a decrease of 3.25 years or 4.11%. Clay and Todd County, South Dakota, have lost average life expectancy by 2.86 and 2.25 years, respectively.

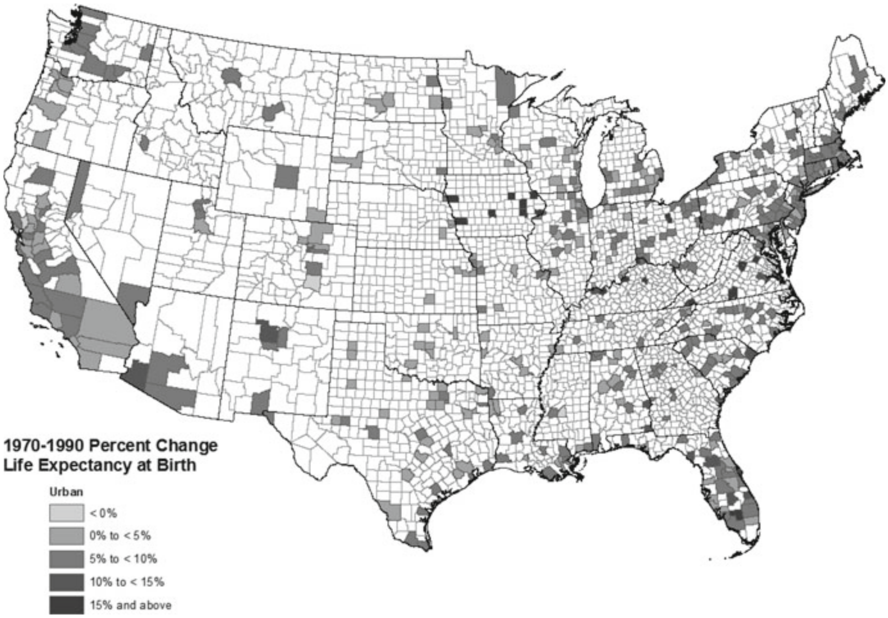

Fig. 14.1 Change in life expectancy at birth in urban countries in the U.S., 1970–1990

Among the non-metropolitan counties, Nantucket County, Massachusetts, gained the most years of life expectancy followed by Leslie County, Kentucky. Life expectancy for Nantucket County, Massachusetts, increased from 56.82 years in 1970 to 76.00 years in 1990, an increase of 19.18 years or 33.76%. Life expectancy for Leslie County, Kentucky, increased from 47.79 years in 1970 to 62.42 years in 1990, an increase of 14.63 years or 53.55% (Fig. 14.2).

Further study of the crude death rates for the counties mentioned above supports our findings. For example, we would expect that the counties that lost life expectancy would have a higher crude death rate for 1990 compared with 1970 and the counties that gained life expectancy would have a lower crude death rate in 1990 compared with 1970. Our data support these hypotheses. For example, the crude death rate for Pueblo County, Colorado, increased from 4.94 per 1,000 in 1970 to 9.91 per 1,000 in 1990, although the percent of the population 65 years of age and older decreased from 11.05 in 1970 to 9.11 in 1990. The crude death rate for Prince George County, Virginia, decreased from 11.48 per 1,000 in 1970 to 4.31 per 1,000 in 1990, although the percent of the population 65 years of age and older has increased from 2.69 in 1970 to 6.04 in 1990.

On the other hand, the crude death rate for Johnson County, Iowa, decreased from 19.49 per 1,000 in 1970 to 4.46 per 1,000 in 1990, although the proportion of the population 65 years of age and older has increased from 6.95 in 1970 to 7.45 in 1990. The crude death rate for Prince George County, Virginia, decreased from 11.48 per 1,000 in 1970 to 4.31 per 1,000 in 1990, although the percent of the

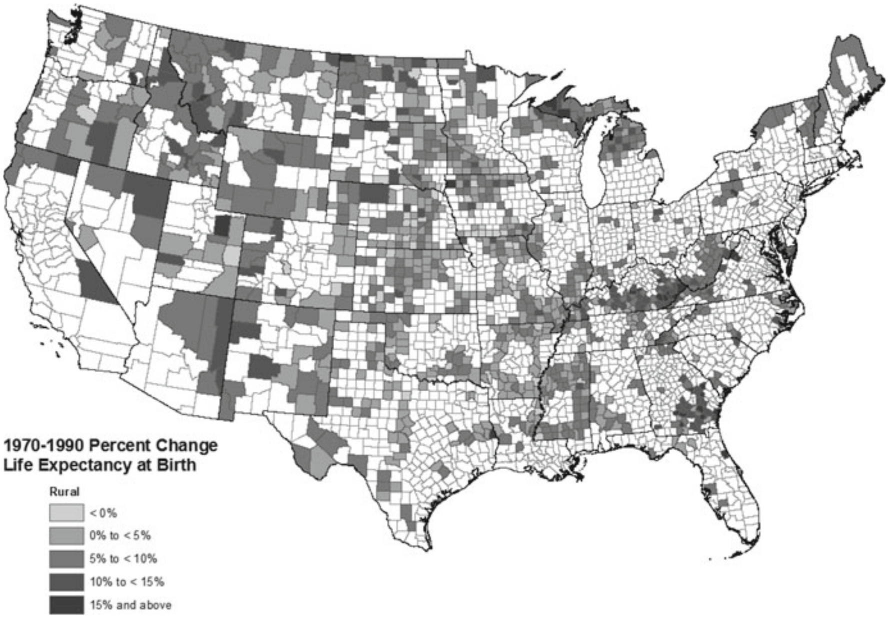

Fig. 14.2 Change in life expectancy at birth in rural countries in the U.S., 1970–1990

Table 14.1 Summary statistics for rural-urban counties, 1970 and 1990

Life expectancy at birth, 1970 and 1990 by county type					
	1970		1990		
County	Mean	Stdev	Mean	Stdev	N
Urban	70.95	3.95	75.51	2.19	489
Rural	71.16	3.52	75.30	2.60	1,086

population 65 years of age and older increased from 2.69 in 1970 to 6.04 in 1990. The same pattern was observed for the nonmetropolitan counties.

As seen in Table 14.1, we find that in 1970 the rural counties had a slightly higher average life expectancy than did the urban counties: 71.16 and 70.95, respectively. By 1990, however, average life expectancy in urban counties exceeds that in the rural counties: 75.51 and 75.30, respectively. The absolute change between 1970 and 1990 was 4.56 years for urban counties compared to 4.14 years for the rural counties. It is of interest to note that the two sample 1-tailed t-test (unequal variances) shows that the difference in life expectancy in 1970 is not statistically significant ($p=.16$), while the same test for 1990 shows that the difference is significant ($p=.05$).

Variation in life expectancy for both the urban and rural sets declined substantially between 1970 and 1990. In 1970, the standard deviation for the urban set ($N=489$) was 3.95 while that for the rural set ($N=1,086$) was 3.52. By 1990, the standard deviation for the urban counties was 2.19 while that for the rural counties was 2.60.

Table 14.2 Dummy regression results

County	a	b	Se(b)	T-score	*P*(b = 0)	r^2
Urban	70.95	4.56	0.20	22.32	<0.001	0.34
Rural	71.16	4.14	0.13	3.19	<0.001	0.31

The dummy regression results for the urban and rural counties are given in Table 14.2. The intercept term in each equation represents average life expectancy in 1970 and the slope coefficient represents the change in life expectancy between 1970 and 1990. Each of the two regression models is statistically significant ($p < .001$), which indicates that average life expectancy did indeed increase.

Discussion

These findings are of practical interest because in the "Tracking Healthy People 2010" report, the U. S. Department of Health and Human Services (2000) cites the elimination of health disparities by the end of this decade as one of its two key goals. Clearly, the finding that the rural-urban disparity increased between 1970 and 1990 does not bode well for meeting this goal. The finding that rural-urban life expectancy differentials tended to increase during the period from 1970 to 1990 is consistent with the literature. Unfortunately, the widening differentials represent a major break with the past. Shortly before his death in 1969, the pioneering actuary, demographer, and biostatistician, Mortimer Spiegelman (1968) wrote that gender, race, spatial, and SES mortality differentials in the United States had been narrowing since 1940. He concluded his paper by stating that (national) leaders were now responsible for seeing that adequately staffed and functioning health facilities were conveniently accessible to the public in order for these trends to continue. He clearly believed that the country's leadership would shoulder this responsibility because he foresaw that even smaller mortality differentials were in the country's future. Unfortunately, from the standpoint of national policy, it appears that his optimism was misplaced.

With the arrival of the 2010 census it will be useful to see if the trends found between 1970 and 1990 changed subsequent to 1990. Such an examination should include the rural-urban divide, but also by each of the three cornerstones of social stratification in the United States: (1) race/ethnicity; (2) gender; and (3) socio-economic status.

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Chapter 15
Demographic Changes in the United States of America: Challenges for Disaster Management

Somporn Khunwishit and Sudha Arlikatti

Introduction

Changing demographic patterns in the United States seem to imply associated changes to the built environment of our cities, shifts in residential location choices, increased scarcity of resources, and concerns of environmental degradation. These in turn seem to increase the vulnerability of certain population segments to hazards, leading to greater losses during disasters. However, these disaster impacts can be reduced by emergency management interventions if planned for in advance through disaster mitigation strategies. In this chapter we discuss the projected demographic changes to four specific population segments in the United States, namely, the elderly, female-headed households, foreign-born population, and in-migrating populations. Specifically, we seek to answer the following questions:

1. What impacts do these projected demographic changes have on American communities with regard to disaster management?
2. What challenges do public managers and emergency management personnel and policy makers face in reducing the vulnerabilities of these populations and managing disasters at the local level?

We begin with a brief examination of the vulnerability framework in disaster management studies. Population data from the U.S. Census 2000 and 2010–2050 projections are used to analyze and support theoretical arguments. Demographic changes and their linkages to disaster management are then made. Finally, the implications of these changes for public managers and emergency management agencies in dealing more proactively with these future crises in U.S. communities are discussed.

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_15,

Disaster Vulnerability

Disaster researchers agree that a hazard agent such as strong winds, storm surge, earthquakes, floods, tsunamis, toxic chemicals and radiation, and infectious agents can become a disaster only when it affects exposed vulnerable populations, causing dramatic losses to human lives and their property (Lindell et al. 2007). That is, if we assume the same level of exposure, some people will die, others will be severely injured, still others slightly injured, and the rest will survive unscathed. Oftentimes the very young, the very old, single women, and those with weakened immune systems are highly susceptible to such environmental stressors. Thus the occurrence of a disaster depends on three key variables, namely, the hazard, the exposure, and human vulnerability. This argument is consistent with that of Wisner et al. (2004) who contend that "there cannot be a disaster if there are hazards but vulnerability is (theoretically) nil, or if there is a vulnerable population but no hazard event" (p. 49). Thus disasters are a result of the interaction or combination of vulnerability and hazard, and the risk of disasters is a compounded function of the natural hazard and the number of people who have different degrees of vulnerability.

The notion of vulnerability has been popularly used to understand the occurrences or development of disasters around the world (Alexander 1993; Blaikie et al. 1994; Wisner et al. 2004; Kiunsi et al. 2006; Bollin and Hidajat 2006; Birkmann et al. 2006), and the social vulnerability framework is being increasingly employed for planning of mitigating, preparing for, responding to, and recovering from a disaster, particularly in highly populated areas and megacities (Uitto 1998; Takahashi 1998; Borden et al. 2007). However, social vulnerability research is varied depending in part on the researcher's epistemological orientation (Cutter 1996), and hence, it is difficult to categorize research of this kind in a way that all scholars would agree upon (Marandola and Hogan 2006; Adger 2006). Thus, we may find that categorizing vulnerability research, its concept or definition, would depend largely on the perspective of each scholar or school of thought. For example, Cutter (1996) categorizes research on vulnerability into three main subgroups, namely, one that focuses on the probability of exposure, another that focuses on the probability of adverse consequences, and a third one that bridges the two. Misomali and McEntire (2008) suggest that vulnerability research is rooted either in *vulnerability as disaster proneness* or *vulnerability as insufficient capability*. For the purposes of our study, we employ the second perspective to develop our construct of vulnerable populations and make theoretical arguments on the possibility of increased disaster occurrences.

Vulnerability as insufficient capability focuses on an entity's lack of capacity to mitigate, prepare for, respond to, and recover from a disaster. In this perspective, the degree of vulnerability is reflected by the ability of individuals, organizations, or communities to protect themselves from a hazard and to cope with a disaster effectively, and thus it is mainly about individuals' resistance to and resilience from a disaster (Blaikie et al. 1994; Misomali and McEntire 2008). Following this line of thought, Wisner et al. 2004 define vulnerability as "the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of natural hazards (an extreme natural event or process)" (p. 11). Furthermore, McEntire (2005) refers to vulnerability as the lack of capacity to perform important functions such as risk communication, evacuation, search and rescue, and sheltering before and after a disaster strikes.

The degree of vulnerability is measured by social status (i.e. class or caste) – differences in wealth, occupation, community tenure, ethnicity, health, age, or immigration status, as well as the nature and extent of social networks, gender (Enarson 1999), and age and disability. Specified populations are even more vulnerable if they live in substandard housing in disaster prone areas, such as along the coast, in flood plains (Dash et al. 1997), or superfund sites (Stretesky and Hogan 1998). Severe disasters and the resulting major losses tend to occur in locations with high vulnerability (Alexander 1993), or in other words, in areas that are populated by larger numbers of vulnerable populations. It should be noted that factors affecting and increasing vulnerability are compounding factors. Thus, a person who possesses more than one or all characteristics of vulnerability would be more susceptible to and affected by a disaster than one who possesses only one or fewer characteristics of vulnerability. For example, an elderly seventy-five year old, single, unemployed, immigrant woman, living in a flood plain will be more affected by an ensuing flood, than one who is in her thirties, unemployed and a single mother in a similar location. In the same way, a large number of low-income, young, immigrant, non-English speaking, single-mothers that are living in an area bordering San Pedro harbor (part of greater Los Angeles) are especially vulnerable compared to those who possess fewer characteristics of vulnerability living in the same area Wisner et al. 2004.

Demographic Changes: The Elderly

In the U.S. the elderly are defined in various ways. While the U.S. Bureau of Census refers to the elderly as the population aged 55 and over, the U.S. Administration on Aging (AoA) clearly defines the elderly as persons 65 years or older. In this chapter we define the elderly as people aged 65 and over and focus specifically on this population group. The data from U.S. Census 2000 indicate that the number of people aged 55 and older was about 57 million. The number will change to about 75 million in 2010 and is projected to increase to 125 million by 2050(See Fig. 15.1).

When looking more closely at the elderly aged 65 and over, the number changes considerably every 10 years. In 2000, the number was about 35 million, but in 2010, the number is estimated to increase to about 40 million and is projected to reach about 82 million by 2050, an increase 51% from 2010. The data also suggest that the number of older women is higher than that of men. In 2000, the number of elderly women accounted for about 59% of the total aged population. This proportion is expected to be maintained for the next 50 years. Figure 15.2 shows the population aged 65 and over by gender.

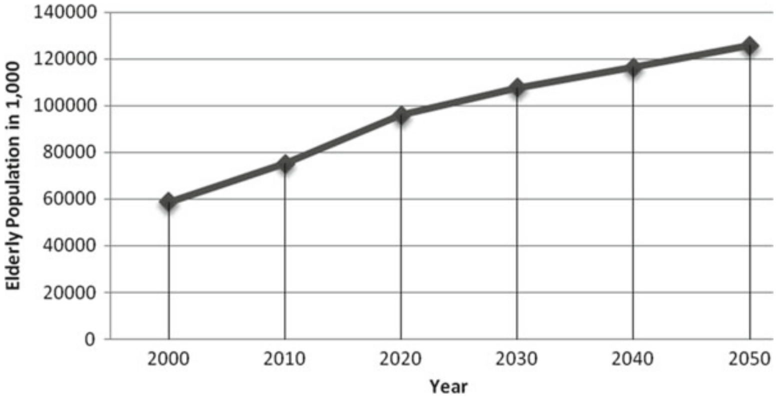

Fig. 15.1 Population age 55 and older, 2000–2050 (in 1,000) (Source: U.S. Census Bureau, projection of the resident population by age, sex, race, and hispanic origin: 1999–2100)

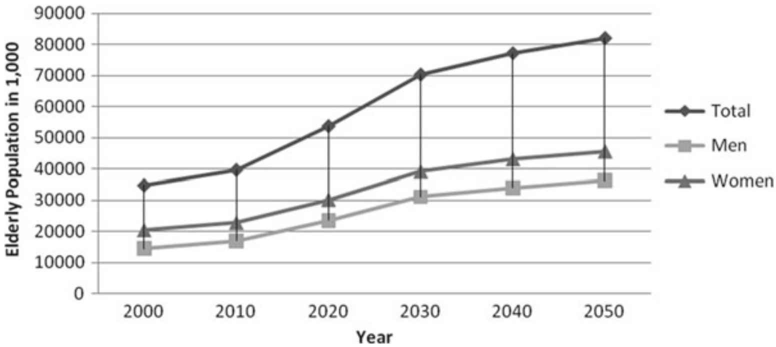

Fig. 15.2 Population age 65 or older by sex, 2000–2050 (Source: U.S. Census Bureau, projection of the resident population by age, sex, race, and hispanic origin (1999–2100))

The Elderly in Disasters

American societies will become more vulnerable in the near future because of a significant increase in aging populations (U.S. Census Bureau 2000). Previous studies suggest that they suffered or experienced the greatest losses and needed the most services in times of disasters (Friedsam 1960). In more recent times, the 2005 Hurricane Katrina studies provide evidence of vulnerabilities of the elderly. In Katrina, of the 1,330 deaths,[1] nearly half of the victims were elderly, who were over 75 years of age, and approximately 71% of those who died were over 60 years of age (AARP 2007). A report made to Congress by CRS estimates that 88,000 persons aged 65 and older

[1]Other sources estimate 1,800 persons died (See for example Cahalan and Renne 2007).

were likely displaced by Hurricane Katrina, and that 12.4% of this population was affected by flooding and/or storm damage (Gabe et al. 2005). Additionally, the hurricane likely displaced an estimated 45,000 persons aged 75 and older.

Vulnerability of the elderly is often times compounded by their disabilities, which make them more dependent on the next of kin, social workers, nursing home staff, and first responders during a disastrous event, especially evacuation stages. Large numbers of disabled elderly were found injured or dead in Katrina. Nearly half (48%) of all persons aged 65 or older living in flooded or damaged areas reported having a disability, and over one-quarter (26%) reported two or more types of disabilities. Moreover, persons aged 65 and older (13%) living in the flood or damage affected areas reported a self-care disability, and one-quarter of those reported a disability that made it difficult for them to go outside unassisted.

A vulnerability study in urban areas of the U.S. finds that cities with a greater number of elderly residents are more vulnerable than those cities that have a lower number of older populations (Borden et al. 2007). Because of disabilities, the elderly become the population with special needs. Special needs are needs generated by functional limitations of the elderly (Penner and Wachsmuth 2008). Limited abilities of the elderly are caused by sensory disabilities such as blindness, deafness or severe hearing impairment, activity-limiting disabilities making it difficult for them to learn, remember, or concentrate on new things, and self-care disabilities making it difficult for them to dress, bathe, or get around the home or go outside the home alone to shop, visit a doctor's office, etc. (Gabe et al. 2005). The limited abilities of the elderly to take preparedness and response actions in times of disasters make the communities they reside in more vulnerable.

Women are more likely to live alone as they get older (Friedland and Summer 2005) because their life expectancies are longer, making them more likely to be widowed. Moreover, older women are less likely to remarry than older men. Aging people who live alone are especially vulnerable to disasters (Enarson 1999). Their abilities to perform evacuation actions and to access public resources during and after disasters are very limited, not only because of their disabilities but also because they have nobody (other members of their families or relatives) to take care of and help them. The increase in the aging population implies that special needs will increase in times of disasters, and special attention from disaster planners and responders will be required. Thus, emergency management personnel have to be aware of these necessities and prepare for them appropriately before a disaster strikes.

Demographic Changes: Foreign-Born Populations

One of the major changes in the U.S. demographics that can pose a challenge to local governments' emergency management is the steady increase in foreign-born immigrants. In another half a century, non-Hispanic Whites will no longer be the largest segment of the population in the U.S. This change implies that American communities will

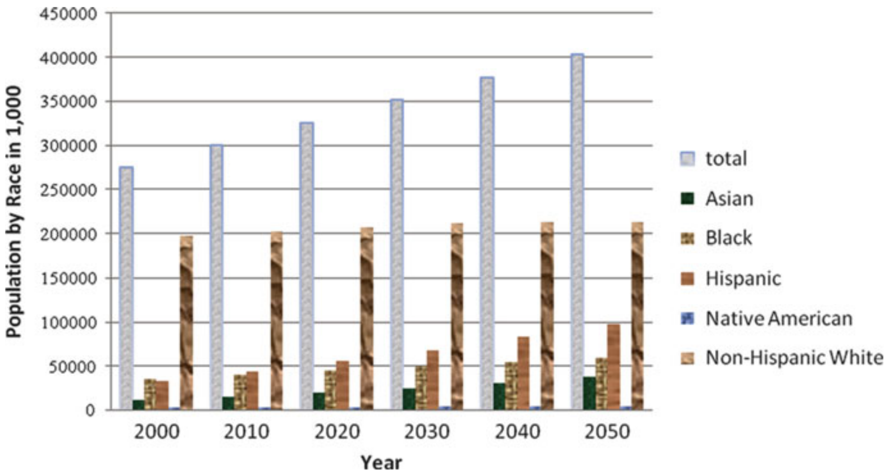

Fig. 15.3 Population by race and hispanic origin, 2000–2050 (Source: U.S. Census Bureau, projection of the resident population by age, sex, race, and hispanic origin: 1999–2100)

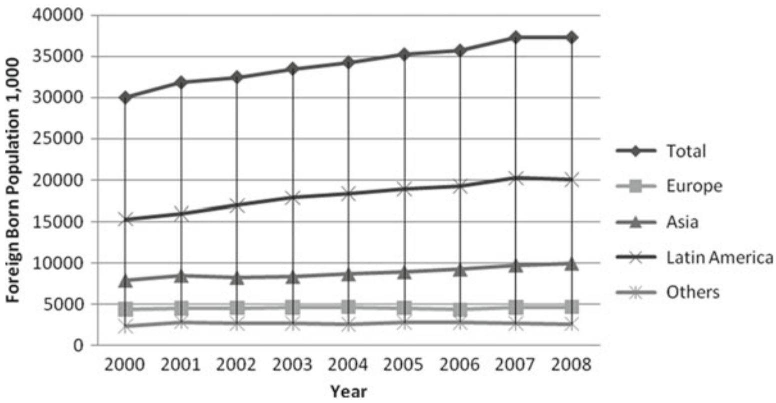

Fig. 15.4 Foreign-born population by world region of birth from 2000 to 2008 (Source: U.S. Census Bureau, foreign population of the United States, current population survey, 2000–2008)

be communities of mixed races, cultures and languages. In 2000, Hispanics accounted for about 12% of the total population, while Asians accounted for about 4% and Black Americans 13%. However, by 2050 the Hispanic population will account for about 24% of total population, with the number rising to 98 million, Asians will account for 9% and the Black American population will account for about 15% (U.S. Census Bureau 2000). Figure 15.3 presents population by race.

Foreign-born populations immigrating to the United States come from different parts of the world and have different socio-economic characteristics. However, a majority of them seem to come from Latin America, Asia, and Europe (See Fig. 15.4). People from Latin America accounted for one-half of the total foreign-born populations, whereas people from Asia accounted for more than a quarter

(U.S. Census Bureau 2000). Most Latin Americans in the U.S. come from Mexico, Cuba, the Dominican Republic, and El Salvador, and most Asians come from China, the Philippines, Vietnam, India, and Korea. They tend to gravitate to large multicultural and/or economically prosperous states such as New York, Florida, Texas, New Jersey, and Illinois. In terms of education, on average, foreign-born populations have a level of education lower than that of natives, and among foreign-born populations, those from Latin American reported having the lowest education rate. Census 2000 data also suggests that foreign-born populations were less insured compared to natives. Specifically among the foreign born, those from Latin America reported having the least insurance coverage, and also the lowest median income and highest poverty rate. However, the foreign-born population from Europe had the same percentage insurance coverage as that of American citizens. These findings suggest that the degree of vulnerability varies among foreign-born populations, and the degree of vulnerability depends in part on their region of origin.

Foreign-Born Populations in Disasters

A change in foreign-born populations not only increases racial heterogeneity but also increases the complexity of the U.S. population. Generally, foreign born immigrants are vulnerable in times of crises because of their lower economic status and the foreign languages they use to communicate (especially in the cases of Hispanics and Asians) or their unfamiliarity with the hazard agent, the preparedness measures, and the laws and regulations in place (Burby and Wagner 1996). Societies with larger numbers of foreign populations are more vulnerable to disasters than those with lower numbers of these populations. For example, a study of the vulnerability of 132 U.S. cities finds that cities with more Hispanic residents are more vulnerable than those cities that do not have these populations (Borden et al. 2007). The vulnerability of foreign populations, characterized by their low socioeconomic status, complicates disaster response operations, especially in communications regarding warning, evacuation, sheltering, and rescue activities. Public managers have to be aware of a change in population in their communities because the more complex the population composition in their jurisdictions, the more difficult it is to plan for and respond to a disaster.

One of the most important issues associated with this change in the composition of the population is language. Communicating with people who speak different languages or have a limited understanding of English may be a recurring challenge for emergency management personnel, especially when issuing watches and warnings, evacuation orders, and other instructions during sheltering and recovery activities, as recent immigrants may not understand these instructions well or do not trust the government and/or fear the government (Gladwin and Peacock 1997) and would thus be more vulnerable. The increase in minority populations in U.S. communities suggests that public managers have to take cultural factors into consideration when planning and managing disasters. They need to make note of their ever changing multicultural and multi-racial communities while making disaster plans and informing the public.

Demographic Changes: Residential Location Choice

In-migration can cause some areas to be more populated and thus more vulnerable to disasters than others. Areas that would be more vulnerable to disasters are those located in coastal states. The U.S. National Oceanic and Atmospheric Administration (NOAA) conducted a study of population change along the nation's coasts and found several interesting demographic trends.

According to NOAA (1990), coastal states like Florida, Texas, and California are estimated to have dramatic growths in populations by 2010. Florida's 1960 population of 5 million is projected to reach more than 16 million by 2010, a 226% increase. This change raises Florida to the nation's fourth most populous state, with California and Texas taking the first and second place, respectively. It is estimated that in 2010, about 68% of all coastal counties will have a population density increase of more than 10%.

This suggests that the populations of coastal counties will continue to increase significantly. For example, some counties in the northeast are projected to have a population density of over 830 persons per square mile in 2010, five times more than that of non-coastal counties. Coastal counties in the Great Lakes region are expected to have a population density of 275 persons per square mile, which is relatively lower than that of the Northeast but higher than the overall U.S. figure of about 70 persons per square mile. Some of these areas are Cook and Lake counties in Illinois, Macomb and Ottawa counties in Michigan, Monroe County in New York, and Brown and Milwaukee counties in Wisconsin. For Southeast regions, the most densely populated counties are located in Eastern Florida, especially those containing or adjacent to Jacksonville, Miami, Fort Lauderdale, West Palm Beach, and Orlando and also those in Savannah and Charleston. These areas are projected to have a population density of about 520 persons per square mile by 2010.

Residential Location Choice and Disasters

Families that move to a new community "can increase the vulnerability of that community because they do not share the same disaster history as other residents in the area" (Misomali and McEntire 2008, p. 29) and hence are not familiar with hazards that often threaten the community and do not know how to prepare or respond to them appropriately (Burby and Wagner 1996) or may not be able to afford the protective action measures that the government suggests they take, such as building stronger homes to meet better building codes, retrofitting older homes, and purchasing flood or earthquake insurance (Arlikatti et al. 2007). Thus, migration and urbanization can make one community more populated than others and make it more vulnerable to disasters. A study of vulnerability of U.S. cities finds a positive relationship between the degree of a city's vulnerability and the population size and density of the built environment (Borden et al. 2007). This means that the areas with larger populations and higher rate of built environment density are more vulnerable to disasters than those with lower populations and built environment densities. Similarly, a study of flood casualties in Texas showed that "for every unit increase in population density, the odds of flood casualties rise by a factor of 2.99" (Zahran et al. 2008, p. 552). Large populations bring about housing and infrastructure stresses and often put more people in the path of floods, and as a result, flood disasters often occur in areas that are prone to waterlogging where new immigrants live (Wisner et al. 2004, p. 217).

Misomali and McEntire (2008) explain that, "growing populations lead to an increase in vulnerability as more people are concentrated in one location, there is a higher likelihood of disastrous consequences when the area is faced with a hazard" (p. 26). Giving the example of the 9/11 terrorist attacks, they note that while approximately 3,000 people were killed in New York City when terrorists crashed a plane into the twin towers of the World Trade Center, many fewer people died from the crash at the Pentagon in Virginia and in the rural fields of Pennsylvania. Thus, they claim that populated areas can be more vulnerable to disasters than less populated areas. As discussed, the most densely populated counties are located in the eastern part of the country, which is also prone to recurrent hurricanes, strong winds, and inland flooding. A study of the vulnerability of U.S. cities to environmental hazards conducted by Borden et al. (2007) supports this observation. They noted that the physical, social, and built environment characteristics together contributed to natural hazards vulnerability of urban areas in the United States and the most vulnerable cities were those cities located in the eastern half of the country and some parts of western Florida and the western Gulf Coast (Borden et al. 2007).

Emergency response systems can be easily overwhelmed in areas with a higher concentration of populations because too many individuals require assistance when a disaster occurs (Misomali and McEntire 2008). Therefore, public managers and emergency personnel may inevitably face response demand challenges that arise from emergency operations in these densely populated coastal areas. Another challenge is identifying and specifying the exact number of people residing in densely populous areas. Furthermore, because of a higher economic status and attractive landscapes, these areas may be temporarily populated by tourists, transient workers, and illegal foreign laborers, making it a more multi-cultural and complex society. This temporary population makes disaster planning and management even more complicated, especially the adequate allocation of personnel and resources.

Demographic Changes: Female-Headed Households

Recent census data indicate that the number of female householders has steadily increased (U.S. Census Bureau 2009). Figure 15.5 shows the trend of change in female-headed households. The number of female-headed families increased dramatically from 2000 to 2007 (from about 12.7 million families to about 14.4 million families) and continued to steadily increase from 2008 to 2009 (to 14.5 million families). Census data (2009) suggest that the three ethnic groups with highest

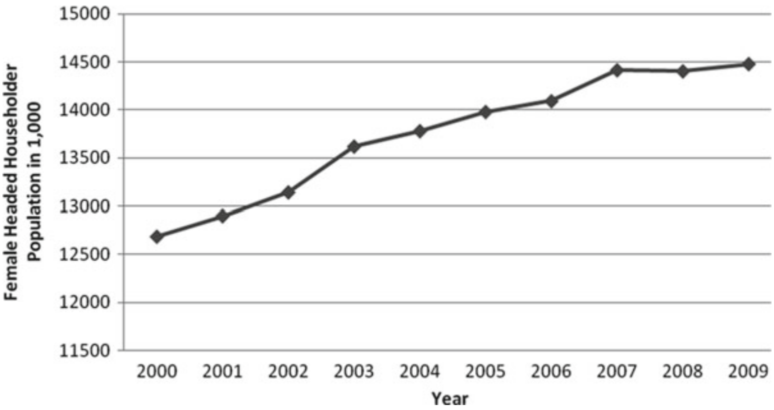

Fig. 15.5 Female householder, 2000–2009 (Source: U.S. Census Bureau, current population survey, 2009)

numbers of female householders are White, Black, and Hispanics, respectively, and most of the households have two or three members in the family. Poverty is one of the main characteristics adding to the vulnerability of these female-headed families. They tend to have a higher rate of poverty than male-headed families and all other family types. Census data regarding the poverty rate and families in poverty in the U. S. reported that, in 2008, there were 4.2 million female-householder-with-no-husband-present families that had a poverty rate of 28.7%. These numbers are much higher than that of male householders, with a 13.8% poverty rate and 723,000 families, and married-couple families with a 5.5% poverty rate and 3.3 million families (U.S. Census Bureau 2009).

It is documented that poverty in female-headed families is in large part attributed to the relatively low total income of many female-headed families that is due to "the presence of at most only one (female) wage earner and women's lower earnings in the labor market" (Snyder et al. 2006). This factor makes these families more vulnerable during and after disasters, especially because there are dependent children to take care of, feed, and clothe. This change in the number of female-headed households is another change in the demographics of the U.S. population that will pose multiple challenges to disaster management.

Female-Headed Households and Disasters

Single mothers/female-headed families are more vulnerable than families with married couples. Previous research has often found that female-headed families were likely to reside in poorer housing that was inadequately equipped to withstand a storm, and they were thus forced to migrate after a disaster (see for example Morrow-Jones and Morrow-Jones 1991; Peocock and Girard 1997; Hunter 2005).

Single mothers are vulnerable to disasters because they lack the resources to adequately respond during disastrous events (Enarson 1998), and “they are more likely to remain with family members in emergencies to nurture, assist, and protect them” (Mileti 1999). Public managers and emergency management personnel need to realize the increase in this special population and take it into consideration when planning and managing for disasters and other emergencies.

Towards a Proactive Disaster Management

Demographic changes imply that aging and foreign born immigrant populations as well as rapidly growing populations in some coastal, highly developed areas are central concerns to future disaster management. Population and demographic data can be used for long-term community planning (10-year, 20-year, 30-year, 40-year, or even 50-year plans) and also used in proactive planning. Public administrators and emergency management personnel must not only respond to disasters by reacting to them using traditional methods, but also need to proactively work to mitigate potential hazards that could possibly turn into disasters. The following section is organized under the four phases of the comprehensive disaster management cycle, namely: *mitigation, preparedness, response,* and *recovery,* as articulated by the Federal Emergency Management Agency (Lindell et al. 2007). It is intended to highlight the implications of utilizing projected demographic data related to special population segments in U.S. communities to plan for and manage future disasters.

- ***Disaster mitigation*** involves any efforts or activities undertaken to reduce or limit the likelihood of disaster occurrence and its impacts.

  Population and demographic data can be used to educate citizens through friends, family, and peer group networks to take protective actions even before the threat of a disaster is eminent (Lindell et al. 2009). The data are also helpful in creating hazard mitigation plans that target all segments of the population and facilitate a conduit for funding and reimbursement from FEMA in case a disaster occurs. They can be used to undertake hazard risk analyses that help reduce losses to human lives (Arlikatti et al. 2006). Demographic data can provide information about the number and residential locations of elderly, immigrants, and single-mother populations within a geographic area, enabling the identification of hot spots that are increasingly vulnerable. Such analyses can help target specific mitigation practices such as land-use controls, coastal regulation zones, and community protection works such as levees and floodwalls to protect the populace.
- ***Disaster preparedness*** involves activities such as developing plans and procedures, identifying and preparing resources, and training and exercising first responders. It aims at protecting lives and property and facilitating rapid recovery.

  Preparedness activities are undertaken to make sure that first responders are ready and capable to perform their tasks in real disaster situations. For example, evacuating the elderly who need special care, but who live in their own homes, rather than in nursing homes or assisted living facilities, requires additional planning of pick up routes, extra time to load and unload evacuation vehicles, and special resources such as buses equipped with wheelchair lifts (Bascetta 2006, p. 8). Thus, public managers and emergency personnel need to utilize demographic data to carefully plan for evacuating these populations in times of disasters. Such data may be vital to plan or revise evacuation plans to reflect the reality of growing population as much as possible. With regard to emergency training and exercising, demographic data will allow emergency managers to develop or design training courses that are more relevant to future situations. For example, by realizing the increase in elderly populations, public managers can incorporate courses for first responders that cover evacuation and sheltering of elderly with disabilities and with special needs. Well-trained responders can work more effectively with the elderly when evacuating them in real situations. This training can reduce unnecessary loss of life or injury to the elderly during a disaster.

- ***Disaster response*** involves warning, evacuation, search and rescue, shelter, and provision of emergency food and medical care and has the goals of limiting damage from the primary impact and minimizing damage from secondary impacts.

  Knowing the numbers and locations of vulnerable populations such as the elderly and immigrants will allow public managers and emergency management personnel to respond to a disaster more effectively. For example, emergency managers can issue warnings, evacuation orders, and sheltering instructions in multiple languages to accommodate people with limited English proficiency, who can thus take appropriate actions during a disaster. Likewise, these warnings, evacuation orders, and sheltering instructions should be presented via multiple media and tailored to accommodate the needs of elderly persons who are hearing or visually impaired.

  Studying demographic projections will allow emergency managers to note the dramatic increase in the number of elderly, and thus allow them to coordinate with agencies such as Area Agencies on Aging (AAA), senior centers, home health care groups, nursing homes, and public health officials/centers through “mutual aid agreements” in case special resources, expertise, and specialists are needed to assist with evacuation, sheltering, and emergency food and medical operations. In case of foreign-born populations, emergency agencies could work with organizations such as local Mexican, Korean, or Chinese associations, or faith-based associations like temples, mosques, or churches to communicate with these foreign-born populations when they need to be evacuated or during shelter operations in order to meet culture-specific needs.

- ***Disaster recovery*** is a “hazard management strategy that has the goal of restoring the normal functioning of a community” (Lindell et al. 2007, p. 16) and involves activities like clearing debris, providing housing, renewing government services, and renewing economic activities.

  All these activities are aimed at bringing back the normal life to affected people. Thus, timely and accurate information is very important. Following disasters, victims require timely and accurate information for obtaining essentials such as food, water, shelter, medical care, transportation, and housing (Penner and Wachsmuth 2008). Information regarding disaster recovery must accommodate disabilities associated with an aging population and needs of single-mothers. It is essential that the information not only be presented in multiple languages to help foreign-born populations but also via multiple media to help different special needs populations. In short, public managers may need to set up special, multi-lingual taskforce/teams to translate application procedures into multiple languages so that those who have limited English proficiency can understand the procedures correctly; simplify application procedures for disaster assistance funds to benefit the elderly and single-mothers; and possibly assign a special team to work closely with female-headed families who need to obtain counseling, child-care, food subsidies, and school related help.

Conclusions

As noted by Alexander (1993), the impact of hazards has become more profound as the complexities of societies increase. Since disasters occur when vulnerability meets with hazards (McEntire 2005), societies with a higher number of vulnerable populations will be more likely to face disasters. In this chapter we defined the notion of vulnerability as insufficient capacities of certain population groups, and this helped in identifying four specific population groups for analyses and discussions. The selected vulnerability framework allowed us to make a theoretical argument that future American communities will be more vulnerable to disasters, making it imperative for public managers and emergency planners to pay special attention to special population groups while creating disaster planning and management goals for their communities.

Our study showed that increasing population and changes in demographic patterns will make American communities more vulnerable to disasters and increase the severity of consequences when disasters occur because population increase leads to a change in the socio-economic makeup of communities, which may affect a person's or a community's ability to respond to and recover from hazardous events (Borden et al. 2007, p. 2). This rationale applies to areas that are densely populated. The built environment can either intensify or attenuate the effects of hazards (Borden et al. 2007, p. 2). Therefore the areas with poor buildings and infrastructure are more likely to experience greater losses from disasters.

The chapter concludes by showing how the notion of vulnerability helps us make linkages between the field of population/demographic studies and emergency management. We can borrow or incorporate knowledge of population studies and demographic dimensions into vulnerability analyses and disaster planning and management, thereby making them more comprehensive and proactive. By tracking the changes in population and demographic data in their jurisdictions, public managers, emergency management personnel, and policy makers can anticipate potential hazards that can be harmful to specific groups in specific areas. They can then effectively plan ahead to mitigate, prepare for, respond to, and recover from future disasters in an expeditious and effective manner. This is indeed a valuable practical contribution as it helps to raise awareness among public managers and emergency management personnel who can then work at making American communities safer.

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Chapter 16
Mental Health and Suicide: An Ecological Hierarchical Analysis of U.S. Counties and States

Augustine J. Kposowa and Aikaterini Glyniadaki

Introduction

Suicide is a leading cause of death both nationally and internationally (World Health Organization 2008; Nock et al. 2008, 2009). Recent statistics show that in 2000 there were an estimated one million suicides worldwide, a figure that translates into an alarming calculation of 1 suicide death every 40 seconds. Especially bothersome is the observation that the world's suicide rate has increased steadily over the last 50 years. For instance, the male suicide rate rose from 17 per 100,000 in 1950 to 28 per 100,000 in 2000, and suicide now ranks as the world's 13th leading cause of death (World Health Organization 2008; Stack and Kposowa 2011). Recent concerns have focused especially on the rise in suicide among youth and the associated rise in years of potential life lost (Stack and Kposowa 2011). The proportion of suicides among the relatively young to early middle age group (ages 5–44) rose from 40% of all suicides in 1950% to 55% of all suicides in 2000. World-wide, suicide now ranks as the third leading cause of death for the young (World Health Organization 2008). Given the increasing young age of suicide victims, years of potential life lost in suicides is much higher than for the top leading causes of death, cancer and heart disease (Stack and Kposowa 2011). For every completed suicide, there are family members and significant others whose lives are severely affected emotionally, economically, and socially by the death.

An extensive literature now exists in psychiatry, general medicine, and clinical psychology suggesting that mental illness elevates suicide risk (Beautrais et al. 1996; Harris and Barraclough 1997; Borges et al. 2008; Nock et al. 2008; Scocco et al. 2008; Nock et al. 2009). A major limitation that characterizes most of the

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_16, © Springer Science+Business Media B.V. 2012

above studies, as well as the biomedical literature on suicide in general, is the failure to adequately control for sociological variables. In a major study using the WHO Mental Health Surveys, for example, Nock et al. (2009) controlled for a vast array of DSM-IV psychiatric disorders in their analysis of risk factors for attempted suicide, suicide ideation, and suicide planning, yet no sociological controls were used except age, age cohort, and sex.

A second and perhaps more severe limitation is that the psychological and psychiatric investigators typically focus on suicide ideation, attempted suicides, and repeated attempts (Spijker et al. 2009; Scocco et al. 2008; Campo and Bridge 2009). Although completed suicides have to be attempted before being completed, not all attempts end up in suicide. Furthermore, the variables that predict attempts may differ from those that predict completed suicides. For example, past U.S.-based research shows that females are more likely to attempt suicide but less likely to complete the process, owing in part to differential methods selected. As a result, there is a predominance of males in the completed suicide population (Kposowa 2000; Kposowa and McElvain 2006; Scoliers et al. 2009). Some analysts admit that although mental disorders are associated with suicide ideation, the mental disorders may be much less useful in predicting which individuals with suicidal thoughts eventually move on to making serious plans and attempting suicide (Borges et al. 2008; Nock et al. 2009).

Commenting on the general problems facing the mental heath-suicide literature, Stack and Kposowa (2011) recently observed that research that finds conditions such as depression, anxiety, bipolar and other mental disorders to be related to suicide risk is often based on psychiatric patient samples including those high in depression or schizophrenia at baseline (Exline et al. 2000; Neal 1981; Huguelet et al. 2007). Some of these studies are in effect selecting their samples around the dependent variable. Stack and Kposowa (2011) argue that population-based longitudinal research is needed to determine what covariates protect at baseline against the development of psychiatric disorders that place individuals at high risk of suicide. Cross sectional research based on at-risk psychiatric patients limits the odds of uncovering the protective role of one of the key sociological variables social integration, since serious psychiatric disorders have already developed in this select group of patients.

Sociologists and social demographers have erred in the other direction, as well. While numerous sociological studies have been accumulated since the publication of Emile Durkheim's *Le Suicide* (1897), with few exceptions (e.g. Fernquist 2007), sociological studies have often shied away from acknowledging or controlling for psychological or psychiatric variables, such as depression, affective disorders, schizophrenia, anxiety disorders, and bipolar disorders (Breault 1994). Neglect of psychiatric risk factors in the sociological sciences has often been blamed on a writing of Durkheim's classic work in sociology that appeared to suggest that mental disorders were not a cause of suicide (Durkheim 1897/2002). As Breault (1994) reminds us, however, Durkheim's conclusions were not a refutation of psychology or psychiatry as disciplines, but a reflection of the quality of psychiatric data at the time, and his analysis of them.

The present study was undertaken in an effort to bridge the gap between the two research streams noted above by investigating the impact of mental illness (a key psychiatric variable) and suicide while controlling for a variety of sociological variables. The study also considers the effect of formal versus informal management of mental illness by examining the association between mental institutions and suicide. It is the view of the authors that one very serious problem that exists in suicide research is not that investigators do not wish to control for variables, but at least in the United States, such covariates are simply not available at the individual or even aggregate levels, especially in publicly available official data sources. The basic questions asked are the following: (1) Does mental illness at the state level influence county suicide rates? (2) Does the percentage of the population in mental institutions in a county influence suicide rates; (3) Do any observed associations between mental illness and suicide remain after taking into account the effects of social integration?

Counties were selected for analysis based on three considerations. First, they are independent geographic and political entities. Second, they often constitute a critical unit for the formulation of mental health and social service policies, and third, data on health and social services are readily available at the county level. Given that hierarchical modeling is to be employed, states were selected because the only direct measure of mental illness was available at the level of the state.

Theoretical Framework

In his 1897 work, Durkheim argued that suicide rates tend to be high among social groups or in communities that exhibit low levels of domestic integration. As he famously indicated, "suicide varies inversely with the degree of integration of the social groups of which the individual forms a part . . . As collective force is one of the obstacles best calculated to restrain suicide, its weakening involves a development of suicide" (Durkheim 1897/2002, p. 246).

As proposed by Durkheim (1897/2002) and other social scientists in the middle to late nineteenth century (Morselli 1881), social integration refers to the quantity and quality of ties that bind individuals to others, to their community, and to society. It indexes the degree of cohesion in social and interpersonal ties (Breault 1994; Stack 2000; Kposowa et al. 1995). The association of well-being and social integration, including mortality, has been shown in various studies (Berkman and Kawachi 2000; Berkman and Syme 1979). From this perspective, marriage constitutes a bond that ties individuals to others, to social networks, and to the wider community. Those who are not married and those who are divorced or separated have few stakes in society and as a result are more likely to exhibit risky behavior (Kposowa et al. 1995). Stack (2000, p. 167) reported that divorce increases mortality risk because it severs the bonds between people and their marriages. Accordingly, divorced and separated persons especially may suffer from depression, which in turn could trigger mental and emotional distress and risk-taking behavior, including self harm (Lagarde et al. 2004; Sorock et al. 2006).

Unlike Durkheim's (1897/2002) classic statement, in which social integration and social control were made theoretically and empirically distinct, many modern researchers and critics consider social integration to include social control, that is, the control exerted by and on people in social relationships (Umberson 1987). With regard to mortality from suicide, divorced, separated and single persons – as opposed to married – may lack the social control that moderates suicide ideation, suicide attempts, and completed suicides. Furthermore, the lack or loss of social integration in the case of divorce, separation, and being single may cause frustration that, in the absence of social control, contributes to alcohol consumption, depression, feelings of anxiety, hopelessness, and mental disorders.

Recent controversy has emerged as to which theories of Durkheim's have received wider support in the literature and which ones have been less tested (Breault 1994; Fernquist 2007). We are staying away from the controversies, but we submit that for testing psychiatric or psychological variables, his theory of egoistic suicide would be appropriate. Durkheim (1897/2002) argued that egoistic suicide occurs when social integration is low, and he suggested that modern societies are especially prone to this form of suicide. One of the hallmarks of egoism is that in modern societies, people become too self-centered, individualistic, and they are not strongly integrated into social groups. They thus suffer from low social integration, that is, they are not strongly attached, connected, or bonded to one another (Kposowa et al. 1995; Breault 1994). Implicit in Durkheim's description of social integration is the importance of social and emotional ties, as well as the amount and intensity of such ties (Breault 1994, p. 13). Low levels of integration increase suicide risk because individuals feel alienated from a group; there is less interconnectedness among people. The type of suicide that results is egoistic because it stems from less meaningful, weak, or non-existent ties to a social group, such as family, religion, or even a political group. Durkheim likewise argues that high educational attainment increases egoistic suicide because education reduces cohesion to society owing to greater questioning of group belief and ideology. Education encourages greater individualism, and hence the higher the level of education, the higher the likelihood that the educated individual might challenge existing social arrangements and even break ties to societal institutions, including the church.

At the aggregate level, past studies testing Durkheim's ideas have shown that measures of area social disintegration, such as divorce rates are consistently strong predictors of suicide (Breault 1986; Trovato 1986; Evans et al. 2004; Leenaars and Lester 1999; Neumayer 2003; Kposowa 2009). Other studies have found that area social disintegration measures are stronger determinants of suicide than area deprivation and area socio-economic status (Middleton et al. 2004; Whitley et al. 1999; Crawford and Prince 1999).

Much of the existing research on mental illness has focused on individual risk factors with relatively little attention paid to contextual effects. Although past work has investigated the association between mental illness and suicidal behavior, it is unclear whether this relationship might hold at the ecological level. Studying the link between mental health and suicide at the aggregate level is important because although there is evidence to suggest that contact between suicide victims and care providers prior to suicide is common (Matthews et al. 1994; Isometsä et al. 1995; Appleby et al. 1999; Williams et al. 2007), it is unclear what role contextual factors play in the eventual suicide. In a review of the literature on mental health and suicide, Luoma et al. (2002) concluded that one third of suicide victims had contacted mental health providers within a year of committing suicide. Luoma et al. (2002) also observed that a higher percentage (75%) of suicide victims had contacted primary care practitioners before committing suicide than with mental health specialists. Given the extent of pre-suicidal contact, and the recognized relationship between severe mental illness and suicide at the individual level (Evans et al. 2004; Hahm and Segal 2005; Kalmar et al. 2007; Pascual et al. 2008), it is legitimate to investigate whether mental illness indicators at the aggregate level also predict suicide even after taking into account social integration and social disadvantage measures.

Methods

Data

Data for level 1 were obtained from the 2002 release of the Area Resource File (ARF). The ARF is a county-level database that combines information from over 75 primary data sources into a single file to facilitate health analysis. The file contains over 6,000 variables for all counties in the United States with the exception of Alaska, for which there is a state total, and certain independent cities that have been combined into their appropriate counties. The 2000 ARF comprises 3,224 records. The ARF is designed to be used by planners, policymakers, researchers, and other analysts interested in the nation's health care delivery system and factors that may impact health status and health care in the United States. The basic county-specific file is the nucleus of the file, although the data can easily be aggregated into larger geographic units (Bureau of Health Professions [BHP] 2002).

Data contained in the ARF are cumulative, and the database contains statistics on the following categories of health resources: health professions, health training programs, health facilities, measures of resource scarcity, and health status. It also contains specific geographic codes and descriptors and information on economic activity and socioeconomic and environmental characteristics. All information is derived from existing data sources, such as the National Center for Health Statistics (mortality records), American Hospital Association (facilities statistics), American Medical Association (physician specialty data), and the U.S. Bureau of the Census (social and demographic information). More than 50 data source files are used, and millions of micro data records are processed to create the ARF. The file is routinely expanded to incorporate additional data requested by the community of ARF users. ARF is maintained and disseminated by Quality Resource Systems (http://www.arfsys.com/) under contract to the National Center for Health Workforce Analysis within the Health Resources and Services Administration (BHP 2002; http://bhpr.hrsa.gov/healthworkforce/). Several other agencies within the Department of Health and Human Services help support and sponsor the data collection and maintenance project. Since the Area Resource File is a compilation of data from other existing sources, one of its potential shortcomings is that the data reliability depends on how accurate primary sources are. Nevertheless, one criterion for data inclusion in the ARF is that they be accurate, or at least generally accurate if no better information exists (BHP 2002, p. 109). http://www.ahcpr.gov/http://www.cms.hhs.gov/http://www.cdc.gov/http://www.hrsa.gov/http://www.samhsa.gov/ The 2002 ARF file was used in preparing this report because it was the most recent available to the authors that had the relevant independent variables (http://www.arfsys.com/).

Data for level 2 (state level analysis) were derived from the Statistical Abstract of the United States (U.S. Department of Commerce 2008) and from state estimates of past year major depressive episode (MDE) obtained through the National Survey on Drug Use and Health (NSDUH). Data were obtained by launching a query for each state successively for a calculation of mental health estimates for each year from 1993 to 1995 inclusive. Queries were launched using a menu at the website of the Centers for Disease Control and Prevention (CDC 2009).

Variables and Measurement

The dependent variable used comprised suicides occurring in 1990, 1991, 1992, 1993, 1994, and 1995. Suicides were defined using the tenth revision of the *International Classification of Diseases* (ICD-10) with the underlying cause codes X60-X84 and Y87 (World Health Organization 2005). To obtain rates, suicides occurring in each year were divided by the county population, and multiplied by 100,000. The resulting rates were then summed and divided by 6. One of the advantages of averaging data over a longer time frame is that it improves reliability and stability in values and reduces the consequences of unexpected fluctuations in numbers. This is especially important in counties with relatively few suicides within a selected year.

The independent variables were selected based on theoretical relevance as well as findings from past research. To minimize problems arising from endogeneity, as much as feasible, independent variables were measured prior to the outcome variable. In addition, care was taken to select measurements based on a census year (e.g. 1990) as opposed to those based on estimates provided in an inter-censual period. The main independent variable was the *percentage of the state's population with frequent mental distress, 1993 through 1995*. Frequent mental distress is also defined as the percentage with 14 or more mentally unhealthy days (CDC 2009). The percentages are estimates that are believed to provide information about the prevalence of major depressive episodes (MDEs) in each state based on standard definitions and survey methods applied uniformly throughout the nation. NSDUH includes questions for persons aged 12 or older to assess lifetime and past year MDE. For these estimates, MDE is defined using the diagnostic criteria set forth by the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders*

(DSM-IV), which specifies a period of 2 weeks or longer during which there is either depressed mood or loss of interest or pleasure and at least four other symptoms that reflect a change in functioning, such as problems with sleep, eating, energy, concentration, and self-image (CDC 2009). To improve reliability and stability, data covering the 3 years were averaged, and entered into a separate state file to be merged with the much larger county file.

The second mental health variable was the *percentage of population in mental institutions*. It was measured as the number of persons in mental institutions divided by the county population and multiplied by 100. Given widespread deinstitutionalization of the mentally ill in the United States over the past 40 years, debate has raged about the composition of the population remaining in psychiatric homes (Mechanic and Rochefort 1990) as well as the prevalence of mental illness among the homeless, including those deinstitutionalized (Snow and Anderson 1993). The variable employed here is not a measure of the composition of the population in mental institutions or even how persons got into such places. Rather, we sought to capture formal control of mental illness relative to a less formal control. It is suggested that a mental/psychiatric setting with in-patients offers a more formal control or management of those patients and their symptoms than an outpatient clinic, those homeless, or those in the care of relatives or friends.

To measure social integration, the *divorce rate* was used. The divorce rate has been found in sociological science as the strongest and most reliable indicator of social disintegration (Breault 1986; Stack 2000; Leenaars and Lester 1999; Ben-Park and Lester 2006; Kposowa 2009). It was measured as the percentage females divorced, 1990. The total divorce rate could not be used because it was not available in the Area Resource File.

All other variables used were selected based on the literature as potential confounders. Although an extensive literature now exists, widely divergent findings have been reported on the link between area deprivation (disadvantage) and suicide rates. While some studies find that suicide rates are strongly associated with community-based measures of social disadvantage (Manuck et al. 2005), others find little or no association (Hawton et al. 2001). In a meta-analysis, Rehkopf and Buka (2006) observe that a primary reason for the contradictory findings is study design features. They point out that analyses at the community level are more likely to find lower rates of suicide in high socio-economic areas than studies using larger units of analysis. In the United States, the county is the lowest level of aggregation for which deprivation measures are available, and most variables used in this research are based on counties. It is plausible that an overlooked reason for the discrepant findings may be the increasing reliance of researchers on indices. While an index improves reliability of constructs in some cases, it may ignore potentially important sources of variation that might exist within a given index component. It is also plausible that while one component may have a positive impact on the response, another component may have opposite results. An alternative strategy might be to use indicators separately, and then judiciously create indices if necessary.

To index area deprivation, three measures were used. They included (1) the *unemployment rate,* which was measured as a percentage of total population aged

16 years and above that is unemployed (not actively looking for work) in 1990; (2) *educational attainment*, measured as a percentage of persons aged 25 years and above with less than 9 years of formal schooling, and (3) *median household income, 1989,* broken into percentiles; there was one for counties with median household above the 75th percentile, and one for counties with median household income below the 50th percentile. Counties with median household incomes between the 50th and 75th percentiles were the reference group for comparison. To reduce the risk of multicollinearity, the effects of median household income and education were estimated in separate models in the analysis.

The variable *farming dependency* was defined as follows: counties were declared farming-dependent if farming contributed a weighted annual average of 20% or more of total labor and proprietor income over the 3 years from 1987 to 1989 (Bureau of Health Professions 2002, p. 7). Counties that met this criterion were coded 1 and all other counties were the reference group. Inclusion of farming dependency into the analysis is based on results from many studies at the individual level that show excess suicide mortality among persons in farming. Studies continue to demonstrate that farmers have one of the highest suicide rates of any occupation, for example Pratt 1990; Fraser et al. 2005 (for the United States); Nishimura et al. 2004 (for Japan); Koskinen et al. 2002 (for Finland); Stark et al. 2006; Sutton et al. 2005, and Simkin et al. 2003 (for the United Kingdom).

Suicide rates in the United States have been found to be especially high among persons in the older age groups (Kachur et al. 1995; Kposowa et al. 1995; Ben-Park and Lester 2006). These and other studies report that elderly populations have higher suicide rates than persons in all other age groups. Numerous studies also indicate that male suicides exceed female suicides in every age category (Kachur et al. 1995; Kposowa 2000; Stack 2000). To capture the age-gender suicide disparity, the present research controls for the *percentage of the male population 65 years or over in 1990*.

Change in Population White, 1980–1990 was measured as the difference between percentage of county population non-Hispanic white in 1980 and 1990. This variable was included in the analysis because past work has indicated much higher suicide rates in the United States among non-Hispanic whites than among other racial/ethnic groups (Kachur et al. 1995). It is thus expected that perhaps counties that have experienced growth in the white population will also exhibit high suicide rates.

Two other variables measured at the state level were included. They were the *Gini coefficient of inequality, 1990*, and the *percent of men with arrears in child support payments, 1990*. The Gini coefficient was included to capture consequences of economic inequality in terms of relative deprivation. Child support payment arrears were designed to assess whether stressful events that men (especially the middle aged) experience as a consequence of losing child custody in family courts would be related to the suicide rate. Both variables were obtained from the *Statistical Abstract of the United States* (U.S. Department of Commerce 1995).

Descriptive statistics for all variables employed in the study at both levels are shown in Table 16.1.

Table 16.1 Descriptive statistics of the variables in the analysis at both levels

Variables	N	Mean	SD	Min	Max
Level 1 (counties)					
Suicide rates, 1990–1996	3,080	13.920	7.427	0	100.000
Percent in mental institutions, 1990	3,080	0.041	0.262	0	6.684
Female divorce rate, 1990	3,080	7.625	2.192	0.800	17.500
Unemployment rate, 16+, 1990	3,080	6.208	2.790	0	36.100
Change white population, 1980–1990	3,080	−0.903	3.704	−27.700	74.700
Pct Persons 25+ W/<9 years schooling, 1990	3,080	14.538	7.283	0.600	56.300
Pct male pop aged 65+ , 1990	3,080	6.210	1.908	0.520	15.730
Percent foreign-born pop., 1990	3,080	2.224	3.619	0	45.100
Median income 1990					
< $25,000	3,080	0.500	0.500	0	1
$50,000–$75,000	3,080	0.250	0.433	0	1
> $75,000	3,080	0.250	0.433	0	1
Level 2 (states)					
Frequent mental distress, 1993–1995	3,080	8.282	1.393	4.233	11.866
Gini coefficient of income inequality, 1989	3,080	0.452	0.017	0.410	0.537
Percent in child support arrears, 1990	3,080	3.007	0.947	0.200	5.800

Statistical Estimation

Since the data set created constitutes a hierarchical structure with individual counties located in their states, hierarchical linear modeling techniques were used (SAS Institute 2009a; Singer 1998; Raudenbush and Bryk 2002). Due to the fact that information was collected on counties nested within states, there are two levels of analysis in the data. The lowest level (level 1) comprises counties, and the second level (level 2) consists of states. The approach selected was to model fixed and random effects at both levels 1 and 2. The hierarchical linear model (Raudenbush and Bryk 2002; Singer 1998) may be summarized as follows:

$$Y_{ij} = \gamma_{00} + \gamma_{10}X_{ij} + \gamma_{01}W_j + \gamma_{11}X_{ij}W_j + u_{0j} + u_{1j}X_{ij} + r_{ij} \tag{16.1}$$

Where:

Y_{ij} = the score on the dependent variable for a given county ($_i$) located in state ($_j$)
γ_{00} = grand mean (average intercept)
X_{ij} = a level 1 (county) predictor
W_j = a level 2 (State) predictor
r_{ij} = a level 1 random effect
u_{0j}, u_{1j} = level 2 random effects

The underlying assumptions in the model include:

$E(r_{ij}) = 0$;
$\mathrm{Var}(r_{ij}) = \sigma^2$;
$\mathrm{Cov}(u_{0j}, r_{ij}) = \mathrm{Cov}(u_{1j}, r_{ij}) = 0$.

The model allows both fixed effects at either level as well as cross-level effect modifiers if theoretically warranted. The various fixed effect coefficients are represented by the γs in Eq. 16.1. Parameters for the model were estimated via full information Maximum Likelihood using the MIXED procedure available within the SAS environment, version 9.2 (SAS Institute 2009b). All other covariates were grand mean centered in order to aid in the interpretation of the intercept term. Following mean centering, the intercept reflects the average suicide rate (mean value) for all variables.

Results

The Unconditional Means Model

The essential question addressed in multilevel models adopted here is how much of the variability in the dependent variable (suicide rates) is attributable to differences between states and how much to differences between counties within the United States. We thus started the analysis by estimating a null or unconditional means model, which allows for the decomposition of variability in the response variable into within-group and between-group components (Snijders and Bosker 1999; Raudenbush and Bryk 2002). The dependent variable, which is suicide for county $_i$ nested in state $_j$ (Y_{ij}) is equal to the average suicide rate in state $_j$ plus a county level error term represented by r_{ij}. The variance of r_{ij} may be denoted as σ^2 and the variance of u_{0j} may be represented as $\tau_{00.}$ It can be seen that $\tau_{00} = \mathrm{var}(u_{0j})$ provides an estimate of the between-state variability and $\sigma^2 = \mathrm{var}(r_{ij})$ gives the within-state variability in the suicide rate. One may calculate the percentage of observed variation in suicide that is attributable to state-level characteristics by computing ρ, the intra class correlation coefficient, where $\rho = \tau_{00}/(\tau_{00\,+}\ \sigma^2)$. Subtracting 1- ρ similarly provides the percentage of variation that is not due to state characteristics, but to county characteristics instead. Thus the estimated (unconditional means) model had one fixed effect (the intercept or overall mean) and two variance components (random effects), one representing the variation between states on suicide and the other component indexing variation among counties on suicide within states. Relevant results are shown in Table 16.2.

As may be seen in Panel A, both the covariance parameter estimates (random effects) are statistically significant. The between-state estimate is 15.522 ($z = 4.49$, $p < .0001$), and the within-state variance (or variation within states across counties) is 45.877 ($z = 38.90$, $p < .0001$). These estimates suggest that states in the U.S. differ significantly in suicide rates. There is, however, greater variation in suicide among counties within states. In an attempt to determine what portion of variance in the suicide is attributable to state differences, we computed an intra-class correlation coefficient. It indicates the proportion of variance in suicide that is due to state membership. The calculation (15.522/[45.877 + 15.522]) yielded .253. It means that 25.3% of the

Table 16.2 The unconditional means model for suicide rates

Panel A					
Random effects	Estimate	Std error		z-value	p-value
Variance components					
Intercept (τ_{00}) (Between-states)	15.522**	3.456		4.49	0.0001
Level 1 variance (σ^2) (Within-states)	45.877**	1.179		38.90	.0001
Intra-class correlation	0.253				
Panel B					
Fixed effect	Estimate	Std error	df	t-value	p-value
Intercept (γ_{00})	14.499**	0.578	51	25.08	0.0001
−2 Log likelihood	20665.8				
Number of states	51				
Max obs. per state	253				
Total sample (level 1)	3,080				

**Significant at $p=0.01$

total variance in the county suicide rate can be explained by state membership or differentials. One obvious implication is that a much larger proportion of variance in suicide rates (1-.253 or 74.7%) is due to disparities among counties. The single fixed effect in Panel B of Table 16.2 (14.499) is the overall intercept or grand mean (γ_{00}), which indicates the average state suicide rate in the universe of states studied. The significant variance component for τ_{00} suggests the need to incorporate variables at level 2 in an effort to account for some of the state level variation. Accordingly, in the analyses that follow, we incorporate measures at both levels 1 and 2.

Multivariate Results

In the unconditional means model, it was observed that 25.3% of the variance in county suicide rates was due to state membership. The first stage in the multivariate analysis was thus to determine whether the state component of the variance diminishes and whether in fact it is necessary to include variables at level 2. A starting point to make sound judgment is to have a model with only level 1 variables. Accordingly, in Table 16.3 only county level covariates are shown.

As may be seen in Table 16.3, the between state variance (τ_{00}) declined from 15.522 in the unconditional means model (Table 16.2) to 11.458 in the model with only level 1 variables. However, the overall proportion of variance in suicide rate that is due to state differentials still remained relatively high, as judged by the intra-class correlation ($p=22.1\%$). What these findings suggest is the need to include variables at level 2. It should be pointed out, also, that since the variables were grand mean center the intercept term (γ_{00}) tells us the suicide rate when the independent variables are at their mean values.

Table 16.3 Hierarchical linear regression results of the effect of mental institutions on suicide rates, area resource file, 2000, **level 1 variables only**

Variables	β	Std error	t-value	p-value
Intercept (γ_{00})	14.337	0.504	28.43	0.0001
Level 1 (counties)				
Percent in mental institutions, 1990	−0.941*	0.453	−2.08	0.0377
Female divorce rate, 1990	0.744**	0.074	10.11	0.0001
Unemployment rate, 16+, 1990	0.362**	0.055	6.49	0.0001
Change white population, 1980–1990	0.065	0.035	1.85	0.0642
Pct persons 25+ W/<9 years schooling, 1990	−0.087**	0.025	−3.39	0.0007
Pct male pop aged 65+ , 1990	0.716**	0.079	9.07	0.0001
Percent foreign-born pop., 1990	−0.160**	0.043	−3.72	0.0002
Variance components				
Intercept (τ_{00}) (Between-states)	11.458	2.630	4.36	0.0001
Level 1 variance (σ^2) (Within-states)	42.585	1.095	36.89	0.0001
Intra-class correlation	0.221			
−2 log likelihood	20425.9			
LRS (df)	239.6** (7)			
Maximum obs. per subject	253			
Number of counties	3,080			
Number of states	51			

Note: All covariates were grand mean centered
LRS= likelihood ratio statistic; + based on z-test; **Significant at p=0.01; *p=0.05

Relevant regression results (Table 16.3) on the impact of the covariates on suicide illustrate that the percentage of the population in mental institutions (the only psychiatric variable at level 1) substantially reduced the county suicide rate ($\beta=-0.941$, $t=-2.08$). Specifically, for every 1% increase in the percent of the population in mental homes, the county suicide rate declined by 0.941, holding constant other variables in the model. Divorce significantly increased the suicide rate ($\beta=0.744$, $t=10.11$). For every 1 unit increase in the divorce rate, the suicide rate increased by 0.744. Unemployment increased county suicide rates ($\beta=0.362$, $t=6.49$). With the exception of change in the white population (1980–1990), all level 1 variables were statistically important. At 7° of freedom, the Likelihood Ratio Statistic (LRS=239.6, df=7) provided an adequate fit to the model in Table 16.3.

At stage 2 of the multivariate analysis, all variables at level 1 were maintained and the three state level variables were added to the model. Relevant results are shown in Table 16.4. As may be seen in the table, the state's frequent mental distress significantly elevated the county suicide rate ($\beta=0.747$, $t=2.52$). Interpreted meaningfully, the coefficient means that for every 1% increase in the percent of the state population reporting frequent mental distress (depression), the county suicide rate increased by .747, adjusted for other variables in the equation at both levels 1 and 2. Percent of the state divorced male population in child payment arrears did not reach

Table 16.4 Hierarchical linear regression results of the effect of mental illness on suicide rates, area resource file, 2000, **controlled for education**

Variables	β	Std error	t-value	p-value
Intercept (γ_{00})	14.146	0.466	30.34	.0001
Level 1 (counties)				
Percent in mental institutions, 1990	−0.926*	0.452	−2.05	0.0407
Female divorce rate, 1990	0.755**	0.074	10.26	0.0001
Unemployment rate, 16+, 1990	0.355**	0.056	6.37	0.0001
Change white population, 1980–1990	0.068*	0.035	1.94	0.0521
Pct persons 25+ W/<9 years schooling, 1990	−0.077**	0.026	−2.96	0.0031
Pct male pop Aged 65+ , 1990	0.706**	0.079	8.93	0.0001
Percent foreign-born pop., 1990	−0.159**	0.042	−3.26	0.0002
Level 2 (states)				
Frequent mental distress, 1993–1994	0.747**	0.297	2.52	0.0119
Pct in child support payment arrears, 1990	0.037	0.388	0.09	0.9248
Gini coefficient of income inequality, 1990	−68.397**	21.004	−3.26	0.0011
Variance components				
Intercept (τ_{00}) (Between-states)	9.288	2.176	4.27	0.0001
Level 1 variance (σ^2) (Within-states)	42.489	1.092	38.90	0.0001
Intra-class correlation	0.179			
−2 log likelihood	20409.6			
LRS (df)	256.2** (10)			
Maximum obs. per subject	253			
Number of counties (level 1)	3,080			
Number of states (level 2)	51			

Note: All covariates were grand mean centered
LRS= likelihood ratio statistic; + based on z-test; **Significant at p=0.01; *p=0.05

statistical or meaningful significance, but the state Gini coefficient of income inequality (a measure of relative deprivation) significantly reduced the county suicide rate (β=−68.397, t=−3.26).

The county unemployment rate elevated the suicide rate. In effect, for every 1% increase in the percent unemployed, the suicide rate increased by nearly 0.36, holding constant other variables in the model (β=0.355, t=6.37). Change in white population was marginally associated with suicide rate (β=0.068, t=1.94). Lower education was significantly associated with suicide in the negative direction, such that for every percentage increase in the percent of persons aged 25 or above with less than 9 years of education, the suicide rate declined by 0.077. An increase in the percent of the male population 65 years or older was associated with a substantial elevation in the county suicide rate (β=0.706, t=8.93). Immigration (indexed by the percent of the foreign born population in a county) was significantly associated with the county suicide rate (β=−0.159, t=−3.26). The model χ^2 (LRS) was 256.2. At 10° of freedom, this was an acceptable fit. Results in Table 16.4 indicate a reduction in the variance in suicide rate due to state differences. After adding level 2 variables, it went down from 11.458 in the previous model (Table 16.3) to 9.288 (Table 16.4), with a corresponding drop in the intra-class correlation. To determine further whether adding level 2 variables improved model above level 1 variables, a change in log likelihoods was calculated using the formula:

$$\delta \mathrm{LR} = \mathrm{LR}_{\text{model 1}} - \mathrm{LR}_{\text{model 2}} \tag{16.2}$$

where:

$\mathrm{LR}_{\text{model 1}} = -\log$ likelihood for model 1 (the baseline model with only level 1 variables and the variance components), and
$\mathrm{LR}_{\text{model 2}} = -\log$ likelihood for the expanded model with level 2 (state variables).

A change in log likelihoods is distributed as a chi-square and significance is determined on the basis of the difference in degrees of freedom between the two models. The change in log likelihoods yielded a χ^2 of 16.3 ($p = .05$), which was highly significant at 3° of freedom (where $df = 10 - 7 = 3$).

To further explore the bi-level data, cross-level interactions were calculated on variables for theoretical relevance and also on the basis of past research. It was thought that perhaps the effect on suicide of the percent of the population in mental homes at a county level might depend on the prevalence of mental distress in the state in which the county is located. Earlier analysis showed clearly that both main effects were statistically important. The question was whether the two variables have joint effects across levels in addition to their main effects. The second cross-level interaction was based on past suggestions in the literature (Kposowa 2000, 2003) that part of reason for the high suicide rate in the U.S., especially among men, may have to do with practices in family court, especially with regard to child support and child custody. An interaction term comprising the female divorce rate and the percent of divorced men in child payment arrears at the state level was included in the model.

In results not presented, the cross-level interaction term comprising percentage of population in mental homes and state mental distress was in the positive direction, but did not reach statistical significance based on conventional criteria, although the coefficients of the main effects remain virtually unchanged. The second effect modification of divorce and percent in child support arrears was statistically important ($\beta = 0.154$, $t = 2.27$). A change in likelihood ratio was calculated to determine if the model with the significant interaction was an improvement over the previous model (Table 16.2) without any interaction, using the formula in Eq. 16.2. The calculated χ^2 was 5.8. At 2° of freedom, it did not reach statistical significance at $p = .05$.

Discussion

At the ecological level, mental illness is an important covariate of suicide rates. Findings showed that the percentage of the state population in frequent mental distress is a strong and significant predictor of county suicide rates. This finding clearly suggests a link between prevalence of mental illness (especially depression) and completed suicides. Results here confirm those in psychiatry that have shown strong associations between mental illness and suicide (Harris and Barraclough 1997; Evans et al. 2004; Gould et al. 1996; Campo and Bridge 2009). Percent population in mental homes also significantly reduced suicide rates at the county level. One possible explanation is that despite debates about the quality of care in mental institutions, and despite the widespread deinstitutionalization that has taken place in the United States (Mechanic and Rochefort 1990), there may be some beneficial aspects of formal management of mental illness. It is plausible that while not all mentally ill patients should be placed in institutions, there might be some that ought to be placed in such institutions for better care management.

Findings show that even after controlling for mental illness, sociological variables, especially divorce remain, significant predictors of suicide. Results confirm recent observations by Kposowa (2009) that divorce was the strongest determinant of suicide even after taking into account availability of psychiatric services and primary care. These ecological findings are also consistent with results observed by investigators at the individual level about the influence of divorce and separation on suicide (Verbrugge 1979; Burnley 1995; Ben-Park and Lester 2006; Kposowa and D'Auria 2010). One implication of the results is that interdisciplinary research is essential in knowing more about suicide and in any efforts to combat it. Durkheim's original theory on egoistic suicide, stating that low social integration elevates suicide rates was confirmed by the analysis. The divorce rate was profoundly the strongest predictor of suicide. Durkheim originally argued that divorce is the weakest form of matrimonial regulation; it breaks the ties that bind individuals to meaningful social groups, and therefore, its occurrence leaves group members vulnerable to acts of self destruction. The negative finding on the Gini coefficient could be seen as supportive of Durkheim's suggestion that poverty reduces suicide rates.

Much has been made of Durkheim's alleged dismissal of psychiatric variables in suicide causation. His comments on alcoholism and insanity have in our view been taken out of context. We concur with Breault (1994) that Durkheim's position was not a dismissal of psychiatry and psychology as disciplines. Rather, he looked at data at the time that led him to conclude that alcoholism and insanity were not correlated with suicide (Durkheim 1897/2002). The quality of the data on mental health during his time was likely not ideal. It may well be that had he higher quality psychiatric data and found support for insanity and alcoholism, he would have modified his position about social factors alone being the main determinants of suicide. He had no other choice but to draw the conclusion that he did because he was an empirical thinker. His conclusions were not a dismissal of the two disciplines. Were he alive today, he would most likely call for usage of variables in psychiatry, psychology, and sociology in explaining suicide. Accordingly, our research findings demand that psychiatrists and sociologists work together because clearly the covariates of suicide are variegated, and no discipline has a monopoly on studying the phenomenon.

We are concerned with the lack of adequate data on mental health and completed suicides. Factors that influence suicide ideation, suicide attempts, and suicide planning may be very different from those that predict completed suicides. We call on demographers to lead the way in collecting population-based longitudinal data that can be used in linking measures of mental health at the individual level to death information using the National Death Index. Only then can definitive conclusions be drawn about mental health and completed suicides. The availability of the American Community Survey, the National Health Interview Survey, and even the National Survey of Family Growth provides opportunities for data linkage with adequate safeguards and masking techniques for assuring confidentiality and privacy. The much publicized WHO World Mental Health Surveys (so far done in 21 countries) is weak on sociological variables, and its measures of suicidal behavior do not include completed suicides. Despite the tremendous advantages of such a huge data collection effort, failure to include several measures of social conditions may well represent another opportunity lost and potentially widen the gulf between social science researchers on the one hand and psychiatric investigators on the other.

Although child support arrears by itself was not a statistically significant predictor of suicide, analysis showed that its interaction with divorce exerts a strong and significant influence on suicide rates. This finding once again points to the detrimental context and consequences of divorce and family courts.

The study has some limitations. One of them is that although we have used hierarchical modeling, the lowest level was not that of individuals, but counties. Ultimately, therefore, we have tried to explain county outcomes (suicide rates) using county and state characteristics. Thus, caution should be exercised in interpreting the findings, and one must beware of the ecological fallacy (Robinson 1950). Second, our measures of mental illness are limited; we had only two: severe mental distress (depression) and percent of population in mental institutions. There is a wide range of mental disorders (including anxiety disorders, impulse-control disorders, post traumatic stress disorder, social phobia, drug dependency) that have been found to be strongly associated with suicide and suicidal behavior at the individual level (Bostwick and Pankratz 2000; Vickers and McNally 2004; Nock et al. 2008, 2009). Ideally, we would have liked to have some of these variables in the analysis for a more comprehensive test of the performance of social factors vis-à-vis psychiatric covariates, but they are simply not available at the ecological level. It should also be reiterated that percent of the population in mental or psychiatric institutions is a very rough proxy for formal management of mentally ill patients, given that the variable is not a reflection of the quality of care that patients receive as individuals. Furthermore, it is unknown how residents ended up in the institutions. Despite the shortcomings, this research contributes tremendously to the emerging literature that bridges the gap between sociology and psychiatry in understanding the etiology of suicide.

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Part V
Methodological Advances

Chapter 17
The Grouped Answer Method for Estimating Immigration Status: Analysis of Data from the 2004 General Social Survey*

Eric M. Larson and Judith A. Droitcour

Introduction

This paper analyzes foreign-born respondents' acceptance and understanding of a question on their immigration status asked in a 2004 household survey of the general population aged 18 or older. The question uses an innovative "grouped answer" method that was devised earlier by the Government Accountability Office to reduce question threat. Questions aimed at estimating all immigration statuses—including foreign-born respondents who are illegally present in the United States; that is, undocumented—have, in general, been deemed too threatening to ask in a federal survey of the general population. The goal of devising, testing, and developing a method for collecting survey data on immigration status is to improve the federal government's capacity to provide policy-makers with information on the foreign-born population, including those who are illegally present or undocumented. Five main sections of this paper cover (1) background, (2) determination of eligible respondents, (3) respondents' answers to key questions, (4) interviewers' judgments and written-in comments, and (5) discussion of results.

*This paper reflects the views of the authors, and does not necessarily reflect the policy or position of the U.S. Government Accountability Office (GAO). Please address comments to Eric M. Larson, GAO, 441G Street, N.W., Washington, D.C. 20548, telephone (202) 512–3599; e-mail larsone@gao.gov

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_17, © Springer Science+Business Media B.V. 2012

Background

Prior and Current Testing

In 1998–1999, GAO introduced the grouped answer method and presented the results of initial testing. That testing included using bilingual GAO staff as interviewers (for pre-test and cognitive interviews), and contracting for 81 survey interviews with foreign-born Hispanic farmworkers. These early tests were conducted with Hispanics only; survey materials were printed in Spanish—and the selection of Hispanic persons for initial testing focused on those likely to be illegally present in the United States. Based on results of these field tests, GAO recommended that the Bureau of the Census and the Department of Homeland Security (DHS) conduct research to further evaluate and develop the grouped-answer method. In earlier work, we referred to this technique as the "3-card method" (see GAO 1998, 1999) and subsequently developed a version using two cards; however, grouped answers are the foundation of and more accurately describe this method.

In response to GAO's recommendation, the Census Bureau—with funding provided by DHS—inserted a question module in the 2004 General Social Survey (GSS) conducted by the National Opinion Research Center (NORC) of the University of Chicago (Davis and Smith 2005). The GSS question module represents the first time the grouped-answer method has been applied in a household survey of the general population. Key GSS data include foreign-born respondents' answers and interviewers' judgments, and comments written by interviewers, reflecting interviewer observations and statements made by respondents. An independent statistical expert reviewed the Census Bureau's analysis of the GSS data; GAO's separate analysis of the GSS data and the expert's findings are included in a detailed report on the feasibility of federal agencies using the grouped answer method to collect information on the immigration status of foreign-born persons residing in the United States (see GAO 2006).

The Grouped Answer Method

The grouped answer method features two or more alternative immigration-status cards, each of which is used with a different sub-sample of foreign-born respondents. Each card features a 3-box set of immigration-status answer categories; the respondent chooses the box that contains his or her immigration status (an example card is included in Appendix I).

Box A contains one or two non-sensitive immigration status(es); Box B contains the sensitive undocumented status and a variety of other non-sensitive statuses; the remaining box—Box C—is for some other category, not in Box A or Box B. The various cards alternate the non-sensitive statuses appearing Box A versus Box B; thus, it is possible to obtain direct estimates of each non-sensitive (Box A) category and, via subtraction, to obtain an indirect, "residual" estimate of the sensitive, undocumented status. No individual respondent is ever associated with the sensitive, undocumented or illegally present status.

The grouped answer method, as originally designed and field-tested, asked each respondent who chose Box A to carefully re-check the mix of statuses in Box B to be sure that those statuses did not apply to him or her. In addition, specific follow-up questions were asked. For example, respondents choosing Box A with the category "legal permanent resident" were asked whether they had applied for U.S. citizenship (legal permanent residents are eligible to apply after 3–5 years), and if so, whether their application had been approved—and whether they had been sworn in. They were also asked under what program they applied for their "green card" and whether and how they had received it. This allowed interviewers to redirect respondents to Box B if they had mistakenly chosen Box A, as might occur if a respondent did not read Box B carefully (especially if, for example, he or she (1) used to be in the Box A status, (2) had applied for the Box A status, or (3) perhaps wanted Box A status—but was currently in a Box B status). The follow-up questions are intended to help respondents correctly choose between Box A and Box B.

The General Social Survey (GSS)

The GSS is a personal interview survey conducted by NORC on a periodic basis. Partial funding is provided by the National Science Foundation. Probabilistic sample selection proceeds in stages: initial selection of areas, subsequent selection of households within selected areas, and finally, selection of a single respondent (age 18 or older) within each selected household.

Interviewers attempt to interview each selected respondent in his or her home. Some interviews are conducted over the telephone, as a last resort when the interviewee cannot be interviewed in person. In other cases, no interview can be completed. The overall response rate is about 70%.

The core questionnaire is developed by NORC; additional question modules developed by others may be added for a fee, if approved by a GSS board. The various modules are checked against the core questionnaire for consistency and possible overlap. NORC also told us that: "Often if a prior question does what an item in a module is to do, the module is revised to avoid redundancies (e.g., not asking labor force status twice). However, other times two very similar questions will be asked, because of some small difference in the item." According to NORC, the 2004 GSS data do not allow deductive disclosure of respondent identity. To illustrate protection against deductive disclosure, in the 2004 GSS data, the respondent's current place of residence is described in terms of region of the country but not by "size of place."

Limited GSS Coverage of the Foreign-Born Population

The 2004 GSS was conducted in English only, although household members were allowed to help respondents who were less than fully fluent. Because interviews were conducted in English only, the data cover those persons who spoke English sufficiently to complete the interview. We believe these data cannot be viewed as representative of the foreign-born population. Especially likely to be omitted are recent immigrants—a group within which illegal immigrants may be concentrated. One researcher estimated that 30% of illegal immigrants residing in the United States in 2004 had arrived in 2000 or later (Passel 2006, p. 8). We note also that even surveys that offer interviewing in English and Spanish may not fully cover the foreign population—partly because some immigrants may not speak either of these languages. Other reasons for less than full coverage are that some illegal immigrants may avoid being interviewed, others may reside in unconventional or nontraditional living quarters not identified by survey enumerators, and so forth (see GAO 1998, p. 43, Table 4.2).

Because they provide results on a different and much broader spectrum of the foreign-born population, however, we view the 2004 GSS data as complementary to GAO's earlier work that examined the grouped-answer method.

Key GSS Questions

As discussed below, key questions occur in three sections of the 2004 GSS: the core questionnaire, the immigration module, and a national identity module.

The 2004 GSS core questionnaire asked all respondents whether they—and their parents—were born in the United States, as well as a number of basic demographic items, such as age, sex, race, and education. The core questionnaire also asked a variety of other questions, including a question about whether—"around the time" the respondent was age 16—the respondent lived with his own mother and father or with other "substitute" parents (e.g., one or more step-parents, or relatives).

The immigration module (see Appendix I) tested respondent reactions to one of the alternative immigration-status cards—specifically, the one with "legal permanent resident" in Box A. In the module, respondents were asked four questions:

- a direct question on the respondent's country of birth,
- two training questions, each using a card with a 3-box answer card to familiarize respondents with this format, and
- an immigration-status question using a 3-box answer card.

The two training cards asked each foreign-born respondent to identify (1) the type of house in which he or she had lived, when in the home country; and (2) the type of transportation he or she had taken from the home country to the United States.

Because the immigration-status card featured the "legal permanent resident" category in Box A, the following categories were mixed together in Box B: U.S. citizen, temporary visa (e.g., student or work visa), undocumented, and refugee/

person granted asylum. Respondents were asked to pick a box—and were told that there would be no further questions on Box B.

The module also had questions for interviewers: When interviewers showed respondents the 3-box cards, the interviewers were asked to record not only which box respondents picked, but also to record any comments or information the respondent might provide. Additionally, GSS interviewers were asked to record (1) comments respondents made, if any, about each of the 3-box cards, (2) their own judgments about whether respondents understood the 3-box cards, and (3) their observations concerning whether respondents objected or delayed answering in response to the immigration-status card. The written comments are not included in the publicly available GSS data set. However, NORC provided the comments at GAO's request. GAO provided these additional data to the Census Bureau. (The immigration module took an average of 3.25 min to administer.)

A "national identity" module, first inserted in GSS in 1996 under sponsorship of the International Social Survey Programme (ISSP), enabled us to determine the U.S. citizenship status of some foreign-born respondents, because some of the questions were repeated in 2004 (the national identity module was not inserted in the 1998, 2000, or 2002 GSS). The national identity module asked a random half of the 2004 GSS respondents to answer various questions including direct questions about (1) the respondent's U.S. citizenship, and (2) whether or not the respondent's parent(s) were U.S. citizens at the time of the respondent's birth. These questions are worded: "Are you a citizen of America?" and "At the time of your birth, were both, one or neither of your parents citizens of America?" (Davis et al. 2005, p. 1638).

Asking a question on the foreign-born respondent's citizenship is inconsistent with a statement in the immigration module. Specifically, when showing respondents the immigration-status card, interviewers stated: "there will be no further questions on Box B." When we noticed this inconsistency in the *General Social Surveys, 1972–2004: Cumulative Codebook* and asked NORC officials about it, they told us that, to their knowledge, neither respondents nor interviewers had noticed the inconsistency. NORC officials added that although there are some checks for overlaps, "In this case, no one spotted the issue you pointed out."

For Box B respondents who were among the "random half" selected for the national identity module, the citizenship question reduced the number of non-sensitive statuses in Box B—and the degree of privacy protection beyond that originally intended. Privacy protection was not eliminated, however, because a respondent who picked Box B on the immigration-status card and later said, in the national identity module, that he or she was not a U.S. citizen, could be (1) undocumented or (2) here on a temporary visa, or as a refugee or a person granted asylum.

Limitations of the Immigration Module

The immigration module represents a limited version or test of the grouped answer method in that it (1) tests only one immigration-status card (not all the alternative immigration status cards) and (2) does not include follow-up instructions or questions for respondents who choose Box A. Although the lack of Box A follow-up questions would invalidate a test of whether respondents choose the correct box, we believe this limitation is not a problem for a test of respondent acceptance and understanding of the immigration status question and the card's 3-box format. (For example, the Box A follow-up questions do not pertain to respondents' picking a Box versus refusing to answer.)

Other Data Limitations

According to the director of the GSS, 300 of the 2,812 completed interviews in the 2004 GSS were telephone interviews. The director also said that NORC will try to reduce that number in the future because the GSS is supposed to be a face-to-face household interview survey. At this time, complete data identifying the mode of interview (person or telephone) for the 2004 GSS are unavailable. At our request, NORC graciously made a special effort to check—by hand—the mode of interview for 16 foreign-born respondents who did not (1) choose a box on the immigration status card, or (2) provide useful information in comments to the interviewer that enabled their classification in a box. These respondents are discussed below.

We initially determined, based on comments written in by some interviewers, that four respondents had been interviewed by telephone. But the extent to which other respondents had been interviewed by telephone was unknown, and we initially conducted our analysis of the 2004 GSS data excluding only four respondents because they were not interviewed in person. That initial analysis indicated there were 16 respondents who did not provide useable answers in response to the immigration status question. When NORC conducted the special check of these 16 interviews, they found that 10 of the 16 had, in fact, been conducted by telephone. We subsequently revised our analyses, eliminating the additional 10 interviews identified as being conducted by telephone. We offered the Census Bureau an opportunity to revise its analysis (U.S. Bureau of the Census 2006) in light of these new data, and it declined.

Another limitation is that GSS data do not unambiguously identify respondents who are U.S. citizens at birth. For a respondent born outside the United States, the citizenship of his or her biological parents at the time of the respondent's birth determines whether the respondent is a U.S. citizen at birth. But the question on where the respondent's parents were born does not specifically refer to the respondent's biological parents (or legal parents at the time of birth). To the extent that a respondent referred to, e.g., step-parents when answering these questions, it may be difficult to correctly determine if the respondent is a U.S. citizen at birth. The same limitation applies to the national-identity-module question on the respondent's parents' citizenship at the time of the respondent's birth.

Approach to Analysis

Our analysis utilizes (1) questions about whether respondents and their parents were born in the United States (from the GSS core questionnaire); (2) questions on the respondents' citizenship, and their parents' U.S. citizenship at the time of the respondents' birth (from the national identity module), and (3) all questions in the immigration module, including those for respondents and those for interviewers. Because many other questions were included in the various GSS modules, additional analyses to those presented here may be directly or indirectly relevant. This paper is limited to analyses that appear to be most directly relevant to the question of respondent acceptance and understanding.

Specifically, to identify eligible respondents, we used data from (1) the GSS core questions, and (2) the question on the respondent's parents' citizenship at the time of the respondent's birth, which was included in the national identity module. We examined respondent answers to all four questions in the immigration module (coded answers and, in some cases, more specific, written-in answers given in response to the immigration-status card in lieu of picking a box); we were able to compare patterns of item non-response across the immigration module questions. We also compared these responses with responses to the question about the respondent's citizenship, which was included in the (subsequent) national identity module.

Lastly, we examined interviewer judgments about whether respondents understood the 3-box format and whether respondents objected to the immigration status question—as well as interviewer notations of respondent comments and other written-in interviewer observations, which related to their understanding and acceptance of the 3-box cards; these were part of the immigration module.

As indicated above, we believe the GSS data on foreign-born persons are likely not generalizable to the foreign-born population residing in the United States. We believe the GSS data included in this analysis are best viewed as a very large-sample pre-test. For this reason, we ran all data unweighted.

Eligible Respondents: Foreign-Born Persons Interviewed Face-to-Face

The grouped answer method is intended for use with respondents who (1) were not U.S. citizens at birth and (2) are interviewed in person. We believe that both these conditions represent logical eligibility criteria for this analysis of respondent understanding and acceptance.

With respect to the first criterion, we define a "foreign born" respondent as one who was not born a U.S. citizen. The GSS core questions identify respondents born outside the United States to parents who were also born outside the United States. However, this apparently "foreign-born" group may erroneously include some respondents who were born U.S. citizens; the reason is that the GSS core questions on nativity:

- do not identify respondents who were born outside the United States to parent(s) who were naturalized U.S. citizens at the time of the respondent's birth; and
- do not specify that only biological parents (or others who were the respondent's legal parents at the time of his or her birth) are to be considered.

Regarding the second bullet point: if a respondent were to answer, for example, that his or her "parents" were both born outside the United States—but was referring to a mother and a step-father, other relatives, or to adoptive parents—the data would seem to indicate that this respondent was not a U.S. citizen at birth, but that would not necessarily be the case.

A question that addresses the first bullet was asked in the national-identity module; however, like the core questionnaire, this module did not specify that only biological parents were to be considered. Also, the national identity module was administered to a random half, rather than all, 2004 GSS respondents.

The GSS core and national identity questions about respondent's citizenship at birth differ from the American Community Survey (ACS) questions on citizenship. The ACS asks first whether the respondent was born in the 50 states, and if not, whether the respondent is currently a U.S. citizen; then, those claiming U.S. citizenship are asked a question to distinguish whether they were "born abroad of American parent or parents" or became a "U.S.-citizen by naturalization." (These questions are quoted and the question order is specified in the ACS interviewer manual. See U.S. Department of Commerce 2004, pp. 4–105 to 4–108.) The ACS direct question on current citizenship is not directly transferable to a survey that includes an immigration status card with U.S. citizen as one of the statuses on the card. However, a different question might draw on the general ACS approach yet still be compatible with the use of immigration-status cards that include the U.S. citizen status. (The section below that discusses results suggests one such approach.)

With respect to the second criterion, GSS data were not available to indicate whether each respondent was interviewed in person (our criterion) or by telephone. NORC told us that it plans to make case-level information on mode of interview available by the end of 2006. Because of these data limitations, we defined eligible respondents as those who—to the best of our knowledge—met the criteria specified above: (1) foreign born, that is, not born a U.S. citizen, and (2) interviewed in person. The specific procedures we used to identify eligible respondents are shown in Table 17.1.

We thus identified 218 eligible respondents. However, we do not know how many—if any—of these respondents might have been deemed ineligible (1) if respondents had been instructed that questions about their parents referred only to persons who were their biological parents (or otherwise their legal parents) at the time of their birth; (2) if all respondents, rather than a random half, had been asked a question about parents' citizenship at the time of the respondent's birth; and/or (3) if the mode of interview (telephone versus in-person) were known for each respondent.

Table 17.1 Procedures for determining eligible respondents[a]

Procedures for determining eligible respondents	Number of respondents
Starting point: respondents born outside the United States	266
Minus those who said their parent(s) were U.S.-born[b]	−29
Minus those who said they did not know whether one or both of their parents were born in the United States	−1
Subtotal: respondents who said they and their parents were born outside the U.S.	236
Minus other respondents who said they were born to parent(s) who were U.S. citizens at the time of the respondent's birth (question asked of a random half)[c]	−4
Subtotal: respondents who were (likely) not U.S. citizens at birth	232
Minus foreign-born respondents known to have been interviewed on the telephone (not face-to-face)[d]	−14
Total eligible respondents	218

[a]Respondents participating in the 2004 General Social Survey (GSS) fielded by the National Opinion Research Center (NORC) of the University of Chicago

[b]All respondents were asked whether their parents were born in the United States

[c]A question about the respondent's parents' citizenship at the time of the respondent's birth was asked in the national identity module administered to a random half of the 2004 GSS sample, subsequent to the immigration-status module. Of the 236 respondents who said that they and both their parents were born outside the United States, 96 were asked about their parents' citizenship at the time of the respondent's birth—the other 140 were not asked. Four of the 96 (about 4%) said that one or both of their parents were U.S. citizens at respondent's birth. Extrapolating the 4% to the 236 yields an estimated 10 respondents whose parents were U.S. citizens at the time of the respondent's birth. Potentially, some of the 218 respondents whom we identified as eligible would have been deemed ineligible if they had been asked about parents' citizenship at birth. Our "best-guess" of this number is 6 persons (10 minus 4); it this was the case, there would be 212 eligible respondents (218−6=212)

[d]In 4 cases, interviewers wrote in comments indicating that the interview was being conducted on the telephone. We asked NORC to identify the mode of interview (person or telephone) for 16 foreign-born respondents who did not (1) choose a box on the immigration status card, or (2) provide useful information in comments to the interviewer that enabled their classification in a box. NORC told us that 10 of the 16 were interviewed by telephone, and we removed these 10 from the group of eligible respondents. The number of telephone interviews that were conducted among the remaining 218 eligible respondents is not known at this time

Respondent Answers

Providing Usable Answers

Logically, respondents who did not provide usable answers may not accept or may not understand a question or a set of responses on a flashcard. Thus, we (1) determined how many of the 218 eligible respondents did vs. did not provide usable answers on the immigration-status question; (2) explored patterns of response among those not providing usable answers on this question; (3) compared, for a subset of the 218 (i.e., for the 92 respondents who were subsequently asked a direct question on U.S. citizenship), the percentages providing usable answers to (a) the immigration-status question and (b) the subsequent U.S. citizenship question. The results are as follows.

How Many Eligible Respondents Provided Usable Answers?

The great majority of eligible respondents—97% (212 of 218) provided usable information when shown the immigration-status card; the other 3% (6) either refused or said "don't know."

Most of the 212 were recorded as picking a box; a few others gave verbal answers that were written in by interviewers and that we deemed usable information. Specifically:

- 82 were recorded as picking Box A (legal permanent resident—38% of the 218),
- 126 were recorded as picking Box B (a mix of several statuses—58% of the 218),
- one was recorded as picking Box C and providing specific verbal information on his immigration status (less than ½ of 1% of the 218).
- three were recorded as not picking a box but as providing specific information on their immigration status (1% of the 218).

The single respondent who picked Box C ("some other category—not in Box A or Box B") stated that he had a student visa—which we deemed recodable as a Box B response. Of the three respondents who did not pick a box but provided specific information, two volunteered that they were U.S. citizens—which we deemed recodable as a Box B response; a third said that he had "papers for job"—arguably, also recodable as a Box B response. A DHS official told us that "papers for job" could refer to (1) an employment authorization document (EAD) issued by DHS, or potentially (2) certain other documents conferring work authorization. Persons with such documents would not be legal permanent residents (Box A), although they may have applied for that status. They could fall into various categories included in Box B, other than citizenship. Although it is sometimes difficult to classify such persons, we believe the cards can be revised to better allow such respondents to pick an appropriate box.

Some respondents apparently prefer to indicate their specific status; indeed, it is possible that some of those recorded as picking a box had actually called out a specific status—and were recorded as picking the corresponding box, by the interviewer. Whether the specific status or the appropriate box is recorded, usable information is obtained.

What Are Patterns of Response for the Six Respondents Who Refused or Said "Don't Know" on the Immigration-Status Question?

Overall, the six refusal-or-don't-know cases have the following characteristics:

- five were born in Hispanic home countries (83%), including three who were born in Mexico,

- three are aged 50+ (50%), none of whom were from Mexico, and
- one has a college education, two have some college education, one is a high school graduate, one has some high school, and one has less than a high school education.

Of the three respondents who said they were born in Mexico, two had less than a high-school education, and one was a high-school graduate. Of the remaining three respondents, one was born in Ecuador, one was born in Honduras, and one had no answer recorded for place of birth. In other words, the six refusal-or-don't-know respondents are a varied group.

The responses that these six gave to the immigration-status card question were coded as follows:

- three refused (50%)
- the other three said "don't know" (50%)

Looking across all four questions in the immigration module, the six refusal-or-don't know cases exhibited the patterns shown in Table 17.2.

For the small number of respondents (6) who did not provide useful information on the immigration status card, all but one also did not provide a meaningful response on one or more training cards, as Table 17.2 shows. Regarding the one respondent who answered both training cards, but said "don't know" on the legal status card, the interviewer wrote: "Don't know if he is a legal resident." The interviewer recorded this comment separately as an other qualified answer when the respondent objected to or delayed answering the immigration status card. (Interviewers were instructed to record an answer if the respondent objected; although this respondent did not object, the interviewer wrote this comment anyway.) We believe from the context of the comment that the respondent, an 18-year-old Mexican male, may have volunteered that he did not know whether he was a legal resident. While this relatively small number of cases does not provide an adequate basis for generalization, we note that it was extremely unlikely for a problem with the immigration status card to occur—without the same sort of problem also occurring on at least one training card.

Considering all 218 respondents as a group, the strongest tendency overall was to provide usable answers on all 3-box cards. Of the 212 respondents providing usable information on the immigration-status card, 205 (97%) had picked a box on both training cards; these 205 also represent 94% of all respondents. Only <u>two respondents</u> who provided usable information on the immigration-status card failed to pick a box on both training cards—and only 5 others (2% of the 212) picked a box on one training card but failed to pick a box on the other.

Table 17.2 Answer patterns for six refusal-or-don't know cases: immigration module

Answer pattern summaries	Number of respondents	Specific country where born	3-box cards (house, transportation, immigration status): Type of house in home country	Type of transportation from home country	Current immigration status
3 respondents refused or said "don't know" on all 3-box cards	1[a]	No answer	Refused	Refused	Refused
	1[b]	Answered	Refused	Refused	Refused
	1[c]	Answered	Don't know	Don't know	Don't know
3 answered one or both training cards, but refused or said "don't know" on the immigration status card	1[d]	Answered	Answered	Refused	Refused
	1[e]	Answered	Answered	Don't know	Don't know
	1[f]	Answered	Answered	Answered	Don't know

[a]Age 52, female, college education, no answer recorded for country of birth
[b]Age 24, female, high school graduate, born in Mexico
[c]Age 50, female, some college education, born in Ecuador
[d]Age 31, female, 7th grade education, born in Mexico
[e]Age 52, male, some college education, born in Honduras
[f]Age 18, male, 11th grade education, born in Mexico; interviewer commented: "Don't know if he is a legal resident"

What Can Be Learned by Comparisons to Responses on the National-Identity Module?

Among the 92 respondents eligible for this analysis who were randomly selected for the national identity module, the numbers providing usable information were nearly identical for the immigration-status card question and the direct question on U.S. citizenship. Specifically, of the 92 respondents:

- 90 (or 98% of the 92) provided usable information on the immigration-status card question, and
- 92 (100% of the 92) provided usable information on the direct citizenship question.

Because 100% of the 92 answered a direct question indicating whether they were naturalized U.S. citizens (and also answered other related questions in the national identity module, which occurred after the immigration module), it appears that asking the immigration card question did not negatively impact respondent willingness to answer later questions. (Of course, there is no way of knowing whether the immigration module may have impacted the way that respondents answered subsequent questions.) We believe this constitutes further evidence of respondent acceptance of the 3-box cards and the grouped-answer approach.

In comparing individual respondents' answers to the immigration-status card question with their answers to the direct citizenship question, we found an inconsistency: eight respondents who picked Box A (legal permanent resident) later stated they were U.S. citizens (on the national identity module). However, we believe it would be inappropriate to highlight this finding—and we did not explore these cases in depth—because the immigration module inserted in the GSS did not include the follow-up checks for Box A respondents. There is also the possibility of misreporting on the American citizenship item that was included in the national identity module.

We note that some researchers have identified over-reporting of naturalized citizenship in the Current Population Survey (CPS) and have corrected for this in current estimates of the illegal population (Passel et al. 1997; Passel 2006, p.18) Additionally, some misreporting may have occurred because the national identity module asked whether the respondent was a "citizen of America" rather than a citizen of the United States; potentially, some citizens of South American or North American countries other than the United States may have been confused by this phrasing, thinking of themselves as citizens of an American country.

Interviewers' Comments and Judgments

Interviewers were asked to note whether respondents presented with the immigration status card objected verbally, or delayed or kept silent. Interviewers were also asked to note any respondent comments relating to each of the 3-box cards.

Only three respondents out of the 218 eligible were coded as objecting verbally (1%) and four as having "kept silent for a while" (2%). Overall, interviewers said that nearly 84% of the eligible respondents (183 of 218) understood the 3-box format and that 10% did not. Their reports differed markedly, however, by whether respondents provided usable information. In some cases, comments and written-in observations are relevant.

Judgments and Comments About the Respondents Who Provided Usable Information

Of the 212 respondents providing usable information:

- 98% (207 of 212) were coded as not objecting, delaying or keeping silent. Only one was coded as objecting verbally.
- All four who delayed or kept silent for a while were in this usable-information group.
- 85% (180 of 212) were coded as appearing to understand the 3-box format, with about 10% appearing not to understand the 3-box format.
- The remaining 5% were coded "other" on the understanding item; in general, no meaningful explanation was written in for the "other" code on this item.

An interviewer wrote in some key comments made by one of the respondents who provided useful information. In response to the first 3-box card (on type of housing in the home country)—and again on the immigration status card—this respondent, who had a graduate school education, questioned the 3-box format. Specifically, he wondered on the first (housing) card, "why an apartment building and a shack" were in the same box, and he made a similar comment on the immigration status card. However, he did pick a box on each training card and on the immigration status card (this respondent was coded as understanding the 3-box format and as not objecting to the immigration status question). No other comments of this nature were written in for any other respondent—whether on the housing card, the transportation card, or the immigration status card. Earlier testing with Hispanic respondents doing jobs associated with lower education levels (such as farm work, lawn care, cleaning, or painting) included some in-depth discussions between interviewers and respondents, but no respondent questions about box groupings were reported (GAO 1999, pp. 40, 80).

Another respondent who provided usable information was described by the interviewer as someone who "just talked" and didn't pay attention to the boxes. However, that respondent (a college-educated woman in her 70s), picked a box on each card—Box B on the immigration status card; she was also selected for the national identity module and stated that she was a U.S. citizen. (The U.S. citizen status is in Box B.) There were no other descriptions of this type of behavior (failure to look at or focus on a box).

More commonly, the comments that interviewers wrote in concerned respondent descriptions of the specific type of house that they had lived in or the specific circumstances of their travel to the United States.

Judgments and Comments About Respondents Who Did Not Provide Usable Information

For the six respondents who did not provide usable information on the immigration status card, interviewers provided unambiguous comments only about 50% of the time as to whether or not the respondent (1) objected or delayed in responding, or (2) appeared to understand the 3-box format. It is difficult to interpret the understanding of one respondent (see Table 17.2, row 1), a 52-year-old female with a college education, who did not identify her country of birth and thereafter refused to answer any 3-box questions. Notably, the interviewer also recorded "refused" in judging whether the respondent (1) understood the 3-box format, and (2) objected to the immigration status card. This respondent may or may not have understood the 3-box format, but clearly did not accept the questions.

Further Specifics on the Six Cases Are as Follows

Three of the six cases were specifically coded as either verbally objecting or not objecting (two objected, one did not object). In two cases there was a lack of usable comments where the respondent said "don't know" or refused to answer the immigration status question, and the interviewer simply "followed suit," by giving the same "don't know" or "refused" answer to the corresponding interviewer judgment question.

Four of the six cases were coded with unambiguous interviewer judgments of their understanding of the 3-box format: three respondents were coded as "yes," one was coded as "no." The remaining two respondents were coded "refused" and "don't know." These latter two respondents also answered "refused" and "don't know," respectively, to all three cards.

Discussion of Results

The immigration module inserted in the 2004 GSS provides a useful indicator of English-speaking respondents' acceptance and understanding of the immigration-status question and related answer card formatted with three answer boxes. These results point the way to future improvements.

The vast majority of eligible respondents—97% overall and 98% of those who could be more carefully screened for eligibility (through their answers to the national identity module)—provided usable information on their immigration status when shown the immigration status card. Further, there was a willingness to answer subsequent questions, including citizenship questions (100% of those subsequently asked about their own and their parents' citizenship answered both questions). Interviewers felt that the large majority of respondents understood and accepted the questions and format. Most were coded as picking a box, and a few are known to have called out specific categories within boxes.

Since a number of otherwise eligible respondents (14 of 232, or 6%) were eliminated because they were interviewed by telephone, we believe a strategy for dealing with telephone interviewing should be considered in any personal-interview survey that relies on the telephone as a last resort. For respondents who can only be interviewed by telephone (at least for a main study), a possible future strategy would be to identify completed telephone interviews in which the respondents are not U.S.-born and then either (1) conduct very brief in-person follow-up interviews asking just the card questions, or (2) drop off copies of the 3-box cards at (or e-mail e-versions of the cards to) these respondents' homes, so that they can refer to them during a follow-up telephone interview. If neither (1) nor (2) is possible, it might be justifiable to ask directly in the telephone interview whether the respondent is a U.S. citizen—instead of using the cards. This option would at least provide usable information for some respondents.

Of the six eligible respondents who did not provide usable information on the immigration status question, five failed to pick a box on one or both of the training cards that immediately preceded the immigration status card. Logically, strategies to improve the information collected from such respondents in future would include the following:

1. To rule out the possibility that a respondent who was born a U.S. citizen would be asked the 3-box questions, one possible future strategy would be to directly ask: "Were you born a U.S. citizen?" Answer categories (based on questions about current citizenship asked in the "long" form of Census 2000 and the American Community Survey; see Department of Commerce 2000, 2005, respectively) might be:

   - Yes, born in the United States
   - Yes, born in Puerto Rico, Guam, the U.S. Virgin Islands, or Northern Marianas
   - Yes, born outside the United States of an American parent or parents (one or both biological parents were U.S. citizens at the time of the respondent's birth)
   - No, born outside the United States to parents who were not U.S. citizens at the time of the respondent's birth

2. Some respondents who refuse or say "don't know" on both training cards—despite clearly being foreign-born—may not accept the 3-box format. Because such respondents "self identify" prior to the immigration status question (by failing to pick a box on each training card), it might be possible to ask them if they would rather answer more directly, rather than using the boxes. If so, such respondents might be asked an alternative, "fall-back," direct question, such as whether they are naturalized U.S. citizens. This could potentially identify a non-sensitive immigration status for at least some respondents who otherwise would likely be categorized as "item non-response."
3. One respondent provided specific information by describing something other than the statuses listed on the card: he said that he had "papers for job;" this answer suggests that a careful review of the statuses and their presentation on the cards would help assure that as few respondents as possible "fall through the cracks."

Overall, the data show a relatively high level of acceptance and understanding. Logical next steps to further assure respondent acceptance and understanding would seem to include, as described above, devising and, to the extent possible:

- testing alternatives that avoid telephone interviews in which eligible respondents cannot see the cards;
- questions that better determine whether respondents were born U.S. citizens;
- one or more direct "fall back" questions on immigration status for respondents who—despite being properly screened and interviewed—fail to provide usable information on the two training cards; and
- immigration status cards that better help every eligible respondent identify his or her status in the correct box.

Additionally, conducting at least some test interviews with portions of the foreign-born population not covered so far, i.e., interviews with non-English-speaking foreign-born persons other than Hispanics who are farm-workers or in other low-education jobs, could be helpful.

In sum, we believe that the GSS data—considered in conjunction with earlier testing on Hispanic farm-workers that was conducted in Spanish—represent an important test of respondent acceptance and understanding and point the way to future improvements. However, we will discuss the GSS results with relevant federal agencies and other expert(s) before coming to definitive conclusions or actually recommending next steps.

Appendix I: 2004 GSS Immigration Module Questions and Flash Cards

GSS 2004 QUESTIONNAIRE – SECTION C – 3CARD (Version 1–6)

IF BORN = 2, GO TO C1, ELSE GO TO SECTION D.

C1. What country were you born in?

NATBORN
SHOWCARD C1

Mexico	1
Canada	2
China	3
Colombia	4
Cuba	5
Germany	6
Guatemala	7
Haiti	8
Honduras	9
India	10
Jamaica	11
Korea	12
Philippines	13
Poland	14
OTHER (SPECIFY) ______________________________	15

NATBRNSPC

The next question refers to [COUNTRY NAMED IN C1]. In a moment, I will show you a card that has three boxes—A, B, and C. There's something I want to explain before I show you the card. We just want you to choose <u>one box</u>. We do <u>not</u> need to know anything specific about what's inside the boxes.

SHOWCARD C2

Box A and Box B show pictures of houses. Box C is for any kind of house <u>not</u> shown in the pictures.

C2. Thinking back to the time when you were born, tell me <u>which box</u> shows the kind of house your family lived in at that time: A, B, or C? We just want you to choose one box.

BORNHOME

Box A...1
Box B...2
Box C (SPECIFY) ______________________ 3 BRNHOMEC
Other answer (SPECIFY) _______________ 4 BRNHMSPC
DON'T KNOW...DK
REFUSED...RF

IF RESPONDENT HESITATES OR CALLS OUT AN ITEM IN BOX B, SAY:

If you're in Box B, we do NOT need to know which specific type of house applies to you. The reason is that, right now, we're focusing on Box A.

IF RESPONDENT HAS TROUBLE READING, HELP HIM OR HER.

INTERVIEWER: NOTE ANY COMMENTS RESPONDENT MADE ABOUT CARD C2, BOXES, OR ANSWER CATEGORIES OR INDICATE NO COMMENTS MADE CARDAVRB

____

____

___ No comments made

The next question is about traveling to the United States. **SHOWCARD C3**

C3. Thinking about the most recent time you traveled to the United States from another country—please tell me which box shows the kind of transportation you took: A, B, or C.
TRAVELUS

Box A...1
Box B...2
Box C (SPECIFY) ________________________ 3 TRAVLUSC
Other answer (SPECIFY) __________________ 4 TRVUSSPC
DON'T KNOW...DK
REFUSED...RF

IF RESPONDENT HESITATES OR CALLS OUT AN ITEM IN BOX B, SAY:

If you're in Box B, we do not need to know which specific type of transportation applies to you. The reason is that, right now, we're focusing on Box A.

INTERVIEWER: NOTE ANY COMMENTS RESPONDENT MADE ABOUT CARD C3, BOXES, OR ANSWER CATEGORIES OR INDICATE NO COMMENTS MADE CARDBVRB

____

____

___ No comments made

In a moment, I am going to show you another card with three boxes. Again, you answer by just picking a box. The question is about immigration, but it does <u>not</u> "zero in" on anything that people might <u>not</u> want to tell us. Here's the card—which I need to explain before you answer.

SHOWCARD C4

As you can see, Box A at the top shows the immigration card for permanent legal residence in the United States; it is also called a "green card." It is an official valid card issued to you by the United States government. Box B shows some drawings for U.S. citizen and other immigration categories; I would be happy to explain these if you like. Box C is for categories not listed in A or B.

C4. Thinking of your <u>current</u> immigration status <u>right now</u>, is that in Box A, B, or C? If it's in Box B, we do <u>not</u> want to know which specific category applies to you, and there will be <u>no more</u> questions about Box B. (IF RESPONDENT ASKS WHY, SAY: Because right now we are focusing on Box A.)

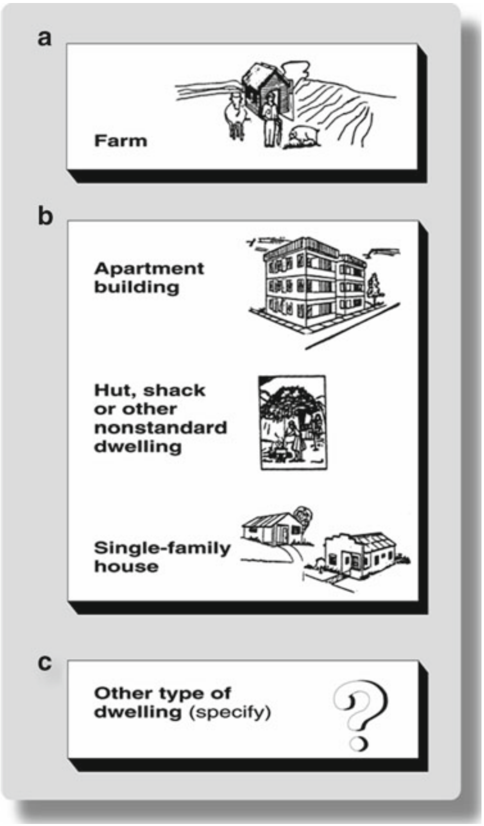
IMMSTATS

Box A	1	
Box B	2	
Box C (SPECIFY) ________________	3	IMMSTATC
Other answer (SPECIFY) ________________	4	IMSTASPC
DON'T KNOW	DK	
REFUSED	RF	

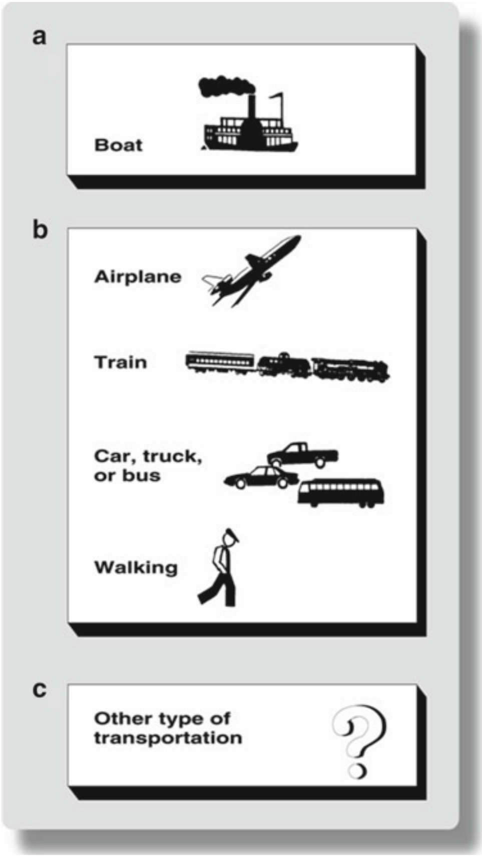
C1

1. **Mexico**
2. **Canada**
3. **China**
4. **Colombia**
5. **Cuba**
6. **Germany**
7. **Guatemala**
8. **Haiti**
9. **Honduras**
10. **India**
11. **Jamaica**
12. **Korea**
13. **Philippines**
14. **Poland**

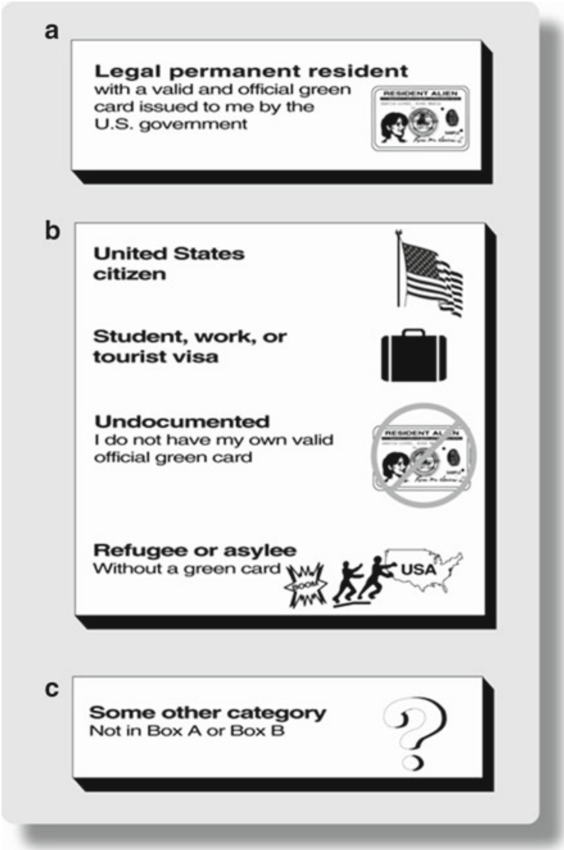
C2



C3


a
Boat
b
Airplane
Train
Car, truck,
or bus
Walking
c
Other type of
transportation

C4



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Chapter 18
Estimating Life Expectancy at Birth for Mexican Municipalities: An Application of a Regression-Based Technique

Miguel Flores, Benjamin Bradshaw, and Nazrul Hoque

Introduction

Life expectancy is one of the most important indicators of general health. Variations in life expectancy exist among the broad geographic regions in the U.S. as well as among the individual states (Lamb and Siegel 2004; Swanson et al. 2009). The purpose of this study is to estimate life expectancy at birth at the substate level in Mexico. Specifically, a regression-based technique is used to estimate life expectancy at birth at the municipal level according to population size, metropolitan status, and geographical region. We explore the extent to which life expectancy differs among regions in Mexico, and we provide new evidence of a health gradient as indicated by life expectancy between urban and rural areas. This study is different from previous studies in many ways. First, nearly all previous studies have used the conventional life table to calculate the life expectancy for the country as a whole or at the state level. Second, as far as we can determine, no previous study has estimated life expectancy for small areas (municipalities) in Mexico. Municipalities are the smallest geographic unit of analysis for which demographic data are available from official sources in Mexico. Thus, this paper is unique because it represents the first attempt to estimate life expectancy for small areas in Mexico.

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_18, © Springer Science+Business Media B.V. 2012

Data and Methodology

In order to estimate life expectancy at birth for municipalities, we used the procedure described by Swanson et al. (2009) in which the estimation is made through standard regression-based techniques. Before describing the procedure in detail, it is useful to mention the differences as well as the appropriateness of this method for estimating life expectancy, as compared to using life expectancy from life tables. First, the regression approach has its roots in Mazur (1969, 1972) with later refinements by Gunasekaran et al. (1981), Swanson and Palmore (1976) and (Swanson and Stockwell (1986)). It has been used and tested mainly in studies of life expectancy differences at state and substate levels, particularly in the United States, and it has proven to be a useful and accurate alternative for such purposes (Swanson 1992, Swanson et al. 2009). Second, although the usual way to estimate life expectancy at birth is through the construction of a life table, there are limitations to the application of that method, particularly its extensive data requirements, such as age-specific death rates. The regression-based method has only three data requirements: (a) total deaths, (b) total population (estimated or enumerated), and (c) the population aged 65 years and over (estimated or enumerated). Given these minimal requirements for its implementation, the regression method may be applied worldwide with particular usefulness in developing countries for which researchers must work with incomplete data.

The application of the regression method to Mexico is useful as historical and recent patterns of internal and international migration may have modified demographic features, particularly in local communities and municipalities. While some regions within Mexico have historically experienced higher emigration to the United States, such as rural municipalities in the Central-Western region, other areas, such as metropolitan areas in the northern Border states have gained large numbers of internal migrants.

While the regression method for estimating life expectancy is broadly useful, there are two conditions under which the method can produce unreliable estimates: (a) a substantial "special" population, such as is found in a 55+ retirement community; and (b) a small population with very few deaths, such that the crude birth rate can fluctuate substantially from year to year (Swanson et al. 2009). A very large difference between the percent aged 65 and over at the state level compared with a given county would warrant further examination. In relation to the second condition, the use of the regression method is generally not recommended where the number of deaths is less than 50.

In the present study, we account for these two conditions in the following manner. We looked at the distribution of the percentage of population 65 and over, finding 12 rural municipalities with a percentage higher than 20%. We did not consider these municipalities in the final analysis. Second, we excluded municipalities with less than 50 deaths. In general, these two restrictions exclude all of the municipalities with a population of less than 2,500 inhabitants.

Table 18.1 Estimated coefficients from the regression based model for Mexican States, 2000

Variable	Regression coefficient
β_0	72.258
β_1	4.105
β_2	−8.970
β_3	0.401
β_4	8.786
β_5	−4.674
R^2	0.38
N	32

The regression equation model for estimating life expectancy is specified as follows:

$$e_0 = \beta_0 + \beta_1 CDR + \beta_2 \ln(P65+) + \beta_2 CDR^2 + \beta_4 \ln(P65+)^2 + \beta_5[(CDR) * (\ln(P65+))] \tag{18.1}$$

where CDR corresponds to crude death rate ((total deaths/total population)*1,000) and P65+ denotes the percentage of the population age 65 and over. The model also includes a term for the square of each of these variables, as well as an interaction term between them.

In estimating Eq. 18.1, fitting Mexican data for the year 2000, total deaths and population data were obtained from vital statistics and the 2000 General Mexican Census, respectively (Instituto Nacional de Estadística y Geografía, INEGI), In order to calculate the crude death rates, total deaths were averaged for the period 1999–2001. For purposes of model estimation and comparison between our results and the official estimates, we consider as the official figures for life expectancies the ones provided by Consejo Nacional de Población (CONAPO)[1]. The calibrated model is then shown in Table 18.1.

Results

Based on national life tables, life expectancy at birth in Mexico has improved significantly over the last two decades, as shown in Fig. 18.1. Life expectancy in 1980 for both sexes was 67 years, but by 2005 this value reached 74.6 years. In regards to sex differences, women show higher life expectancy than men. Life expectancy for females in 1980 was 70 years, while for men it was 64 years. This

[1]CONAPO. Indicadores demograficos basicos 1990–2030. www.conapo.gob.mx.

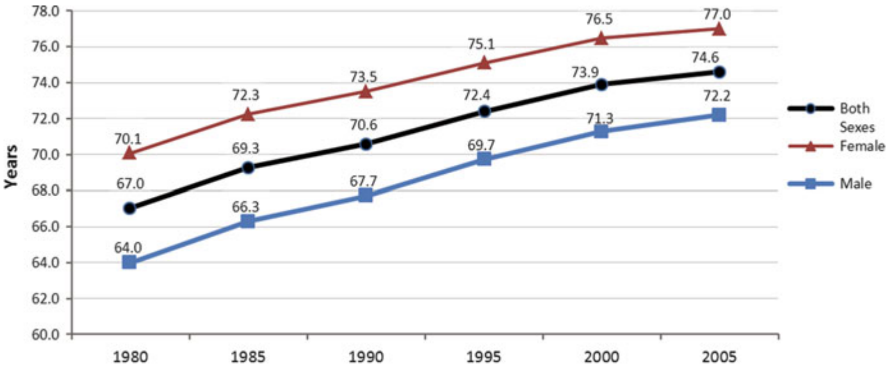


Fig. 18.1 Evolution of life expectancy at birth in Mexico, 1980–2005 (Source: 1980–1985, Indicadores demograficos por entidad federativa, INEGI, www.inegi.org.mx. 1990–2005, Indicadores demograficos basicos 1990–2030, CONAPO, www.conapo.gob.mx)

sex gap in years of life expectancy continues but is decreasing. In 2005 female life expectancy at birth had reached 77 years, while for men it was 72.2 years. The gain in life expectancy at birth from 1980 to 2005 was greater for males (8.2 years) than for females (6.9 years). For both sexes there is a gain of approximately 7.6 years. Thus, the advantage in life expectancy of females over males decreased somewhat over the 25 year period.

In this study we are interested in providing life expectancy estimates for sub-national populations, specifically estimates at the municipal level, by applying the calibrated regression model to the appropriate data for each municipality. But first we evaluate the estimates using the same model at the state level. Table 18.2 shows the estimated life expectancy for each of the Mexican states, the official values reported from CONAPO, and the discrepancy or 'error' between them. As a way to measure accuracy of our life expectancy estimates, this table also includes the mean error and the mean absolute error. The results indicate that the estimated life expectancy nationally was 73.39, compared with the official number of 73.89, a difference of approximately 0.50 years. The resulting average mean absolute error indicates an underestimation of the life expectancy by the regression method of approximately 0.54 years.

The next step is to apply the calibrated model, fitting the required data for municipalities. As shown in Table 18.3, heterogeneity in population size among municipalities could make difficult the comparison of municipalities within and among states. Therefore, we divided the Mexican geography in five regions[2] (Map 18.1).

[2]The regions are Border: Baja California, Sonora, Chihuahua, Coahuila, Nuevo Leon, Tamaulipas; North Central: Baja California Sur, Sinaloa, San Luis Potosi, Zacatecas, Durango; South Central: Queretaro, Nayarit, Jalisco, Guanajuato, Colima, Aguascalientes, Michoacán; Capital: Distrito Federal, Hidalgo, Estado de Mexico, Morelos, Puebla, Tlaxcala; South: Campeche, Chiapas, Guerrero, Oaxaca, Quintana Roo, Tabasco, Veracruz, and Yucatan.

Table 18.2 Estimated life expectancy in Mexican States, 2000

	State	Estimated	Official[a]	Error
1	Aguascalientes	73.44	74.20	−0.76
2	Baja California	75.18	74.81	0.37
3	Baja California Sur	73.77	74.25	−0.49
4	Campeche	73.32	73.02	0.30
5	Coahuila	73.46	71.62	1.85
6	Colima	73.34	74.22	–0.88
7	Chiapas	74.01	73.96	0.05
8	Chihuahua	74.12	73.86	0.26
9	Distrito Federal	73.12	74.69	–1.57
10	Durango	73.36	73.38	–0.02
11	Guanajuato	73.35	73.77	–0.42
12	Guerrero	73.66	73.52	0.14
13	Hidalgo	73.29	71.75	1.54
14	Jalisco	73.30	72.82	0.48
15	México	74.13	73.88	0.25
16	Michoacán	73.22	73.24	–0.01
17	Morelos	73.28	73.96	–0.68
18	Nayarit	73.31	73.66	–0.35
19	Nuevo León	73.35	74.41	–1.06
20	Oaxaca	73.10	71.91	1.19
21	Puebla	73.51	72.58	0.93
22	Querétaro	73.75	73.26	0.49
23	Quintana Roo	74.36	74.18	0.19
24	San Luis Potosí	73.29	73.20	0.10
25	Sinaloa	73.33	73.59	–0.26
26	Sonora	73.62	73.92	–0.31
27	Tabasco	73.61	73.10	0.51
28	Tamaulipas	73.31	73.75	–0.44
29	Tlaxcala	73.30	73.78	–0.48
30	Veracruz	73.23	72.43	0.80
31	Yucatán	73.12	73.05	0.07
32	Zacatecas	73.23	73.26	–0.03
	National	73.39	73.89	–0.50

Mean Error = 0.04
Mean Absolute Error = 0.54
Number overestimated = 16
Number of absolute errors exceeding 1.0 year = 7

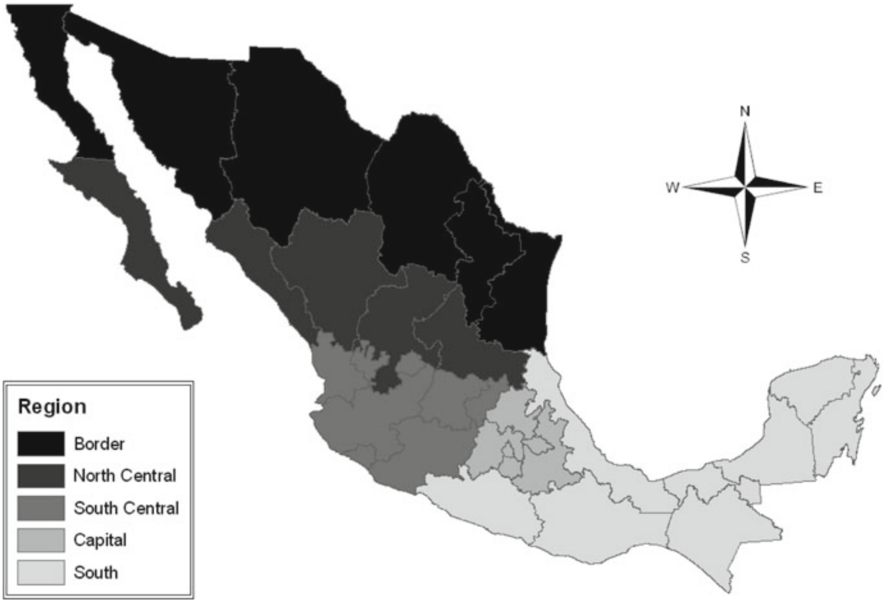
[a]Official estimates reported by CONAPO, Indicadores demograficos basicos 1990–2030

As another way to control for such heterogeneity in population size as well as socioeconomic conditions that may be associated with health outcomes and life expectancy, we classified municipalities according to metropolitan status. That is, we made estimates for municipalities comprising the 56 metropolitan areas of Mexico as defined by INEGI (2007). Therefore, life expectancy at the municipal level is estimated for each region according to population size and metropolitan areas.

Table 18.3 Distribution of municipalities, total population, and population 65+, according to municipality size, 2000

	Total municipalities	%	Total population	%	Pop 65+	%	Total deaths	%
100,000	186	7.6	57,894,483	59.4	2,569,447	54.1	257,231	58.6
15,000–99,999	860	35.2	31,300,265	32.1	1,631,403	34.3	139,419	31.8
2,500–14,999	1,015	41.6	7,767,104	8.0	500,874	10.5	38,947	8.9
<2,500	382	15.6	521,560	0.5	48,587	1.0	3,384	0.8
Total	2,443	100.0	97,483,412	100.0	4,750,311	100.0	438,981	100.0

Source: INEGI, www.inegi.org.mx



Map 18.1 Regional classification of Mexican States

Table 18.3 shows the distribution of municipalities according to population size, population aged 65 and older, and total deaths, which in turn are the variables used for the life expectancy estimates. In 2000, of the 2,443 municipalities, approximately 16% are rural (<2,500 inhabitants), comprising about 0.5% of the total population. Approximately 60% of Mexico's population lived in the 186 urban municipalities (>= 100,000 inhabitants). The population aged 65 and older likewise tends to be concentrated in large municipalities. Total deaths follow the same pattern, as approximately 59% occurred in the largest municipalities.

Table 18.4 shows the estimated life expectancy by size of municipality and geographic region and for metropolitan areas. In all regions there is a gradient in the estimated life expectancy according to the municipality size, though in the North Central region, the range in life expectancies by size of municipality is very narrow.

Table 18.4 Estimated life expectancy in Mexican municipalities by population size and Region, 2000

	National	Border	North Central	South Central	Capital	South
Municipality size[a]						
100,000	73.60	73.82	73.35	73.57	73.61	73.66
15,000–99,999	73.26	73.23	73.28	73.12	73.52	73.33
2,500–14,999	72.82	72.87	72.92	72.36	73.01	73.12
Municipality size[b]						
100,000	73.60	73.82	73.35	73.57	73.61	73.67
15,000–99,999	73.26	73.23	73.31	73.12	73.51	73.33
2,500–14,999	73.03	72.91	73.29	72.77	72.97	73.21
<2,500	71.82	72.01	73.27	70.70	71.21	71.71
Metropolitan areas	73.57	74.77	73.44	73.51	73.61	73.35
Rest of municipalities[a]	73.42	73.66	73.29	73.35	73.67	73.34

[a]Adjusted for municipalities with less than 50 deaths
[b]Not adjusted for municipalities with less than 50 deaths

In general, rural municipalities tend to have lower life expectancy at birth while metropolitan areas show the highest estimates as compared with the rest of the municipalities within the region, with exception of the Capital region.

Regional differences in the life expectancy estimates are notable, particularly for metropolitan areas. The Border region shows an estimated life expectancy of 74.77 that is higher than the national estimate and the rest of the geographic regions. When comparing metropolitan areas with the rest of the municipalities within a region, there are two interesting results to discuss. First and contrary to what was expected, an estimated life expectancy of 73.61 for the metropolitan area in the Capital region was slightly lower than 73.67 corresponding to the other municipalities in this region. Second, the highest difference of life expectancy between metropolitan and other municipalities is found in the Border region, approximately 1.11 years.

In relation to urban-rural differences, the South Central region shows the highest difference of estimated life expectancy, approximately 1.21 years, between urban (100,000 habitants) and semi-rural (2,500–14,999 inhabitants) municipalities. This difference is even higher, 2.87 years when considering unadjusted estimates. The North and South regions recorded the lowest urban-rural differences in life expectancy at birth.

Differences in life expectancy likely stem from a concentration of public health services and medical care in the larger municipalities as well as higher average income, education, and other common metropolitan advantages. A more conclusive inference would entail further analysis, which is left for further research. Nonetheless, we provide a description of selected variables commonly employed as indicators of socioeconomic status and health services for Mexican municipalities. As in Table 18.5, greater disparities are exhibited according to a municipality's population size. But even for metropolitan areas, there still exist regional differences in socioeconomic indicators, as shown in Table 18.6.

Table 18.5 Selected variables of socioeconomic status and health services in Mexican municipalities by population size

	Population			
	>100,000	15,000–99,999	2,500–14,999	<2,500
	Mean			
Estimated life expectancy[a]	73.6	73.3	73.0	71.8
Total doctors in contact with a patient[b]	185.3	17.1	4.2	1.4
% pop. without social security[b]	50.4	74.1	79.4	83.7
GDP per capita (dlls.)[c]	8,746.2	3,807.1	2,902.0	2,274.6
% pop earning 2 minimum wages or less[d]	46.7	68.8	77.0	83.4
% pop in extreme poverty[e]	18.7	40.5	47.7	55.6

[a]Unadjusted estimates. Source:
[b]Recursos humanos y materiales a nivel municipal, 200 and 2005. Nucleo de Accesso y Analysis de Informacion en Salud. Instituto Nacional de Salud Pública. (INSP)
[c]Indice de Desarrollo Humano por municipio, 2000. Consejo Nacional de Poblacion. (CONAPO)
[d]Indice de Marginacion por municipio, 2000. Consejo Nacional de Poblacion. (CONAPO)
[e]Pobreza por ingresos, 2000 and 2005. Consejo Nacional de Evaluacion de la Politica de Desarrollo Social. (CONEVAL)

Table 18.6 Selected variables of socioeconomic status and health care by metropolitan areas and region

	Border	North Central	South Central	Capital	South
	Mean				
Estimated life expectancy[a]	74.8	73.4	73.5	73.6	73.4
Total doctors in contact with a patient[b]	119.4	68.4	127.6	86.1	57.1
% pop. without social security[b]	37.6	33.2	55.1	61.2	62.5
GDP per capita (dlls.)[c]	40,454.1	9,00.2	7,127.5	6,301.6	5,631.4
% pop earning 2 minimum wages or less[d]	32.8	37.4	47.0	55.6	62.9
% pop in extreme poverty[e]	6.7	9.6	18.0	19.0	29.2

[a]Unadjusted estimates. Source:
[b]Recursos humanos y materiales a nivel municipal, 200 and 2005. Nucleo de Accesso y Analysis de Informacion en Salud. Instituto Nacional de Salud Pública. (INSP)
[c]Indice de Desarrollo Humano por municipio, 2000. Consejo Nacional de Poblacion. (CONAPO)
[d]Indice de Marginacion por municipio, 2000. Consejo Nacional de Poblacion. (CONAPO)
[e]Pobreza por ingresos, 2000 and 2005. Consejo Nacional de Evaluacion de la Politica de Desarrollo Social. (CONEVAL)

Discussion

The results presented here indicate the usefulness of the regression method for substate estimates of life expectancy. An advantage for the application of this method in Mexico lies in the fact that the age compositions of the states, regions, and municipalities are quite similar, and there are none that have exceptionally high average ages or unusually large concentrations of elderly persons.

In general, the estimates are consistent with expectations with respect to metropolitan advantages in life expectancy, which probably reflects the concentration of public health services, as well as primary, secondary, and tertiary medical care. There are, however, some anomalous results for which we can offer no satisfactory explanation. For example, the estimated life expectancy for the state of Chiapas in far southern Mexico (74.01 years) is fifth highest of the 32 states, despite Chiapas being among the poorest of the states. The official life expectancy for Chiapas from a life table is also unexpectedly high (73.96), the ninth highest among the states.

Despite these limitations, this study has provided life expectancy estimates for the smallest geographic units, municipalities, from which statistical inferences can be done given data availability. As far as we are aware, there have not yet been studies doing similar analysis. Hence, this study should serve as a departure point for further research regarding relationships between SES and local health outcomes. In this sense, an extension to this study would be to analyze trends of life expectancy at the municipal level and to establish factors that might be associated with the trends.

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Chapter 19
DOMICILE 1.0: An Agent-Based Simulation Model for Population Estimates at the Domicile Level

Cameron S. Griffith, David A. Swanson, and Michael Knight

Introduction

Agent-Based Models (ABMs) collectively represent an individual modeling method that, along with two related approaches, Microsimulation (MSM) and Cellular Automata (CA, also known as Artificial Neural Networks or ANN), has received attention as a demographic forecasting tool in the past 20 or so years (see, e.g., Andreassen 1993; Bandyopadhyay and Chattopadhyay 2006; Billari and Prskawetz 2003; Booth 2006; Charette 2010; Clarke and Holm 1987; Harding and Gupta 2007; Martel 2010; Sokolova et al. 2006; Van der Gaag et al. 2005; Zinn et al. 2010). This development corresponds to observations made by Smith et al. (2001: 367) that while population projections were primarily made at the national and state levels until the 1970s, they started being routinely made for lower levels of geography such as census tracts and block groups, which, in turn, generated demand for even lower levels of geography such as tax assessor files, block faces, and street segments. They observed that this trend implied that projections would eventually be made for individual addresses, households, and people. Indeed, this observation has been borne out and the reason is largely due to the development of individual modeling methods, including ABM.

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_19, © Springer Science+Business Media B.V. 2012

What exactly is ABM? According to the International Microsimulation Association (2006), it is closely allied to the other two other individual-level modeling approaches, CA and MSM. In distinguishing these three related approaches, The International Microsimulation Association (2006) describes them as follows.

1. In a pure CA, all entities are spatially located within a grid of cells, and all entities have only one attribute (alive or dead), with behaviors deterministically dependent upon the state of neighboring cells.
2. In a pure ABM, the emphasis is on the interaction between individuals, with the main attribute of each individual being the operating characteristics (behavioral rules), which evolve stochastically over time in response to the success or failure of interactions with other individuals.
3. In a pure MSM, transition probabilities lack evolutionary and spatial dimensions.

The Association (2006) concludes that as microsimulation models add more behavioral and spatial interaction between individual units, as CAs add a growing range of individual attributes and start to incorporate aspatial behaviors, and as ABMs add both space and fiscal/demographic characteristics to their agents, the three approaches move towards a common ground.

In this chapter, we discuss the ABM "DOMICILE" (DOmicile Model Implemented by Calculating In-migration at the domicile LEvel), that provides a unique approach to the generation of population estimates and projections. The nascent stages of the model development will facilitate assessments of the potential for it to produce suitable data. In this vein, the overall plan for the model is that it will continue to evolve in subsequent incarnations in order to address additional research goals. The model design is presented here in the fashion first proposed by Grimm et al. (2006), under the "ODD Protocol" (Overview, Design concepts, and Details), which is rapidly being adopted by the agent based modeling community as a standard ABM format.

Methods

Purpose of the DOMICILE Model

The model takes baseline datasets at the tract and block group level and makes forward computations by calendar year at the level of the individual person agent (each of which are assigned to a domicile, with varying degrees of family structure). The datasets provide aggregate numbers at the level of the *individual* person by age, and the model then populates domiciles with said individuals, providing family structure based on a set of rules described below.

This model treats the domicile unit as an entity that can take on multiple forms or compositions. Domicile composition refers to the nature of the occupants in a domicile. Within the domicile composition there can be domiciles populated by families and non-families. When a domicile is populated only with related individuals it is essentially a family household. When a domicile is populated with non-families each individual is treated independently from anyone else in the domicile. Currently the model does not provide any detailed classification of group living arrangements (e.g. dorm rooms in a dormitory, military barracks, senior homes, or other group-living arrangements).

State Variables and Scales

We assume the fundamental demographic balancing equation is applicable at the domicile level:

$$P_k = P_{k-1} + (B_k - I_k) - D_k + (IM_k - OM_k)$$

In this equation P_k is the population size at year k and P_k*-1* is the population size in the previous year *k-1*. B_k is the number of births in the year k, I_k is the number of infant deaths in the year k, D_k is the number of non-infant deaths in the year k, and IM_k is the InMigration into the county for year k and OMk is the OutMigration from the county for the year k.

The model population projections include age, sex, and race. Age is tracked in 1-year increments, starting with birth as age zero, up to a maximum of age 74. People aged 75 and above are placed in a single category (Table 19.1).

Sex is broken into two categories, male and female, while race is broken into four race categories: white, black or African American, Hispanic, and other (which includes American Indian or Alaska Native, Asian, Native Hawaiian and Other Pacific Islander). These categories are used to coincide with input population datasets used in implementation and the associated methodological concerns outlined in the ICPSR Data Dictionary (Voss et al. 2004).

Process Overview and Scheduling

The model is based on a forward-looking projection. Thus, the initial population (baseline population) is initially aged before other calculations are made (Fig. 19.1). For example, starting with 1990 census data, the first projection is for the 1991 year. Therefore, people in the year 1990 are aged 1 year before 1991 activities occur. An example of this is that a 20 year-old woman in 1990 will be 21 in 1991, and will give birth at the rate for 21-year-old women.

Design Concepts

Emergence

During the course of a simulation, the number of domiciles that are inhabited and the composition of domiciles are both emergent phenomena. The patterns of OutMigration are emergent as they are dependent upon weighted voting for OutMigration.

Table 19.1 State and auxiliary variables in the DOMICILE model

State variable	Brief description
Age	Age indexed by person agent
Sex	Sex indexed by person agent
Race	Race indexed by person agent
Auxiliary Variable	**Brief Description**
Initial population counts	Number of person agents in the county indexed by age, race, sex
Number of townships	Number of townships in the county
Number of cities	Number of cities indexed by township
Number of census tracts	Number of census tracts indexed by city
Number of block groups	Number of block groups indexed by census tract
Number of blocks	Number of census blocks indexed by block group
Number of domiciles	Number of domiciles indexed by census block
Length of simulation in years	Number of years for forward computations in the simulation
Birth rate	Rate of births, indexed by year, county, age and race of female
Birth ratio	Ratio of female to male births indexed by race
Death rate	Rate of deaths of non-infants, indexed by year, county, age, sex, and race
Infant mortality rate	Rate of deaths of infants, indexed by year, county, sex, and race
InMigration rate	Rate of InMigration, indexed by year, county, age, sex, and race
OutMigration rate	Rate of OutMigration, indexed by year, county, age, sex, and race
Marriage rate	Rate at which potential couples become married couples, indexed by year
Adult age marker	Age at which person agents may live on their own and become married
Min. Motherhood age	Minimum age at which females may give birth
Max. Motherhood age	Maximum age at which females may give birth
Parent race priority	For each child's race, the order of races used for parental assignment in family creation
OutMigration voting weight	Vote weight to OutMigrate indexed by age
OutMigration voting threshold	Minimum percentage of total of votes required for OutMigration decision

Initialization
-Create and initialize hierarchical geographic agents
-Consolidate families from baseline population
-Distribute families and non-family person agents down through hierarchy of geographic agents into domiciles

For each year of the simulation for each population counter:
-Age population one year
-Calculate and apply deaths for non-infants
-Calculate and apply births
-Calculate and apply infant mortality
-Calculate and apply OutMigration at the domicile level
-Calculate and apply InMigration at the county level and propagate down through nested hierarchy

Fig. 19.1 Process overview of the DOMICILE model (The order of computing deaths and births is arbitrary, however, calculating deaths before births results in fewer births than when births are calculated before deaths)

Agent Behavioral Adaptation

Currently the model does not accommodate any behavioral adaptation by agents.

Objectives

The person agents in the DOMICILE model are generally passive in nature, and birth, death, and migration ultimately happen *to them*, rather than these being goals of the agents. The objective of geographic agents within the hierarchy of agent classes is to distribute InMigrating person agents in a balanced manner.

Prediction

Agents in the model do not have predictive behavior.

Sensing

The default method for population distribution of InMigrating person agents directs geographic agents to distribute IM person agents uniformly down through the subgeography hierarchy of agent classes. This method does not include sensing on the part of the geographic agents or person agents with regard to IM.

When person agents in a family consider OutMigrating, they are made aware of the votes of the other family members, so that the entire family as a whole makes a decision to either OutMigrate or remain in place.

Interaction

The only interaction among person agents is local and indirect and takes place during the family voting process with regard to deciding whether to OutMigrate. For geographic agents, interaction takes place during InMigration when person agents are distributed from one geographic agent to its subordinates.

Collectives

Person agents are grouped into families that OutMigrate together if the decision to do so has been made. Geographic agents are grouped into a hierarchy of classes. For example, Township Agents are subordinate to County Agents, City Agents are subordinate to Township Agents, and so on down to Domicile Agents, which are subordinate to Block Agents (Fig. 19.2).

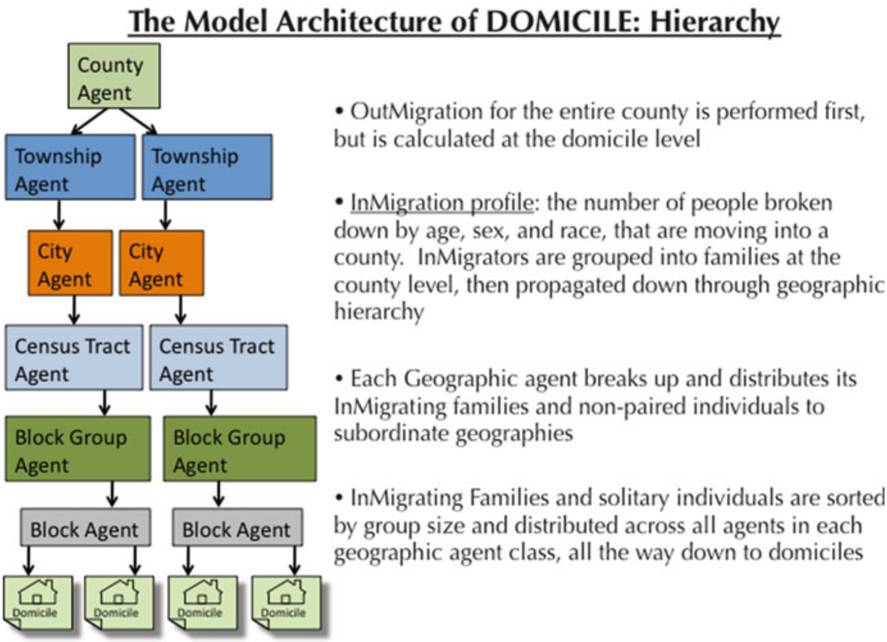

Fig. 19.2 Model Hierarchy

Stochasticity

Because our model works at the level of individual person agents as opposed to groups of people, rates typically applied to groups are interpreted as probabilities applied to individuals.

- Birth
- Birth ratio
- Infant mortality
- Death
- OutMigration
  - Person agents deciding whether or not to OutMigrate either individually or collectively
- InMigration
  - Mother/Child assignment (detailed in the Consolidation discussion in the section on Submodels, below).
  - Marriage

Birth, Birth ratio, Infant mortality, and Death
At the beginning of each simulation year, births, infant mortality, and deaths are computed by applying the corresponding rates as probabilities to individual person

agents. For example, if the cohort of white women aged 25–29 has a birth rate of 23 per 100 women, then an individual 26-year-old white woman person agent will give birth to a single child with the probability of .23.

OutMigration
During each simulation year, person agents decide to OutMigrate with a probability that is equivalent to the OutMigration rate of their cohort. For person agents in a family, this decision is interpreted as their vote to OutMigrate.

InMigration
During each simulation year, after the InMigrating person agents have been determined (non-stochastically) women are assigned children and then husbands by stochastic processes.

For the assignment of each child to a woman, birth rates are used to weight the probability of a woman being selected as the mother of the child. Here we use the birth rate for the woman based on what her age would have been had she actually given birth to the child (e.g. age of woman minus age of child). For example, when selecting a mother for an 8-year-old child, a 48-year-old woman is weighted by the birth rate for a 40-year-old woman.

For the assignment of a husband to a woman, after a potential couple is created, that potential couple becomes an actual married couple with a probability equivalent to the marriage rate provided to the model.

Observation

The data produced by the model are collected at the township and county level, and these are simple population counts by age group, sex, and race, as well as numbers of InMigrators and OutMigrators.

Initialization

At the beginning of each simulation the Hierarchical Agents are created. At the domicile level, each domicile is populated with the starting occupants. The demographic profile of each domicile is determined as described in the Consolidation discussion in the Submodels section, below.

Input

The model takes a suite of initial values as parameters and does not currently require input following initialization. (The initial input values are listed as auxiliary variables in the State Variables and Scales section, above.) In order to build the hierarchy of agent classes, the model requires the number of units in each agent class, a.k.a. sub-level of census geography. For example, the number of townships within a particular county, the number of blocks within a particular block group, and so on. In addition, the model requires the demographic profile of each domicile (e.g. number of occupants and their age, sex, race, family/non-family relationships, etc).

Submodels

Births

Births are computed at the level of the individual. The default age range of women able to give birth is 15–44 years, inclusive. Each woman of fertile age has a probability of giving birth calculated from birth rates by state, county, age, and race of mother. Data associated with births include county, age, sex, and race of infant, and the initial domicile and race of the infant is the same as the mother, and the age of the newborn is set at zero. The default ratio of male to female births is 50:50. Currently the model does not have a provision for a woman to have multiple births, or more than one birth per year.

Infant Mortality

Infant mortality is computed from infant mortality rates broken down by county, sex, and race, and applied as a probability only to newly born infants. Deaths for individuals over zero years of age are handled by a different death rate.

Deaths

Deaths are computed for individuals by from death rates broken down by county, age, sex, and race and applied as a probability. This applies to all individuals over zero years of age.

OutMigration

The OutMigration submodel recognizes two situations:

1. When a person lives as an individual, without family members (this would typically be the case where a person lives in a domicile with a non-related roommate). In this case the OutMigration rate is applied as a probability to the individual.
2. When people live as a group, as a family for example. In this case, the entire group either OutMigrates or remains in the domicile. To decide if the group OutMigrates, the OutMigration rates are applied as a probability to each member of the group. Then, each member of a group that is stochastically predisposed to OutMigrate counts as a vote for the entire group to OutMigrate as a unit. If a sufficient number of votes are cast, then the group OutMigrates.

Therefore, if the OutMigration rate of white 22-year-old males is 7 per 100, then each white 22-year-old male in a family has a 7% chance OutMigrating, i.e. of voting in favor of the family OutMigrating. The model accepts parameters that can weight group/family votes by age of individual, and also parameters that specify what constitutes sufficient vote totals/percentages to OutMigrate the group as a unit, or keep them in place.

For example, there are four people in a family. Mom and Dad have vote weight of 1. Two children have vote weight of 0.7 each. Thus, the highest possible affirmative vote for OutMigration is 3.4. We have decided to make the actual threshold parameterizable. For example, if the threshold for OM is set at 60%, then in this case $3.4 \times .60 = 2.04$. The family cannot decide to migrate with just affirmative votes to OutMigrate from the two adults. However, they could do it with one adult and two children (2.4) or two adults and one child (2.7).

InMigration

InMigrators are first determined for the entire county. Currently the model anticipates that the InMigrating dataset will be comprised of independent individuals with no family structure or other such linkages. Therefore, it is necessary to impose a family structure (or leave some without a family) on the InMigrating individuals. We refer to this as consolidation in the model.

Consolidation

A family structure is imposed on the individuals in the following two steps:

Step 1: Females over the minimum age of fertility (mothers) will be assigned children as follows:

For each child:

1. Determine the current minimum and maximum ages of potential mothers of the child. The minimum age of the potential mother of a child is the age of the child plus the minimum age at which a woman can give birth. Similarly, the maximum age of the potential mother of a child is the age of the child plus the maximum age at which a woman can give birth.
2. Determine a race of the child's mother. This is done according to the parent race priority input variable. For example, a white child has the following order of parent race priority: white, black, Hispanic, and other. If there is no white female of the appropriate age to be the child's mother, the model will seek to choose from black females, and so forth.
3. For each potential mother, determine the potential mother's birth rate for the age she would have been at the birth of the child.
4. This birth rate is used as a weighting mechanism for randomly selecting the child's mother from among the potential mothers.[1]

[1] This method presumes that all children will InMigrate as part of a family unit.

5. If there are no females of the appropriate age to be mothers available in any race category for a given child, then Steps 1 through 4 are applied for males as potential parents instead of females by using the same age range determined for women.[2]

Step 2: Adult females will be assigned adult males (husbands) of the same race as follows:

1. Women form potential couples with others of the opposite sex (men) AND that are in the same age cohort (group) and of the same race (pass 1). There is currently no provision for same sex or interracial couples in the model.
2. The remaining women in an age group that are not part of potential couples then are paired with unpaired men in the first older age cohort and of the same race. Any remaining women after this are paired with unpaired men in the second older age cohort and of the same race. After this, the process continues with the first younger age cohort, then up again to the third older age cohort, and upwards until all the older age cohorts are exhausted, then through the second younger cohort, continuing downward until all cohorts are exhausted (Fig. 19.3).

   Thus, our current age cohorts (groups) for potential coupling within the female-centric method are:

   18–19
   20–24
   25–29
   30–34
   …and so on up to 75+

   The order in which women are potentially paired with men from different age groups is as follows:

   // pass 1: same age group
   // pass 2: +1 age group
   // pass 3: +2 age group
   // pass 4: −1 age group
   // pass 5: +3 age group
   // pass 6: +4 age group
   // pass 7: +5 age group
   // …
   // pass x : −2 age group
   // pass x + 1: −3 age group
   // pass x + 2: −4 age group
   // …

[2]This method does not address the situation where there are no women or men of the appropriate age to serve as a parent to the child. Future versions could potentially address this by determining an appropriate age range for grandparents for child assignment.

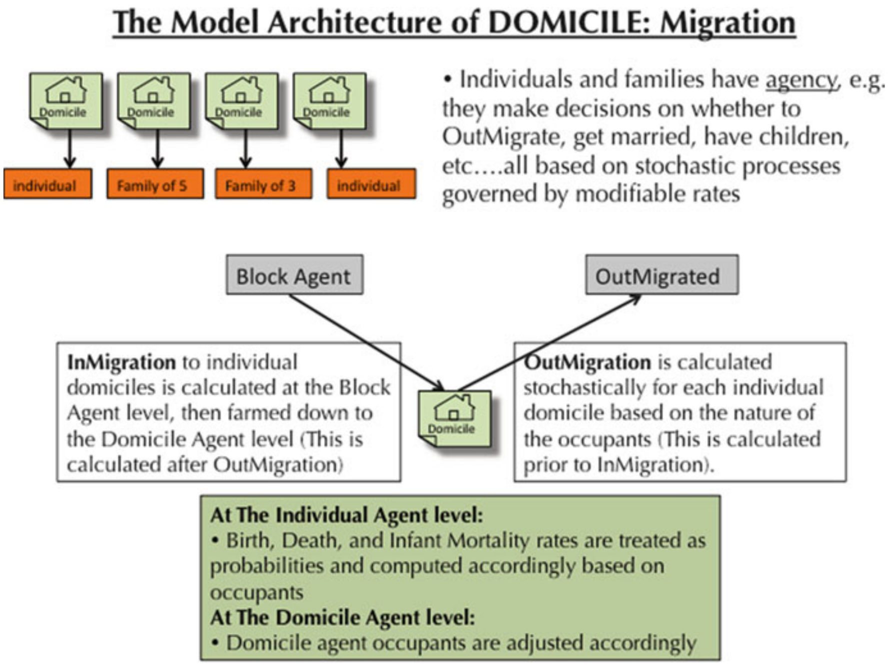

Fig. 19.3 Migration in the Model

This approach results in the maximum amount of potential couples of the same race, regardless of disparities between total numbers of men and women. However, the mechanism for the actual creation of potential couples from groups of men and women is left to the implementer (programmer of the code that implements the model).

3. For each potential couple, the percentage of adults that are married (nationally, or by state, county, etc., based on available input data) is applied as a probability to determine if the potential couple becomes an actual wedded couple. Potential couples that do not become wedded are then treated as individuals with no relationship.

Migration Group Distribution: "Sports Fantasy League" Format

After InMigrating individuals are assembled into groups at the county level, they must be placed in individual domiciles within the sub-geographical hierarchy. InMigrators are distributed down through the subgeography hierarchy of agent classes based on a sports fantasy league method. The following steps are taken for each level of geography down to the domicile level.

Step 1: Sort groups (families and individuals) by size in descending order
Step 2: Assuming there are n geographic subunits in a given level of geography, respectively labeled 1 through n, groups are assigned to the units in the following order:

$$1, 2 ... n,\ n,\ n-1 ... 1.$$

This sequence is repeated until all groups have been assigned to a geographic subunit. For example, A county has three townships total, and there are seven different groups of person agents that need to be assigned. The groups are, in descending order:

G1: family—mom, dad, 3 kids
G2: family—mom, dad 2 kids
G3: family—mom, dad, 2 kids
G4: family—mom, dad, 2 kids
G5: family—mom, 1 kid
G6: individual, male
G7: individual, female

Based on the sports fantasy league group distribution method, the first pass of township assignment would result in this distribution:

T1: G1
T2: G2
T3: G3

The second pass will result in this distribution:

T1: G1, G6
T2: G2, G5
T3: G3, G4

The third and final pass will result in this distribution:

T1: G1, G6, G7
T2: G2, G5
T3: G3, G4

Reflections on Using ODD

We found the ODD standard protocol to be easy to follow, and that the design concepts appendix was also very helpful to us as a checklist. We felt that it was important to distinguish between state variables and auxiliary variables, and we presented this information in tabular form. After having used this helpful distinction in the development of our paper, we feel that it should be adopted as a standard element of the ODD protocol.

Results and Discussion

As noted above, the DOMICILE model is designed to handle a variety of input permutations in order to allow for the option of multiple simulation scenarios. The results of differing simulations can be used in many ways, including simple comparative analysis, model testing, and for sensitivity analysis of the input variables (see Appendix 2 for the variety of different output files that are generated). The results presented here should be considered expedient and preliminary, as the model and implementation are still undergoing testing. In certain instances the input data we used were aggregated, derived, or otherwise less than desirable (see Appendix 1). However, the results are of interest as they represent emergent phenomena based on the stochastic processes in the model. The results presented here are referred to as *projections* despite the fact that for both simulations the ending years are not in the future. This is due to the fact that the model implementation is unaware that it is generating projections for years that have already passed, as the model population growth is not informed by any additional population numbers or modifiers aside from the baseline population data.

Results for San Diego County

Simulation 1, 1990–2000

Figures 19.4 and 19.5 show the population projections for a 10-year simulation run for San Diego County, from 1990 to 2000, with a baseline population of 2,497,604. This number is modified from the 1990 U.S. Census, and was provided to us by the SDfW dataset. There are no births, deaths, InMigration, etc. in the

DOMICILE AGENT-BASED MODEL POPULATION PROJECTION SUMMARY
SAN DIEGO COUNTY FROM 1990 TO 2000

year	births	infant mortalities	noninfant deaths	inmigration	outmigration	black pop	hispanic pop	white pop	other pop	total pop
1990	0	0	0	0	0	152262	486512	1650529	208301	2497604
1991	41584	259	17453	153462	159205	155224	498748	1649498	212263	2515733
1992	40897	283	17242	154531	152271	158391	512562	1653718	216694	2541365
1993	40290	254	17044	157612	140819	162546	529687	1666565	222352	2581150
1994	39756	257	17346	145374	150360	165055	542752	1664410	226100	2598317
1995	38990	257	17607	145586	139696	168449	557624	1668427	230833	2625333
1996	38284	256	17270	143844	133136	171984	573792	1675438	235585	2656799
1997	37990	216	17328	140225	113243	176497	593323	1692895	241512	2704227
1998	38117	218	17146	148826	106744	181909	616465	1719577	249111	2767062
1999	38316	256	17552	155058	95540	188453	644059	1756434	258142	2847088
2000	38813	233	17881	162684	94725	195487	674172	1798361	267726	2935746

Fig. 19.4 Simulation 1, 10-year population projection from 1990 to 2000

Population By Age and Sex for the year 2000	Total	female	male	Percent female
Total population	2935746	1447128	1488618	49
0 to 4	208871	104071	104800	50
5 to 9	245113	122704	122409	50
10 to 14	253089	124338	128751	49
15 to 17	142466	69818	72648	49
18 to 19	87817	42548	45269	48
20 to 24	199087	96662	102425	49
25 to 29	187847	86100	101747	46
30 to 34	243402	102606	140796	42
35 to 39	266074	124737	141337	47
40 to 44	261210	128468	132742	49
45 to 49	215582	108784	106798	50
50 to 54	176165	89875	86290	51
55 to 59	121003	61816	59187	51
60 to 61	38435	19674	18761	51
62 to 64	48019	24401	23618	51
65 to 69	70802	37540	33262	53
70 to 74	61556	33702	27854	55
75 and older	109208	69284	39924	63
Under 18	849539	420931	428608	50
65 and above	241566	140526	101040	58

Fig. 19.5 Simulation 1, population breakdown by age and sex for the year 2000

starting year because the simulation is provided the population value for the start year and the forward projections begin in the following year (Fig. 19.4). The total population at the end of the simulation is 2,935,746. This is larger than the population total provided by SANDAG, based on the 2000 census, which is 2,813,833 (Fig. 19.6), a 4.3% inflation of the population total (121,913 individuals). Figure 19.7 shows the breakdown of the year 2000 projections by age, race, and Hispanic origin. When comparing these numbers to the SANDAG estimates in Fig. 19.8, keep in mind that the DOMICILE model considers Hispanic to be a separate racial category (refer to section "Process overview and scheduling" above and Appendix 1 below for details).

Population by Age and Sex				
(Total Population) (SF1 - P12)	Total	Male	Female	Percent Female
Total population	2,813,833	1,415,097	1,398,736	50%
Under 5	198,621	101,578	97,043	49%
5 to 9	212,829	109,508	103,321	49%
10 to 14	199,669	102,153	97,516	49%
15 to 17	112,542	58,092	54,450	48%
18 and 19	87,377	47,293	40,084	46%
20 to 24	230,953	128,208	102,745	44%
25 to 29	221,273	116,623	104,650	47%
30 to 34	222,087	114,889	107,198	48%
35 to 39	235,183	120,595	114,588	49%
40 to 44	222,080	111,828	110,252	50%
45 to 49	191,181	94,514	96,667	51%
50 to 54	161,622	79,257	82,365	51%
55 to 59	114,391	55,113	59,278	52%
60 and 61	38,193	17,969	20,224	53%
62 to 64	52,082	24,264	27,818	53%
65 to 69	81,763	37,701	44,062	54%
70 to 74	78,296	34,536	43,760	56%
75 to 79	70,851	29,976	40,875	58%
80 to 84	46,433	18,962	27,471	59%
85 and older	36,407	12,038	24,369	67%
Under 18	723,661	371,331	352,330	49%
65 and older	313,750	133,213	180,537	58%
Median age	33.2	31.9	34.6	--

Fig. 19.6 SANDAG population breakdown by age and sex for the year 2000

Simulation 2, 2000–2010

Figures 19.9 and 19.10 are the population projections for a 10-year simulation run for San Diego County from 2000 to 2010. The baseline population for 2000 is 2,797,298, from the 2000 U.S. Census. Once again, there are no births, deaths, InMigration, etc. in the year 2000 because the model projections begin in the following year (Fig. 19.9). The total population at the end of the simulation is 3,295,536. However, at the time this simulation output was produced (early 2010) the only estimates available from SANDAG for San Diego county were for the year 2009, at 3,173,407 (Fig. 19.11). As such, although we ran Simulation 2 up to the year 2010, our focus is on the population numbers for 2009. The population projection for 2009 produced by DOMICILE is 3,191,014, which is larger than the SANDAG

Population By Age, Race and Hispanic Origin for the year 2000	Total	black	hispanic	white	other
Total population	2935746	195487	674172	1798361	267726
0 to 4	208871	14761	70093	105045	18972
5 to 9	245113	16282	77173	129324	22334
10 to 14	253089	22126	62328	144812	23823
15 to 17	142466	11318	35258	81099	14791
18 to 19	87817	6497	21497	50499	9324
20 to 24	199087	15335	49474	111048	23230
25 to 29	187847	13796	47077	105788	21186
30 to 34	243402	20879	55029	145862	21632
35 to 39	266074	19914	58573	163858	23729
40 to 44	261210	16687	53741	167247	23535
45 to 49	215582	12236	42185	141538	19623
50 to 54	176165	7942	30805	122775	14643
55 to 59	121003	5643	20616	85230	9514
60 to 61	38435	2289	7036	25698	3412
62 to 64	48019	2587	8030	33750	3652
65 to 69	70802	2832	11811	50910	5249
70 to 74	61556	2117	9299	46111	4029
75 and older	109208	2246	14147	87767	5048
Under 18	849539	64487	244852	460280	79920
65 and above	241566	7195	35257	184788	14326

Fig. 19.7 Simulation 1, population projections for 2000 by age, race, and Hispanic origin

Population by Age and Race and Hispanic Origin
(Total population) (SF1 - PCT12A - PCT120)

			Non-Hispanic						
	Total	Hispanic Origin	White	Black or African Am.	American Indian	Asian	Hawiian or Pacific Isl.	Other	Two or More Races
Total population	2,813,833	750,965	1,548,833	154,487	15,253	245,297	12,164	5,822	81,012
Under 5	198,621	80,261	77,731	12,302	916	14,501	762	626	11,522
5 to 9	212,829	84,771	84,964	14,210	1,186	15,679	935	668	10,416
10 to 14	199,669	71,092	87,228	13,711	1,208	16,016	970	518	8,926
15 to 17	112,542	39,322	49,278	7,214	675	10,516	604	277	4,656
18 and 19	87,377	29,261	39,631	5,326	598	8,825	429	187	3,120
20 to 24	230,953	74,574	109,760	14,479	1,644	21,328	1,187	631	7,350
25 to 29	221,273	71,715	105,383	13,149	1,264	21,867	1,146	547	6,202
30 to 34	222,087	67,187	111,670	13,715	1,138	21,475	1,133	425	5,344
35 to 39	235,183	59,743	130,994	14,675	1,337	21,497	1,133	445	5,359
40 to 44	222,080	47,699	134,221	12,428	1,244	20,251	962	420	4,855
45 to 49	191,181	34,829	122,761	9,291	1,099	18,636	777	325	3,463
50 to 54	161,622	25,361	110,566	6,703	898	14,427	647	239	2,781
55 to 59	114,391	17,303	79,636	4,633	581	9,934	390	135	1,779
60 and 61	38,193	5,762	25,981	1,785	219	3,645	151	52	598
62 to 64	52,082	7,936	35,334	2,406	242	5,069	232	63	800
65 to 69	81,763	11,579	57,577	2,834	365	7,808	263	78	1,259
70 to 74	78,296	9,628	58,419	2,317	269	6,317	198	70	1,078
75 to 79	70,851	6,701	57,277	1,615	163	4,159	130	51	755
80 to 84	46,433	3,524	39,248	939	118	2,060	81	35	428
85 and older	36,407	2,717	31,174	755	89	1,287	34	30	321
Under 18	723,661	275,446	299,201	47,437	3,985	56,712	3,271	2,089	35,520
65 and older	313,750	34,149	243,695	8,460	1,004	21,631	706	264	3,841
Median age	33.2	24.7	39.2	28.8	30.6	33.2	30.2	25.0	21.3

Fig. 19.8 SANDAG estimates for the year 2000 by age, race, and Hispanic origin

DOMICILE AGENT-BASED MODEL POPULATION PROJECTION SUMMARY
SAN DIEGO COUNTY FROM 2000 TO 2010

year	births	infant mortalities	noninfant deaths	inmigration	outmigration	black pop	hispanic pop	white pop	other pop	total pop
2000	0	0	0	0	0	154530	737804	1538040	366924	2797298
2001	42907	282	22082	171497	174284	156860	754976	1530380	372838	2815054
2002	42407	245	21291	172595	166461	159406	774615	1528079	379959	2842059
2003	42044	281	21058	175952	154886	162586	798811	1533909	388524	2883830
2004	42388	288	20989	162199	164549	164407	817771	1526743	393670	2902591
2005	41453	245	20407	162487	153911	166882	840271	1524446	400369	2931968
2006	42125	278	19899	160574	145387	169723	864998	1526380	408002	2969103
2007	42325	226	19473	156699	124234	173498	895048	1537985	417663	3024194
2008	43597	288	19014	166495	117883	178344	930947	1558065	429745	3097101
2009	44904	275	19014	173692	105394	184434	973022	1588764	444794	3191014
2010	46618	296	19184	182560	105176	191303	1019255	1623400	461578	3295536

Fig. 19.9 Simulation 2, 10-year population projection from 2000 to 2010

Population By Age and Sex for the year 2009	Total	female	male	Percent female
Total population	3191014	1600192	1590822	50
0 to 4	231782	115617	116165	50
5 to 9	247509	123666	123843	50
10 to 14	227686	112101	115585	49
15 to 17	192953	93876	99077	49
18 to 19	107024	52291	54733	49
20 to 24	244436	120105	124331	49
25 to 29	216734	100408	116326	46
30 to 34	226649	103035	123614	45
35 to 39	222929	107656	115273	48
40 to 44	233851	116668	117183	50
45 to 49	247061	124836	122225	51
50 to 54	222366	113674	108692	51
55 to 59	178129	91331	86798	51
60 to 61	58519	29990	28529	51
62 to 64	72626	37334	35292	51
65 to 69	85001	45079	39922	53
70 to 74	59309	33729	25580	57
75 and older	116450	78796	37654	68
Under 18	899930	445260	454670	49
65 and above	260760	157604	103156	60

Fig. 19.10 Simulation 1, population breakdown by age and sex for the year 2009

POPULATION BY GENDER AND AGE (2009)	Total	Male	Female	Percent Female
Total Population	**3,173,407**	**1,584,994**	**1,588,413**	**50%**
Under 5	230,879	117,290	113,589	49%
5 to 9	210,997	105,883	105,114	50%
10 to 14	200,172	100,325	99,847	50%
15 to 17	131,566	66,957	64,609	49%
18 and 19	106,891	56,780	50,111	47%
20 to 24	251,035	138,436	112,599	45%
25 to 29	225,303	119,436	105,867	47%
30 to 34	228,239	118,522	109,717	48%
35 to 39	230,689	117,144	113,545	49%
40 to 44	222,580	111,089	111,491	50%
45 to 49	232,928	115,272	117,656	51%
50 to 54	214,023	104,725	109,298	51%
55 to 59	179,108	86,522	92,586	52%
60 and 61	64,754	30,882	33,872	52%
62 to 64	78,312	37,361	40,951	52%
65 to 69	100,409	46,845	53,564	53%
70 to 74	78,882	35,406	43,476	55%
75 to 79	67,774	29,761	38,013	56%
80 to 84	56,346	22,923	33,423	59%
85 and older	62,520	23,435	39,085	63%
Under 18	773,614	390,455	383,159	50%
65 and older	365,931	158,370	207,561	57%
Median age	35.0	33.7	36.4	-

Fig. 19.11 SANDAG population breakdown by age and sex for the year 2009

population total by 17,607 individuals, or 0.55%. Figure 19.12 shows the breakdown of the year 2000 projections by age, race, and Hispanic origin. Again, the fact that DOMICILE treats Hispanic as a racial category should be considered when comparing these to the SANDAG estimates in Fig. 19.13.

The results of the DOMICILE model Simulations 1 and 2 presented here demonstrate that for both decades the population projections are comparable to the available estimates for San Diego County. While we are pleased with this outcome, we hesitate to make any grandiose statements about the efficacy of the model or to go into greater detail with our comparisons. We still need to do extensive sensitivity analyses on the variables in the model, and there are many additional elements for us to consider as we move forward with our development of DOMICILE.

Population By Age, Race and Hispanic Origin for the year 2009					
	Total	black	hispanic	white	other
Total population	3191014	184434	973022	1588764	444794
0 to 4	231782	13702	100940	85983	31157
5 to 9	247509	14073	100167	97927	35342
10 to 14	227686	16019	81149	90004	40514
15 to 17	192953	11644	62770	92352	26187
18 to 19	107024	7146	35096	49087	15695
20 to 24	244436	16868	78621	111813	37134
25 to 29	216734	14179	69146	98743	34666
30 to 34	226649	13499	71379	106848	34923
35 to 39	222929	12884	68108	107381	34556
40 to 44	233851	14246	67405	118217	33983
45 to 49	247061	14949	65642	133768	32702
50 to 54	222366	12300	54974	126996	28096
55 to 59	178129	8712	40330	108272	20815
60 to 61	58519	2485	12744	37012	6278
62 to 64	72626	2938	15110	47323	7255
65 to 69	85001	3188	17096	56301	8416
70 to 74	59309	2637	11722	38576	6374
75 and older	116450	2965	20623	82161	10701
Under 18	899930	55438	345026	366266	133200
65 and above	260760	8790	49441	177038	25491

Fig. 19.12 Simulation 1, population projections for 2009 by age, race, and Hispanic origin

Model Limitations and Future Considerations

Currently, the model has no established occupancy limits for domiciles. However, in the future, it may be prudent to have occupancy limits associated with each domicile. One could be a hard limit on the maximum number of people that can occupy a domicile, perhaps set by city ordinance. Another could be the *practical occupancy limit*, reflecting the tendency of individual people to desire to relocate when this limit has been reached or exceeded.

In future versions of the model, where applicable, for each successive year in the simulation, we may want to calculate new building agent construction and destruction (this computation along with the already empty domicile agents affects the amount of InMigration).

POPULATION BY RACE, ETHNICITY AND AGE (2009)		Non-Hispanic				
	Hispanic	White	Black	American Indian	Asian & Pacific Isl.	Other
Total Population	**959,075**	**1,579,146**	**166,516**	**16,974**	**337,305**	**114,391**
Under 5	99,826	84,445	11,689	1,074	24,296	9,549
5 to 9	84,078	82,200	11,780	873	18,272	13,794
10 to 14	73,839	81,187	12,498	1,015	18,775	12,858
15 to 17	52,294	51,749	8,200	719	11,622	6,982
18 and 19	39,050	45,442	6,792	635	9,895	5,077
20 to 24	87,870	110,664	15,994	1,726	23,655	11,126
25 to 29	87,520	89,006	12,306	1,316	25,982	9,173
30 to 34	87,523	91,871	11,815	1,281	27,537	8,212
35 to 39	78,738	102,602	12,774	1,236	28,284	7,055
40 to 44	65,826	109,985	12,832	1,127	26,721	6,089
45 to 49	55,947	130,491	13,210	1,361	25,746	6,173
50 to 54	43,540	129,761	11,052	1,196	23,308	5,166
55 to 59	30,808	114,978	8,120	1,012	20,477	3,713
60 and 61	9,840	43,850	2,568	379	6,860	1,257
62 to 64	11,950	53,459	2,890	440	8,103	1,470
65 to 69	15,325	67,840	3,982	560	10,837	1,865
70 to 74	12,094	52,197	3,183	400	9,563	1,445
75 to 79	9,669	46,751	1,989	282	7,775	1,308
80 to 84	6,990	41,262	1,481	177	5,447	989
85 and older	6,348	49,406	1,361	165	4,150	1,090
Under 18	310,037	299,581	44,167	3,681	72,965	43,183
65 and older	50,426	257,456	11,996	1,584	37,772	6,697
Median age	27.4	42.3	31.7	34.4	36.5	24.0

Fig. 19.13 SANDAG estimates for the year 2009 by age, race, and Hispanic origin

Another option worth considering is to nuance the baseline data by introducing additional data on individual people at the domicilelevel (data on households, head of household, etc., subject to availability). When such nuanced data at the level of the individual person agent exist they could be set to override default values derived from encompassing geographic agents further up in the nested hierarchy.

For the next incarnation of the model, it might be better for the InMigration submodel to first couple men and women and then assign children to women rather than vice versa. This would then allow married women to be assigned children at a different rate than unmarried women.

Our current system of distribution for InMigrators may most likely result in an unrealistic population distribution within the subgeography of a given county. Future versions of the model can account for the differential weighting of elements of the geographic hierarchy with regard to the distribution of InMigrating individuals and groups. For example, some townships are urban, whereas others are rural and have different propensities for InMigration. This could lead to the development of an *affinity index* for InMigration, which quantifies the demographic composition of agent classes by race, family size, household income, etc. The affinity index could then be used to influence InMigration distribution by allocating like individuals together in subgeographies.

Appendix 1: Input Values and Parent Datasets for Implementation of the Model

The section on State Variables and Scales, above, outlines the variables required by the model. For the simulations presented in this paper, Simulation 1 refers to projections from 1990 to 2000, and Simulation 2 refers to projections from 2000 to 2010. The data used for the implementation of the model presented in this paper are as follows:

Initial population counts. For both Simulation 1 and Simulation 2, these values came from the "San Diego from Wisconsin" datasets (SDfW), which have population data at the block group level. (Key filenames: SD_P01BG.csv, SD_P02BG.csv, SD_P03BG.csv; these files were provided by the University of Wisconsin APL at the request of Mike Knight). These files have some population counts for individual ages AND some by age ranges. For example, ages 10 and 11 are represented as one group by a single population count, while age 14 had its own count. In the case of age groups, we calculated individual population counts by simply dividing the group population count by the number of ages in the group (e.g. a count of twenty people in the age 10–11 group becomes ten individuals of age 10 and ten of age 11). The DOMICILE model requires 4 races: white, black or African American, Hispanic, and other (this stipulation was requested by Mike Knight). The San Diego from Wisconsin datasets present 5 races: white, black, Native American, Asian/Pacific Islander, and other.

The San Diego from Wisconsin datasets also have Hispanic origin as a category separate from race, and provide counts for the five races denoting Hispanic and Non-Hispanic origin. However, these are aggregate numbers for the racial categories as a whole and are not broken down by age and sex.

Step 1: We use the San Diego from Wisconsin datasets to create preliminary counts for three of the DOMICILE racial categories: white, black, and other. The white and black race preliminary counts come directly from the SDfW dataset. The preliminary count for the DOMICLE Other race category was determined by summing remaining racial categories in the SDfW dataset: Native American, Asian/Pacific Islander, and other.

Step 2: The population counts for the DOMICILE Hispanic race are calculated. This calculation necessarily reduces the preliminary population counts of the other DOMICILE races. The SDfW data provides Hispanic/Non-Hispanic population counts by race as described above. For each DOMICLE race, this data is used to get ratio of Hispanics and Non-Hispanics. This rate is applied to each preliminary population count from step 1, to determine the total number of Hispanics and a final, reduced count for each Non-Hispanic race.

Number of townships, number of cities, number of census tracts, number of block groups, and number of blocks. We set these variables as arbitrary placeholders, with each geographic region being represented by a single unit for now.

Number of domiciles. In the simulations presented here we did not place any limits on the number of domiciles available to the population.

Length of simulation in years. We set the simulation to run for 10 years. Simulation 1 ran from 1991 to 2000, with the baseline population provided for the year 1990. Simulation 2 ran from 2001 to 2010, with the baseline population provided for the year 2000.

Birth rate. The data we used for birth rates are from the Demographic Research Unit of the California Department of Finance (2009). For Simulation 1 we used age-specific fertility rates from Table 2, as there were no subcategories provided from 1990 to 2000. For Simulation 2, we used data from Tables 4d, 4e, and 4h, for age-specific fertility rates for black, Hispanic, and white racial categories, and aggregates for the other racial category.

Birth ratio. The birth ratio remained at the default of 50:50; equal chances for a newborn to be male or females.

Death rate. Death rates were derived from datasets provided by Paul Voss, and were indexed by age group, sex, and race (for details on categories, see the ICPSR Data Dictionary, Voss et al. 2004).

Infant mortality rate. For the simulations in this paper, one general infant mortality rate was used for all races: 6.3 deaths per 1,000 births. This value was based on data from California Department of Health Services (1999:2).

OutMigration rate. OutMigration rates were computed from IRS tax datasets (example filename: co0607Cai.xls … California OutMigration for tax year 2006–2007). A typical IRS dataset for OutMigration lists the number of tax exemptions from tax returns filed in a given year by a non-resident of San Diego County who filed a return in the previous year as a resident of San Diego County. We use the number of exemptions of OutMigrating tax filers as a proxy for the number of people migrating out of San Diego County. The IRS datasets also provide the total number of exemptions for filers of San Diego County that did not leave the county. The total number of exemptions of filers of San Diego County before migration is the sum of the non-migrating exemptions and the OutMigrating exemptions. Therefore we can compute an OutMigration rate by dividing the number of OutMigrating exemptions by the number of total exemptions for San Diego County.

Thus the equation:

$$\frac{\text{OM exemptions}}{\text{OM exemptions} + \text{non migrating exemptions}} = \text{OutMigration rate}$$

InMigration rate. InMigration rates were computed from IRS tax datasets (example filename: co0607Cai.xls … representing California InMigration for tax year 2006–2007). A typical IRS dataset for InMigration lists the number of tax exemptions from tax returns filed in a given year by a resident of San Diego County who filed a return in the previous year as a non-resident of San Diego County. We use the number of exemptions of InMigrating tax filers as a proxy for the number of people migrating into San Diego County. The InMigration rate for San Diego County is computed in a similar fashion as OutMigration.

Thus the equation:

$$\frac{\text{IM exemptions}}{\text{OM exemptions} + \text{non migrating exemptions}} = \text{InMigration rate}$$

It should be noted that the IRS datasets do not provide information on exemptions by age, sex, or race. Our resulting IM and OM rates are therefore uniform across all cohorts. However, the IRS datasets are produced yearly, allowing us to compute IM and OM rates by year. As mentioned above, the IRS datasets are labeled with a consecutive year progression, for example: co0607Cai.xls is a file of InMigrating exemption data. It contains the number of exemptions of filers in San Diego in 2007 who did not file in San Diego in 2006. Therefore, it represents the number of InMigrating exemptions in 2007.

Marriage rate. The marriage rate was set at .47 for both simulations.

Adult age marker. This was kept at the default value of age 18.

Minimum motherhood age and maximum motherhood age. These were the default values of ages 15 and 44, respectively.

Parent race priority. For both simulations the parent race priority is as follows:

[Black] = Black, White, Hispanic, Other
[Hispanic] = Hispanic, White, Black, Other
[White] = White, Black, Hispanic, Other
[Other] = Other, White, Black, Hispanic

OM voting weight. The voting weight for minors and adults was set at 1.0 for both simulations.

OM voting threshold. The voting threshold for OutMigration was set at .4 for both simulations.

Appendix 2: Simulation Output Files

Race Files

A file is created for each race, with population counts by age and sex presented in tabular fashion for the end of the last year of the simulation only. Values for each individual age are presented, with the exception of ages above 74, which are aggregated into the cohort 75 +.

TOTALS Files

The TOTALS files present elements of the output data for each simulation in tabular form. The TOTALS files present limited results by simulated year for all years in the simulation, and the data are presented in a tabular fashion with each simulated year represented by a row (see Figs. 19.4 and 19.9). Each row contains data in the following order:

Year: Simulation year
Births: Number of births that occurred during the year
Infant mortality: Number of deaths of children born during the year
Non-Infant death: Number of deaths of person agents over age zero during the year
InMigration: Number of person agents moving into the county during the year
OutMigration: Number of person agents moving out of the county during the year
Black population: Total population of blacks or African Americans at the end of the year
Hispanic population: Total population of Hispanics at the end of the year
White population: Total population of whites at the end of the year
Other population: Total population of other races at the end of the year
Total population: Total population at the end of the year

TOTALS_STATS Files

The TOTALS_STATS files present statistics on TOTALS files for simulations that were replicated multiple times. For example, if the user desires to run ten identical simulations, a stats file will be generated (the only difference being the random number seed, which insures that each simulation will have different stochastic results). Stats files are in tabular form just like TOTALS files, but they also include the Average, Range, Variance, and Standard Deviation for each variable.

CHART Files

The CHART files contain information for the end of the last year of the simulation only, in two tables, which are fashioned after SANDAG census profile sheets (see Figs. 19.5, 19.7, 19.9, and 19.12).

Table 1, Population by Age and Sex *(for last year of the simulation)*: For the end of the last year of the simulation only, the data are presented in tabular fashion. The initial row of the table contains breakdowns for the total population and succeeding rows give data for the following age groups:

Under 5, 5–9, 10–14, 15–17, 18 and 19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60 and 61, 62–64, 65–69, 70–74, 75 and older, Under 18, and 65 and older.

Each row contains, in the following order:

Age group: Age group descriptor.
Total: Total population fort the age group.

Male: Total male individuals for the age group.
Female: Total female individuals for the age group.
Percent female: Percentage of female individuals for the age group.

Table 2, Population by Age and Race (for last year of the simulation): For the end of the last year of the simulation only, the data are presented in tabular fashion. The initial row of the table represents breakdowns for the total population, and succeeding rows give data for the following age groups:

Under 5, 5–9, 10–14, 15–17, 18 and 19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60 and 61, 62–64, 65–69, 70–74, 75 and older, Under 18, and 65 and older.

Each row contains, in the following order:

Age group: Age group descriptor.
Total: Total population for the age group.
Hispanics: Total Hispanic population for the age group.
Whites: Total white population for the age group.
Blacks: Total black or African American population for the age group.
Other: Total all other races for the age group.

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Chapter 20
Demosim, Statistics Canada's Microsimulation Model for Projecting Population Diversity*

Éric Caron Malenfant, André Lebel, and Laurent Martel

Introduction

Owing to persistent low fertility and strong immigration, Canada has seen its population rapidly change in recent decades. Thus, from one census to the next, there has been an increase in the proportion of persons born abroad, persons whose mother tongue is neither English nor French, and persons belonging to visible minority groups[1] as defined by the *Employment Equity Act*, to cite only a few examples.[2] However, this change is not occurring at the same pace throughout the country: while very rapid in the largest metropolitan areas, especially Toronto, Vancouver, and Montréal where most newcomers settle, it has thus far remained quite modest elsewhere in Canada.

Because of the various public policy implications of these rapid changes in the composition of the Canadian population, three federal departments (Canadian Heritage, Human Resources and Skills Development Canada and Citizenship and Immigration Canada) commissioned Statistics Canada to compute projections of the ethnocultural diversity of the Canadian population up to 2031. Owing to the great number of variables to be projected (visible minority group, generation status,[3]

[1] This paper is an extract of the report released in 2010 by Statistics Canada entitled Projections of the Diversity of the Canadian Population, 2006 to 2031 (catalogue number 91–551 published by authority of the Minister responsible for Statistics Canada. © Minister of Industry, 2010).

[2] On this subject, see Chui et al. (2007).

[3] Generation status ranks of the respondent's generation since the settlement of his or her family (meaning direct ascendants) in Canada. Immigrants are the first generation; the second refers to non immigrants born of at least one foreign-born parent ; the following generations (third or more) refer to non immigrants born of two parents born in Canada.

[*] This paper focuses on the methodology of Demosim, Statistics Canada's microsimulation population projections model, and is an extract of the report entitled Projections of the diversity of the Canadian population, 2006 to 2031. Demosim was designed (catalogue number 91–551).

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_20, © Springer Science+Business Media B.V. 2012

religious denomination, mother tongue, place of birth, Aboriginal identity, for example), Statistics Canada's Demography Division, in collaboration with Modeling Division and Social Survey Methods Division, revised, enhanced and further developed its microsimulation model called Demosim to compute these projections. Models based on aggregated data proved to be inappropriate for this type of exercise. Programmed using the *Modgen* microsimulation language, Demosim also projects the Canadian population at the regional level, that is for the 33 Census Metropolitan Areas[4] (CMA) of the country.

The goal of this paper is to provide an overview of the Demosim projection model using microsimulation: its content, overall functioning, events simulated, methods, data sources and scenarios. Thus, the focus of this article is on the tool used to produce population projections. Readers interested in results about the ethnocultural diversity of the Canadian population can access free of charge the full report entitled *Projections of the diversity of the Canadian population, 2006 to 2031* (catalogue number 91–551) on Statistics Canada web site.

Content of Demosim

The starting point for the projections is the micro data file based on the 20-percent sample of the 2006 census of the population of Canada.[5] This database, which includes close to seven million persons with their characteristics, has been adjusted to take account of the net undercoverage in the census according to age, sex and place of residence. These adjustments were made by recomputing the sampling weights associated with each individual in the database. Also, some variables of interest needed for projection but absent or incomplete in the census were imputed into the database. These included individuals' graduation dates, the generation status of the population under 15 years of age and the province or territory of birth for a small portion of the respondents to the 2006 Census.

The variables contained in the initial file can be divided into two major groups. The first consists of the key variables that were projected for public release purposes:

- Age
- Sex
- Place of residence
- Religious denomination[6]

[4] A census metropolitan area (CMA) is an area with a population of at least 100,000, including an urban core with a population of at least 50,000. Canada now has 33 CMAs. They are Canada's largest metropolitan centres.

[5] Except for religious denomination, which was not asked in the 2006 Census. Thus, this variable is projected separately based on the 2001 Census.

[6] Data on religious denomination is collected once every ten years in the Canadian censuses. For that reason, religious denomination is projected from 2001 in Demosim.

- Visible minority group
- Immigrant status
- Generation status
- Continent/region of birth
- Mother tongue
- Highest level of schooling
- Labour market participation

The second group consists of so-called support variables, that is, variables that are included in the model only because they serve to increase the quality of the projection for the variables in the first group. Most of the time, these are variables used to predict events simulated by the model. They are the following:

- Marital status[7]
- Province or territory of birth of non-immigrants
- Year of immigration
- Age at immigration
- Aboriginal identity
- Registered Indian status
- Presence and number of children in the home
- Age of youngest child in the home
- Sex of youngest child in the home
- Dates on which diplomas were obtained

Overall Functioning of the Model and Probabilities Associated with Events

Like any population projection model, Demosim makes the initial population change over time by adding births and immigrants and subtracting deaths and emigrants. Also, as in "traditional" models, the future number of births, deaths, immigrants and emigrants is based on assumptions that can be changed or combined in various scenarios.

However, since it proceeds on the basis of microdata, the functioning of Demosim differs greatly from that of models based on aggregate data.[8] As in "traditional" projection models, the method is designed to obtain an estimate of the population of Canada at a future reference date; but it obtains this estimate by simulating, one at

[7]Including the mixed or non-mixed nature of the union. Two types of mixed unions are possible: with a partner whose immigrant status is different and/or with a partner whose Registered Indian status is different. This information is used to assign generation status and Registered Indian status to newborns.

[8]See Van Imhoff and Post (1997) for a discussion of the details of microsimulation projection models and Bélanger et al. (2008) for a discussion of the previous version of the model.

a time, the future of each individual included in the original file. These individuals are therefore likely to "experience," in the course of projection, a number of events, the main ones being the following: birthday, birth of a child, death, migration from one part of Canada to another, emigration, change of education level, change of marital status, change in labour market participation and change of religion. Using a Monte Carlo procedure and the probabilities associated with each event, the model calculates for each person, based on his or her particular characteristics, the probabilities that the person will experience these events as well as the time that will elapse before they occur (waiting time). The event with the shortest waiting time is the one that will occur first. After each event, the probabilities and waiting time are recalculated to take account of the new individual situation. The model accordingly advances the individuals to the end of the projection period, unless they die or emigrate in the meantime. New individuals are also added over time through birth or immigration, after which they are subject, like the rest of the population, to the probabilities of experiencing the events simulated by Demosim.

It should be added that the functioning of Demosim is maintained by *Modgen*, a programming language specially designed by Statistics Canada's Modeling Division to facilitate the development of microsimulation models. *Modgen* has been used to develop various microsimulation models, including Statistics Canada's *LifePaths* and *Pohem* microsimulation models. More information on Modgen may be obtained on the Statistics Canada website at http://www.statcan.gc.ca/spsd/Modgen.htm.[9]

Events Simulated, Methods, Data Sources

Demosim could not function if the various probabilities associated with each event that it simulates were not established in advance. The methods used and the variables selected for calculating the parameters of the module were determined on the basis of data availability and the objectives of the different modules of the model. The rest of this section briefly describes the functioning of the main modules[10] of Demosim, summarized in Table 20.1.

The fertility module was designed in part to take into account the differences in fertility reported in the literature between visible minority groups, religious groups, immigrant groups and other categories of the population.[11] Based on 2006 Census data to which the own-children method[12] was applied, this module was created in

[9] Statistics Canada's Modelling Division may also be contacted at microsimulation@statcan.gc.ca

[10] Demosim has one module per simulated event.

[11] On this subject, see Bélanger and Gilbert (2003), McQuillan (2004) Ram (2004) and Caron Malenfant and Bélanger (2006).

[12] This is an indirect method of estimating fertility that considers women living with at least one of their children under one year of age at the time of the census as having given birth during the previous year. Please see Cho et al. (1986), Desplanques (1993) and Bélanger and Gilbert (2003) for a description and discussion of this method.

two steps. In the first step, a base risk of giving birth to a child was derived from fertility rates by age, number of children and Aboriginal identity. These base rates were aligned by age to Vital Statistics data for 2006 and 2007 and then, for subsequent years, projected in order to attain targets with respect to the intensity and tempo of fertility. In the second step, relative risks, calculated using log-log logistic regressions carried out on the same database and stratified by age, number of children and Aboriginal identity, were applied to base risks to increase or decrease the probability of giving birth according to a number of relevant variables. For non-Aboriginal populations, the variables used in the models are age, marital status, place of residence, place of birth, period of immigration and generation status, visible minority group, religious denomination, highest level of schooling, and an interaction between highest level of schooling and visible minority group. For Aboriginal populations, these variables are age, Aboriginal identity, Registered Indian status, place of residence, marital status and highest level of schooling.

In general, this approach, which distinguishes between base risks and relative risks, has the following two advantages: (1) it lends itself to creating parameters that combine the robustness of a data source such as Vital Statistics with the wealth of variables offered by other sources such as surveys; and (2) it makes it easier to prepare alternative assumptions, which can be obtained by changing base risks only, relative risks only or both.

When a birth occurs in the simulation process, a new record is added to the database and must be assigned *at birth* a value for each projected characteristic so that new records will have the minimal attributes to enable them to be subject to the probabilities of "experiencing" the events that the model provides for. Most characteristics of newborns are assigned deterministically: children are 0 years of age, not in a union, have no high school diploma, are born in the mother's region of residence, and so forth. Mother tongue, visible minority group and Aboriginal identity are instead assigned probabilistically, using mother-to-child characteristics transition matrices calculated on the basis of 2006 Census data to which the own-children method[13] has previously been applied. These matrices include the following variables: a mother tongue is assigned to the child based on the mother's mother tongue, immigrant status and region of residence; the child's visible minority group depends on that of the mother and her immigrant status; and Aboriginal identity is assigned to the child based on the mother's Aboriginal identity and Registered Indian status.

Assigning generation status to newborns is a special case, in that it is necessary to know the father's immigrant status when the mother herself is not an immigrant; in that event, the child is second generation if the father is an immigrant and third generation or more if the father is not an immigrant. Because births are linked only to the mothers in Demosim, the information regarding the father's immigrant status was "registered" along with the mother's marital status (which indicates whether or not her spouse has the same immigrant status or, in other words, whether or not the

[13] This is basically the same method as was used to develop fertility parameters.

Table 20.1 Key methods, data sources and variables used for parameters estimates in Demosim

Module	Method(s)	Data source(s)	Variables
Fertility	1. Base risks: projected fertility rates 2. Relative risks: log-log regressions	2006 Census (to which we applied the own-children method) and Vital statistics	Age, parity, Aboriginal identity, Registered Indian status, time elapsed since immigration, generation status, visible minority group, religion, place of residence, place of birth, education and marital status
Characteristics of new borns	1. Transition matrices of mother tongue, visible minority group, Aboriginal identity and Registered Indian status from mother to the child 2. Deterministic and probabilistic imputations of the new-borns' characteristics	Census 2006 (with own-children method for calculation of transition matrices)	For transition matrices: Immigrant status, Registered Indian status, visible minority group, Aboriginal identity, mother tongue, marital status, mixed unions and place of residence of the mother
Mortality	1. Base risks: projected mortality rates using a variant of the Lee-Carter method 2. Relative risks: proportional hazards regressions	Vital statistics and 1991 Census mortality follow-up file	Age, sex, place of residence, time elapsed since immigration, education, visible minority group and Aboriginal identity
Immigration	1. Annual number of immigrants is set according to assumptions 2. Allocation of characteristics using an imputation by donors	Census 2006 and Citizenship and Immigration Canada data	All characteristics assigned to each new immigrants
Emigration	1. Base risks: emigration ratios 2. Relative risks: proportional hazards regressions	Statistics Canada population estimates and Longitudinal Administrative Database	Age, sex, place of residence, time elapsed since immigration and place of birth
Internal migrations	1. Out-migration rates: log-log regressions specific to each region 2. Choice of a destination: origin-destination matrices	Censuses 1996, 2001 and 2006	Age, marital status, presence of children at home and age of the youngest child, education, place of birth, time elapsed since immigration, visible minority group, mother tongue, Aboriginal identity, place of residence, generation status and religion

Module	Method(s)	Data source(s)	Variables
Highest level of schooling	1. Graduation probabilities calculated using data collected in 2001: logistic regressions 2. Probabilities are projected to 2006 3. Probabilities are adjusted to match the 2006 Census distribution	General Social Survey 2001 and 2006 Census	Birth cohorts, age, sex, place of birth, visible minority group and Aboriginal identity
Change of religion over the life course	1. Out-religion rates (specific to each religion) 2. Choice of a new religion: origin-destination matrices	Ethnic Diversity Survey 2002 and Censuses 1981, 1991 and 2001	Age, sex and religious denomination
Marital status	"Embedded" multiple logistic regressions and time trend parameters	Censuses 2001 and 2006	Age, sex, presence of children at home and age of the youngest child, visible minority group, mother tongue, Registered Indian status, Aboriginal identity, education, place of residence, generation status and religion
Departure of children from parental home	Proportional hazards regressions	General Social Survey 2006	Age, sex, visible minority status and place of birth of the youngest child as well as sex and place of birth of parents
Labour market participation	1. Base rates: projected participation rates 2. Relative rates: ratios	Labour Force Survey and 2006 Census	Age, sex, place of residence, time elapsed since immigration, education and visible minority group

union is mixed). This makes it possible to assign newborns' generation status correctly and directly, based solely on their mother's characteristics.[14]

The mortality module was designed to reflect the secular decline of mortality in Canada along with the differences that separate, in this regard, the various population groups for which the projection is made.[15] As in the case of fertility, the method used entails two steps. In the first step, a base risk of dying was calculated according to age and sex on the basis of mortality rates projected by means of a variant of the Lee-Carter model applied to Canadian Vital Statistics data from 1981 to 2006.[16] In the second step, relative risks of dying according to place of residence, immigrant status, period of immigration, visible minority group, Aboriginal identity, highest level of schooling and age were obtained from age and sex-stratified proportional hazards regression model applied to the Canadian census mortality follow-up database.[17] These relative risks serve to increase or reduce, as the case may be, the basic risks obtained from the projected rates by age and sex.

The functioning of the immigration module, central to the future ethnocultural composition of the population, assumes, first, that a number of newcomers is determined for each year of the projection period. This number, which is set outside the model, can be changed to create alternative assumptions regarding the volume of immigration. Next, each new immigrant must be assigned a value for each of the projected characteristics, which is done using a donor imputation method. Donors are selected in the micro database for the 2006 Census from among persons who report having recently immigrated to Canada. Alternative assumptions can also be created on the composition of immigration.

The emigration module was developed according to the same principle as the fertility and mortality modules, namely by distinguishing between base risks and relative risks, notably taking account of the immigrants' greater propensity to emigrate, especially in the first years after their arrival in Canada. The base risks were derived from the total emigration probabilities by age and sex, calculated using Statistics Canada annual population estimates. These were then augmented or reduced using the results of a proportional hazards regression which, carried out on the Longitudinal Administrative Database,[18] estimates the probability of emigrating according to place of residence, being a recent immigrant (settled for 15 years or less) and, for persons in the latter category, place of birth and time elapsed since immigration to Canada.

The internal migration module serves to project changes of residence between the 47 regions in the model, taking account of the various characteristics of interregional migrants, namely age, marital status, presence of children, age of youngest

[14]The module for mother-to-child transmission of Registered Indian status is largely based on the same principle.

[15]In particular, see Chen et al. (1996) and Wilkins et al. (2008).

[16]Li and Lee (2005).

[17]This database results from records linkages between the 1991 Census and Canadian Vital Statistics data from 1991 to 2001. On this subject, see Wilkins et al. (2008).

[18]This database includes tax data and is linked to a longitudinal database on immigrants.

child, place of birth, time elapsed since immigration, visible minority group, Aboriginal identity, mother tongue, highest level of schooling, generation status and religious denomination. It draws on the Canadian population censuses, which include, apart from the variable of interest, information on individuals' one year geographic mobility. On this basis, the probabilities of leaving each of the 47 regions were first calculated using log-log logistic regression models including a number of variables suited to the specificities of the regions for which they were estimated. Origin-destination matrices, which take account of age, place of birth, time elapsed since immigration, visible minority group, mother tongue and Aboriginal identity, are then used to distribute the migrants among the other 46 regions. This method can also be used to create alternative assumptions by estimating the models and matrices for different periods.

To make projections of religious denomination, it was necessary to add a religious mobility module, so as not to underestimate the future number of persons who report having no religion, since this group has seen its numbers grow over time owing to the mobility of individuals who have left their religion and not subsequently reported having another one.[19] This module was constructed in the same way as the geographic mobility module. First, the probabilities of migrating from one religion to another—"exit rates," so to speak—were established by age and sex for each of the main religious groups by combining the information drawn from the 2002 Ethnic Diversity Survey (EDS) and a cohort-based analysis of the 1981, 1991 and 2001 censuses.[20] The "migrants" were then distributed among the other religions using origin-destination matrices by sex drawn from the Ethnic Diversity Survey.[21]

Demosim also includes two socioeconomic modules, one modelling changes in highest schooling level and the other modelling labour market participation. The education module is made up of probabilities of graduating, which are designed to reflect differences in this regard between the projected ethnocultural groups. They were established as follows. First, probabilities of graduating by age cohort, sex and place of birth were estimated using logistic regression models, applied to data from the 2001 General Social Survey. These probabilities were then projected to 2006 before being calibrated so as to allow exact reproduction of the population

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[19] Readers interested in data on the increase in the number of persons reporting no religion, or more generally in the change over time in the numbers for the major religions in Canada, are invited to consult Statistics Canada (2003).

[20] The Ethnic Diversity Survey allows us to compare respondents' religion with that of their mothers when the respondents were under 15 years of age. The results of the EDS must therefore be interpreted as measuring both intergenerational mobility (since respondents are compared with their mothers) and intragenerational mobility (since a change in religion can take place in one's later years). The age at the time of a change was estimated by means of a cohort-based analysis of data from the 1981 to 2001 censuses, similar to what was used by Guimond (1999) to estimate the ethnic mobility of Aboriginals.

[21] It should be noted that in the model, this module is applied only to non-Aboriginal populations, since Aboriginals are not part of the target population of the Ethnic Diversity Survey. By way of compensation, the results of a mother-to-child religion transmission matrix calculated with 2001 Census data are used to assign a religion to Aboriginals who are born in the course of simulation.

distributions by schooling level, age, sex and place of birth, visible minority groups and Aboriginal identity in the 2006 Census.[22]

Labour market participation is simulated by annually imputing a labour market activity status to each individual. Participation rates used for imputation were derived in two steps. Firstly, participation rates by age, sex, highest level of schooling and province of residence were established by drawing on annual data from the Labour Force Survey. Ratios based on labour market activity contained in the 2006 Census were used, secondly, to increase or decrease, for each combination of age, sex and schooling level, the labour market participation of the population according to visible minority group, immigrant status and immigration period. Each of those two modules also allows for different assumptions to be built.

Demosim also includes other modules primarily designed to update, in the course of projection, variables that influence other events in the model. Among them, the marital status module stands out in that it greatly improves the projection of births in particular. The function of this module is to assign—i.e., to impute—annually to each individual a marital status according to the results of logistic regression models estimated on the basis of the 2006 Census. Stratified by sex and Aboriginal identity, these models estimate the probability of being in a union and then, among persons in a union, the probability of being married (as opposed to living in a common-law union), taking account of age, place of residence, visible minority group, mother tongue, presence of children at home, age of youngest child, generation status, education, Registered Indian status and religious denomination. The mixed or non-mixed nature of a woman's union (that is, whether she is in a union with a spouse who has a different immigrant status or Registered Indian status) is then modelled using logistic regressions so as to make it possible to assign generation status or Registered Indian status to children born over the course of the simulation. Trend parameters were also added to the model, in part to take account of the increase in common-law unions within the Canadian population.

A module for projecting the departure of children from the parental home was also developed in order to update the number of children in the home, an intermediate variable important for the internal migration module; it basically consists of the results of two proportional hazard regression models (one for males and the other for females) estimated with data from the 2006 General Social Survey. The child's age, sex, visible minority status and place of birth as well as the father's or mother's place of birth were covariates in these models.

Scenarios

Population projections are different from forecasts. This is an important nuance, because forecasts are used to tell what the future will most probably be, whereas projections instead are used to tell what would happen if the assumptions and

[22] The modelling of education in Demosim is documented in Spielauer (2009).

scenarios chosen were to prove correct. In this sense, making projections is a prospective exercise whose purpose is much more to support the planning of public policies and nourish public debate than to predict the future.

The capability for Demosim to project the population based on various scenarios of future evolution was therefore a key aspect and like other projections models, Demosim allows for scenario building. Those scenarios are built from a combination of various assumptions on components of population growth. Numerous assumptions can be made, either on the level (base risks) or the differentials (relative risks) for one component. For example, one can build three assumptions on future fertility level (1.5, 1.7 and 1.9 children per women) and two assumptions on future differentials (status quo and convergence) according to some covariates. Demosim can also be used to build specific scenarios for sensitivity analysis, for example a scenario with zero immigration, to assess the impact of immigration on future population growth.

Conclusion

Demosim was designed first for the specific objective of providing an insight into what the ethnocultural makeup of the Canadian population might be by 2031. Methods, assumptions and scenarios were chosen with a view to achieving this objective. Despite the wealth of information contained in Demosim, the number of variables projected remains relatively limited because of the framework determined by the objectives of the project, and also because of the limitations inherent in the starting population, which contains only information that can be obtained from the 2006 Canadian Census of Population.[23] As a result, it was not possible, when estimating parameters, to include all variables that the literature recognizes as explaining the demographic behaviours simulated by Demosim, since variables can be taken into account only if they are themselves projected.

Also, the Demosim microsimulation model was built using various data sources, each with its own limitations. While the data sources were selected and used with a view to obtaining the most reliable and robust parameters possible, it goes without saying that coverage of the target populations can vary from one source to another, and that parameters estimated on the basis of a sample survey are subject to variability due to sampling error. In other words, parameters used in Demosim have different sources of uncertainty related to the source data. Although generally quite low, some variability is also associated with the Monte Carlo process used to calculate waiting times in the simulation model.

Despite those limitations, Demosim represent a powerful and relevant tool for complex population projections. Through microsimulation, a user may easily not

[23] Unless, of course, the information is imputed into the database.

only project multiple characteristics of a population but also take into account differentials in demographic behaviours between groups of the population. Therefore, composition effects are explicitly taken into account in the results of the projections, providing for more accurate results in the long run.

Acknowledgments The authors are grateful to the Department of Canadian Heritage, Human Resources and Skills Development Canada and Citizenship and Immigration Canada for funding of the projections. The authors also wish to thank other members of the Demosim team that contributed to the model development and validation: from Statistics Canada, Patrice Dion (Demography Division), Iván Carrillo-García, Dominic Grenier, Chantal Grondin, Christiane Laperrière and Robert-Charles Titus (Social Survey Methods Division), and Claude Charette and Martin Spielauer (Modelling Division). Also, from the Institut national de la recherche scientifique (INRS), Alain Bélanger and from the Department of Indian and Northern Affairs, Éric Guimond.

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Chapter 21
Expert and Local Knowledge: Poverty Researchers Meet Community Leaders

Joachim Singelmann, Dudley L. Poston Jr., and Rogelio Saenz

Introduction

Traditionally, research and its application have involved two different groups of people. Scientists typically generate the knowledge that enters the public arena through the vetting process of peer review and publication in professional journals. The scientific findings are then applied by various groups for their specific purposes, such as the following: extension agents in agriculture use the findings to inform farmers about best practices; nonprofit organizations make recommendations for specific programs; or government program planners use the knowledge for public policies. Nowhere in this process is there an explicit place for the experience and knowledge of local residents to be included in the planning process. For some issues, there might be public hearings, or the public is invited to make comments before directives are issued. But even at this stage, the locals would only have contact with the program managers, but not with those whose science was the basis for the specific programs. Yet, there is growing evidence emerging about the importance of knowledge gained on the ground from those who are directly affected by policies and, especially, from those whose participation is essential for the success of the policy implementation. According to this emerging body of research, policies and programs are most successful when they incorporate all three forms of knowledge: expert, managerial, and local knowledge. The purpose of this chapter is to demonstrate the usefulness and applicability of the types-of-knowledge framework

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2_21,

for federal research projects and their extension efforts. To that end, the chapter will first review briefly some of the pertinent literature regarding different forms and types of knowledge in the context of development projects, with a particular focus on rural development. The review is followed by a summary of how, as part of a USDA-funded research project on poverty in the Mississippi Delta and the Texas Borderland, we set up town-hall meetings in six communities to facilitate the exchange of expert and local knowledge. We conclude the chapter with a discussion of the benefits of making such expert-local exchanges a part of research projects on economic and social development.

Past Research

A very influential claim in the literature on the production of knowledge and scientific inquiry is the notion by Gibbons et al. (1994) that the traditional form of knowledge production—Mode 1—has become challenged during the latter part of the twentieth century by Mode 2. Accordingly, Mode 1, "characterized by the hegemony of theoretical or, at any rate, experimental science … was being superseded by a new paradigm of knowledge production ('Mode 2'), which was socially distributed, application-oriented, trans-disciplinary, and subject to multiple accountabilities" (Nowotny et al. 2003:179). Mode 1 has come to be associated with what we commonly refer to as scientific knowledge, whereas Mode 2 recognizes the importance of local knowledge as a contributor to a more comprehensive body of knowledge. This section of our chapter reviews some of the pertinent literature regarding the role of knowledge in development.

Scientific Knowledge

During the 1970s, coinciding with the end of the postwar period, researchers from several different fields called attention to the growing importance of science, knowledge, and technology in advanced industrial societies. Bell (1973) pointed to the *Coming of Post-Industrial Society*; others (cf. Gershuny 1978; Singelmann 1978; and Gershuny and Miles 1983) noted the rise of service industries and their demand for professional and technical occupations; and Drucker (1994) made extensive use of the term "knowledge society." These approaches viewed knowledge in a postindustrial, service, or knowledge society as being largely scientific, codified, and replicable. Knowledge was therefore viewed as advanced through scientific methods that are acquired through formal scientific training. While Bell (1976), for example, discussed knowledge as the new foundation of societal power and examined the contest over the production of knowledge in advanced capitalism, his understanding of knowledge was always scientific or expert knowledge. As noted by Dargan and Shucksmith (2008:275), "theories around innovation have often focused on innovation in firms aimed at technological, product and process development. Innovation more generally has tended to be viewed as a scientific and technical sequential process driven by experts … while other forms of knowledge-creating activities are ignored."

More recently, however, scholars have begun to recognize the limitation of this one-dimensional approach to innovation, knowledge, and development (Leach et al. 2005; Long 1992; Latour 1987). Moreover, the very notion that scientific knowledge always solves societal problems has been questioned by sociologists such as Beck (1992) who, in his book *The Risk Society*, argued that scientific knowledge is often a cause of, not a cure for, social problems, and that this is especially the case with regard to the environment. A recent example is the application of glyphosate on U.S. farms to combat weeds. Hailed as a technology to increase yields by eliminating weeds, its use has led to the appearance of over ten glyphosate-resistant weed species (New York Times 2010). As a result, farmers have to use their experience, that is, their local knowledge, to find ways to combat the new weed species, including a return to practices of some 20 years ago, such as regular plowing and the hand-pulling of weeds.

Local Knowledge

Kloppenburg (1991) had called attention to the importance of local knowledge for agricultural science. More recently, Tovey (2008:1987) noted that "Knowledge has become increasingly contextualized." As the example above regarding resistant weed species demonstrates, scientific knowledge has the potential of increasing risks, and when it does, it often does not offer a solution. The "coproduction of knowledge between 'experts' and 'lay' knowers" has become a major focus in the discussion of rural development projects; that approach recognizes "that there are multiple ways of knowing, evaluating and acting" (Tovey 2008:191). Similarly, Koutsouris (2008) called for a better integration of local knowledge into theories of a knowledge society.

An important study by Siebert et al. (2008) reviewed the prevalence of scientific and local knowledge in the area of nature conservation and biodiversity in 12 European countries (which were part of the EU-funded comparative research project CORASON: A Cognitive Approach to Rural Sustainable Development—The Dynamics of Expert and Lay Knowledges). The authors make an important distinction "between local knowledge in the narrow sense, as it is analyzed in academic discourse, and the knowledge held by locals" (Siebert et al. 2008:235; see also van der Ploeg 1993). Accordingly, the "true" or "real" local knowledge is argued to be a knowledge system that, in their case, refers to local resource-use practices, but could also refer to local social relations regarding the persistence of poverty in a study of inequality, or to local health practices in projects addressing health outcomes.

Siebert et al. (2008) also echoed Pellizzoni's (2003) observation about the difficulty of including lay persons in the process of policy planning. Yet they clearly showed that projects in which there is a co-operation between scientists and local actors tend to be far more successful than projects that are implemented in a top-down manner. Such cooperation is facilitated by a mutual recognition of scientists and local actors regarding the value of knowledge held by the other group.

The use of managerial knowledge to mediate between scientists and local actors is another, and increasingly important, path to the application of a more integrated body of knowledge to development projects (Siebert et al. 2008:235). As noted by Bruckmeier and Tovey (2008:314), "This new model is less hierarchical and hegemonic and comes from the target groups, beneficiaries and local people more than from the actors in the policy process and scientific discourses, and it requires a more in-depth study of knowledge interaction and knowledge management."

The above review of the importance for linking scientific and local knowledge informed our design for town-hall meetings held in the summer of 2009 in which we offered our scientific findings about the causes of poverty in the Mississippi Delta and the Texas Borderland to communities in those two regions in order to engage in a discussion with local actors and stakeholders who brought the knowledge of locals to the table. The next section of our chapter summarizes our comparative regional poverty project and discusses the approach we took to introduce our tailored findings to each of the six town-hall communities.

The Poverty Project and Town-Hall Meetings

Poverty in the Delta and the Borderland

The scientific data and inputs we presented at our scheduled town-hall meetings were generated in a 3-year USDA-funded study of poverty in the Mississippi Delta and the Texas Borderland. The Delta and the Borderland are two of the three poorest regions in the United States (Central Appalachia is the third region). Almost all of the Delta and Borderland counties have poverty rates above the U.S. average. Moreover, almost one third of the Delta counties and over one half of all Borderland counties have poverty rates that are more than twice the national average. Poverty in these regions has a long history; the majority of counties in the two regions have been persistently poor, i.e., since 1970 their poverty rates have consistently exceeded 20% (see Fig. 21.1). Table 21.1 presents the county-level poverty rates for the Delta and the Borderland by race and ethnicity. These data clearly show the race/ethnic differentials of poverty in the United States, with the poverty rates of blacks and Latinos being more than twice that of whites. Moreover, blacks in the Delta and Latinos in the Borderland fare even worse vis-à-vis their white counterparts than they do nationally.

The purpose of this chapter is not to analyze the correlates of poverty, but rather to discuss how we used the project results for the town-hall meetings.[1] In brief, we

[1] We have already reported the results of several of our analyses in studies of family poverty (Slack et al. 2009), changes in poverty (Fontenot et al. 2010), contextual effects on individual poverty (Poston et al. 2010), and poverty and race (Singelmann et al. 2010).

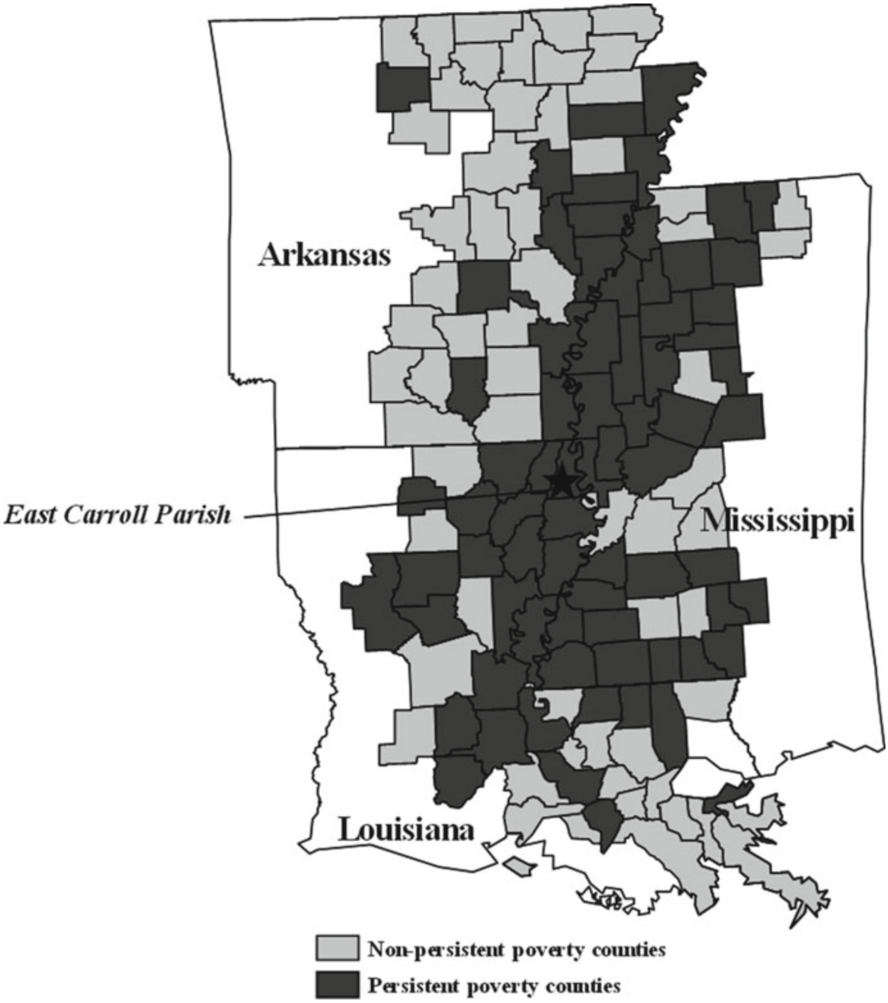

Fig. 21.1 Persistent poverty counties in the Lower Mississippi Delta

Table 21.1 Percent poor for the United States, the Delta, and the Borderland

	Total population	White	Black	Hispanic
United States	12.4	9.1	24.9	22.6
Delta	22.6	12.9	37.8	–
Borderland	29.5	10.0	17.2	34.0

Source: 2000 census summary files

Table 21.2 OLS regression models of Delta total, White, and Black family poverty, 2000

Variables	Total	White	Black
Percent FIRE	–0.081*	–0.201***	–0.124**
Percent manufacturing	–0.117***	–0.301****	–0.150**
Percent agriculture	0.044	–0.079	0.035
Net migration	–0.075**	–0.046	–0.077
Percent less than HS diploma	0.206****	0.579****	0.159**
Nonmetro	0.143****	0.227****	0.115**
Percent under age 15	0.143***	0.080	0.389****
Percent employed	–0.184***	–0.098	–0.519****
Percent female-headed	0.471****	0.194***	0.187***
Intercept	5.783	5.376*	18.721****
Adjusted R-square	0.902	0.737	0.757

*p<.1; **p<.05; ***p<.01; ****p<.001

Source: Singelmann et al. 2010

Note: Cell entries are standardized OLS coefficients. Race-specific variables are used for the race-specific models with the exception of net migration and nonmetro (N = 119)

used regression models to estimate the effects of factors that have been found to be associated with poverty in previous research. Those factors tapped the economic structure, human capital, demographic structure, and the metro-nonmetro divide. We show in Table 21.2 the regression analysis for the Lower Mississippi Delta as an example of our approach.

While not all expected correlates of poverty were shown to be statistically significant, those that were significant had the effects as anticipated. The significant factors also covered the four broad categories listed above. Table 21.2 also shows that while the determinants of black and white poverty are similar, some key differences exist between the two race groups. Most surprising is the lack of an effect of percent employed on white poverty; usually, employment is a key factor depressing poverty. However, it appears that in the Delta, there is little variation in the percent employment for whites.

We used these findings as a basis for tailoring the modeling of poverty to each of the three town-hall meetings held in the Delta: Lake Providence, LA; Greenville, MS; and Pine Bluff, AR For each statistically significant factor, we computed its magnitude for the United States, the Delta, the state, and the specific county in which the town-hall meeting was held; in addition, we showed the county-Delta gap and the county-state gap. A similar approach was taken in the three Borderland town-hall meetings in El Paso, TX; Laredo, TX; and McAllen, TX. We present the data for East Carroll Parish—the location of Lake Providence, LA—in Tables 21.3 and 21.4 as an illustration for our approach.

Table 21.3 shows the extremely high poverty in East Carroll Parish (32.6%), a rate that is double that of the Louisiana (15.8%) and the Delta (16.1%) average. In that parish, everything points in undesirable directions: those factors that tend to lower poverty (percent employed and net migration) are below the Delta and Louisiana average, whereas the parish is above average on those factors that

Table 21.3 Total family poverty, 2000

Variables	United States	Delta	Louisiana	E. Carroll Parish	Parish-Delta	Parish-State
Percent poor	9.2	16.1	15.8	32.6	16.5	16.8
Percent employed (−)	71.2	64.7	64.4	47.4	−17.3	−17.0
Percent manufacturing (−)	14.1	13.4	10.1	7.6	−5.8	−2.5
Net migration (−)	4.6	−0.2	−1.6	−15.7	−15.5	−14.1
Percent under age 15 (+)	22.8	22.2	24.0	27.1	4.9	3.1
Percent female-headed (+)	11.9	17.2	16.7	30.3	13.1	13.6
Percent < HS diploma (+)	19.6	26.3	25.2	42.1	15.8	16.9
Nonmetro (+)	66.0	71.0	55.0	Yes	–	–

Source: U.S. Census Bureau. Variables shown to be associated with family poverty derived from multivariate regression analysis of county/parish-level data in the Delta. The cell entries represent the distribution of each variable at the respective geographic level. The (+) sign indicates a local factor that is associated with higher family poverty, while a (−) sign indicates a local factor that is associated with lower family poverty in the region (From Singelmann et al. 2009)

Table 21.4 Black family poverty, 2000

Variables	United States	Delta	Louisiana	E. Carroll Parish	Parish-Delta	Parish-State
Percent poor	21.9	32.4	33.2	48.7	16.3	15.5
Percent employed (−)	59.1	53.2	53.0	40.0	−13.2	−13.0
Percent FIRE (−)	6.5	3.6	3.8	1.8	−1.8	−2.0
Percent manufacturing (−)	13.0	15.2	10.1	8.2	−7.0	−1.9
Percent under age 15 (+)	28.0	29.7	29.6	30.9	1.2	1.3
Percent female-headed (+)	34.2	37.0	36.5	47.7	10.7	11.2
Percent less than h.s. (+)	27.9	37.6	36.9	47.5	9.9	10.6
Nonmetro (+)	66.0	71.0	55.0	Yes	–	–

Source: U.S. Census Bureau. Variables shown to be associated with black family poverty derived from multivariate regression analysis of county/parish-level data in the Delta. The cell entries represent the distribution of each variable at the respective geographic level for blacks specifically. The (+) sign indicates a local factor that is associated with higher black family poverty in the region, while a (−) sign indicates a local factor that is associated with lower black family poverty in the region. FIRE stands for finance, insurance, and real estate (From Singelmann et al. 2009)

contribute to the existence of poverty (percent under age 15; percent single female-headed families; and percent of persons 25 and older with less than high school degree). In addition, the parish is not part of a metropolitan area; our research shows that nonmetro counties tend to have higher poverty rates than metro counties.

The nation's historical legacy of racial oppression and inequality is clearly reflected in differences in family poverty rates by race. As shown in Fig. 21.2, racial inequality in family poverty is especially pronounced in East Carroll Parish. The poverty rate of black families (48.7%) in East Carroll Parish is more than five times higher than the poverty rate of white families (8.2%). White families in this parish are hardly at a greater risk of poverty than they are in Louisiana or in the Delta as a whole.

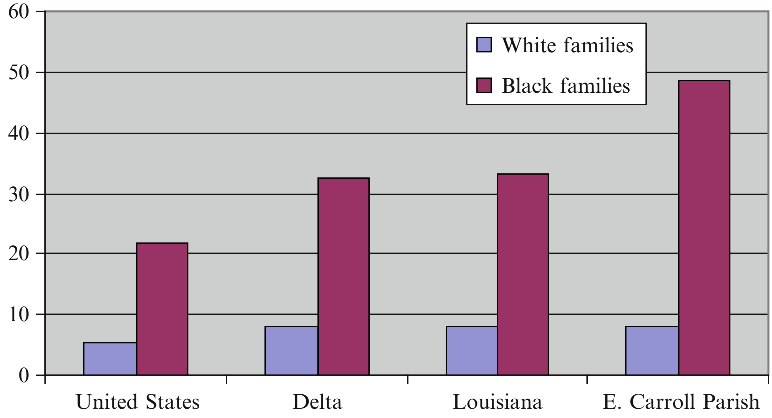

Fig. 21.2 Family poverty by race, 2000

Table 21.4 shows that among the factors that tend to reduce poverty for black families, the East Carroll Parish is worse than the Delta or Louisiana in terms of the percent employed, and it compares unfavorably to the Delta regarding the manufacturing employment percentage. Among the factors that tend to increase the poverty of black families, this parish has a substantially higher percentage of female-headed households and population with less than a high school education, compared to the Delta and to the state of Louisiana as a whole.

Organization of the Town-Hall Meetings

We began our 3-year research project with the organization and conduct of the town-hall meetings as a key feature of the project. While only one of us (Singelmann) had extensive experience in conducting such meetings, all three of us knew at the outset that a key component for a successful town-hall meeting is the identification of local actors and stakeholders.[2] For that reason, we brought on six consultants to our project, one from each of the three Delta states of Arkansas, Louisiana, and Mississippi, and three from Texas. The task of the consultants was to jointly determine with the principal project investigators which communities should be chosen as sites for the town-hall meetings, and to provide us with specific information about the designated communities so that, together, we could identify the key local actors and stakeholders. The consultant regularly attended the three-times-a-year meetings of the project team to be fully informed about the research and to discuss various organizational issues that came up regarding the town-hall meetings.

[2] Tim Slack from LSU also participated in all six town-hall meetings and Kayla Fontenot took notes at the meetings in the Delta.

About 6 months prior to the town-hall meetings, the consultants began sending invitations to a list of potential stakeholders. They had access to our publications that would be distributed at the town meetings and could make reference to the project results.

Town-Hall Meeting Proceedings

At the start of every one of the six town meetings, we made it very clear that we did not come with a blueprint for economic development to reduce poverty, but that our purpose was to share with the residents our scientific findings that had been tailored to the locality. We made it equally clear that we had relatively little knowledge about locality-specific issues, both contemporary and historical, that would shed light on the poverty conditions prevailing in the community. While we can claim to be experts on modeling and statistical analysis, we told the local actors and stakeholders that they are the experts on their community. We expressed hope that through this dialogue between us —we as the scientists who brought expert knowledge to the table, and they as the local actors who contributed the knowledge of locals—, all would gain a more comprehensive understanding of what has produced poverty in the locality and what it might take to reduce it. The meetings typically lasted about 2 h. We will summarize the proceedings at two town-hall meetings to illustrate the range of dynamics that took place.

The town-hall meeting in *Lake Providence* in East Carroll Parish, LA was announced by an article appearing on the front page of the local newspaper, the *Banner-Democrat*, that extended an invitation to everyone in the Lake Providence community to attend. In addition, as for all the other town-hall meetings, the consultant had sent special invitations to designated stakeholders in the area. While only a small number of people (10) attended, they represented the private, governmental, and not-for-profit sectors; participants included both blacks and whites. The major issues regarding development in the parish included its geographical isolation from major population centers (which helps to explain the small number of meeting attendees). The town of Lake Providence is not on the way to someplace else; in order to get to Lake Providence, one must purposely go there. The town also lacks easy access and proximity to major highways and railroads. One participant noted that this geographic isolation makes it undesirable for businesses to relocate to the area. Another participant agreed that this isolation is a factor in attracting businesses and said that a program called "bricks to clicks" is currently being promoted to stimulate economic activity in the area by facilitating "home-grown" businesses. This is a local program that assists entrepreneurs and existing businesses in using the internet to market their goods and services to areas outside the immediate locale. It is hoped that the "bricks to clicks" program will allow local businesses to compete in the global economy without being limited by geographic location. Also recognizing the geographical isolation, the East Carroll Cultural Tourism Initiative was launched to promote tourism in communities in Louisiana such as Lake Providence that are situated along Highway 65 (the state highway that intersects the county) by increasing awareness of the unique culture and history of the areas. One outcome of this program is the Soul Food and Heritage Festival which, according to one participant, brings in approximately 4,000 visitors to Lake Providence yearly.

Several participants noted that Lake Providence suffers from limited job opportunities. Structural changes in planting and harvesting mean that agriculture, once the main economic engine for the area, now requires fewer and fewer workers. One participant noted that the only jobs available to residents are in education, health care, and the prison system. There are now three detention centers and one prison farm on the immediate periphery of Lake Providence. These prisons are sources of employment for many people. Residents who wish to remain in the community and have the means to do so often commute 2–3 h a day to better paying jobs in nearby cities such as Vicksburg, Mississippi, Monroe, Louisiana, and various cities in Arkansas.

Other challenges to economic development in Lake Providence and East Carroll Parish include out-migration owing to the previously mentioned geographical isolation and insufficient employment opportunities; inferior infrastructure such as problems receiving cell-phone signals and the unavailability of broadband internet access; race relations that still reflect the legacy of the plantation system and that may be viewed to this day in two completely separate communities in the same town; and absentee ownership of land. While the town-hall meeting did not yield a collaborative project by the scientists and local actors, it established a network for information sharing that can be activated for development efforts as they are planned and designed.

The town-hall meeting in *Pine Bluff* (Jefferson County, AR) followed the same format as that just discussed for Lake Providence, and the arrangements followed in the other four communities. Pine Bluff is close to the state capital of Little Rock, less than a 1-h drive away. In contrast to the other two town-hall meeting sites in the Delta that were situated in nonmetropolitan counties (Lake Providence LA and Greenville MS), Jefferson County, AR is part of the Pine Bluff metropolitan area. While Jefferson Parish has a higher poverty rate than the state of Arkansas as a whole, its poverty rate is not higher than the average for the Delta. The factors correlated with poverty in the Delta are not as unfavorable in Jefferson County as they are in East Carroll Parish, LA and in Washington County, MS (the location of our third town-hall meeting in the Delta). Although it has a lower employment rate than the state average in Arkansas and in the Delta, it boasts a larger manufacturing sector, a structural characteristic which has been shown to typically lower poverty because of its better wages. But the county suffers from a high rate of net outmigration, and a larger proportion of families are headed by a single female than is the case in the state of Arkansas and even in the Delta.

As in Lake Providence, the participants in the Pine Bluff meeting represented the private, governmental, and not-for-profit sectors; they included the city's mayor along with representatives of the city's manufacturing industries. Perhaps because Pine Bluff is a metropolitan area, we had more than 35 participants, the largest number of participants in the three Delta meetings (attendance at the meetings in Laredo, TX and McAllen, TX (in the Borderland) exceeded that number).

Perhaps chief among the concerns expressed by the Pine Bluff stakeholders is the steady population loss of Jefferson County, which is largely due to net outmigration. As a result of the steady population loss, Pine Bluff's metropolitan status is threatened. If the 2010 census shows a population of below 50,000 residents, Pine Bluff would lose substantial federal funding tied to metropolitan-area status. One participant noted that the national tendency of the census to undercount black males is particularly problematic in this area, for blacks make up a large proportion of Pine Bluff's population. Another participant agreed and stated that a Census office will be headquartered in Pine Bluff and that enumerators would be sent out to remote areas of the county to locate and enumerate many of those who would not typically respond to the census. It was also noted that because trust is important, local residents would be needed to make everyone aware of the importance of counting each person who resides in the area. The proximity of Pine Bluff to Little Rock, while advantageous in a number of ways, presents a challenge to its population growth because a large number of persons employed in the Pine Bluff metropolitan area decide to live in Little Rock and commute from there to work.

Another issue raised during the town meeting dealt with the loss of jobs. In addition to the county's large agriculture sector, industries in the area consist of automotive, paper, and housing—all of which are suffering as a result of the economic downturn. One participant noted that many companies in the area are doing their best to try to keep from terminating employees. However, another participant noted that one of the area's major employers, the Pine Bluff Arsenal, will soon complete its mission and close, which will result in a loss of over 1,100 jobs. The Office of Economic Adjustment will be tasked with trying to find replacements for those jobs, another participant stated.

Several participants agreed that it was important to provide technology training to encourage the development of growth industries in the area. For example, one participant noted that the Jefferson Regional Medical Center could be used to train and hire residents in the field of health care technology—a major growth industry. The importance of educating people about the different kinds of work available in health care was also raised. One participant noted that it was important to have collaboration between businesses and training programs so that jobs could be identified and residents trained to fill those positions. Another participant noted that such a partnership already existed. For example, the University of Arkansas at Pine Bluff (UAPB) is partnering with the National Center for Toxicological Research (NCTR) to allow research students to participate in off-campus training at their institution. It was noted that the UAPB-NCTR partnership could be used to attract biotechnology companies while training individuals specifically for the needs of the companies.

Perhaps the most volatile issue voiced during the Pine Bluff meeting concerned race. Well into the second hour of the discussion, the mayor (who is black) made reference to the "800-pound gorilla" that is underlying almost all issues of poverty and economic development in the Delta, namely race. That comment started a lively discussion about race relations. One participant stated that the community was a majority-minority community and that race was a problem that needed to be addressed. Another participant agreed that it was a problem and that communication between blacks and whites was severely limited, resulting in a lack of access to information for poor people. An effort had been made in Pine Bluff to increase communication between the races by engaging in discussions about how to bring whites and blacks together to work in concert for improving the community, but according to one participant, the committee that was formed for this task was unable to get residents outside the committee to participate because the issue of race is so difficult to discuss. The mayor clearly saw the town-hall meeting as an opportunity to have us—the scientists, two of whom are white and one Latino—facilitate communication between the largely black political power structure and the largely white industry community. The extent of the disconnect between the two groups came out clearly after the meeting when both groups, in referring to the other group, talked about "them" being one of the obstacles to development.

The Pine Bluff town-hall meeting has come the closest of the six meetings to result in a joint project between research and local actors. As the mayor put it: "You [the scientists] cannot just come here and stir up a hornets' nest; you must come back and fix it." We received a similar request from the industry representative during the after-meeting conversations. At present, we are in discussion with the local actors in Pine Bluff to define the parameters of our collaboration.

Conclusion and Discussion

This chapter shows how scientific knowledge and local knowledge complement each other to yield a more comprehensive understanding of issues of development. We first summarized the distinction between scientific knowledge, and local knowledge. We then showed how we used such a framework and distinction in the organization of a series of six town-hall meetings in the Lower Mississippi Delta and the Texas Borderland to discuss poverty and development strategies to reduce poverty. While our research project was not designed to actually develop and test a specific poverty-alleviating strategy, we used the town-hall meetings to demonstrate how a better understanding of the conditions of poverty might be gained if scientists and local actors were able to recognize the validity of each form of knowledge that they bring to the table. A key aspect here is the difficulty that lay persons often have in being included in programmatic discussions (cf. Siebert et al. 2008; Pellizzoni 2003). Thus, we strongly believe that it is the scientists who should make an extra effort to bring about the incorporation of local actors into the planning process. Our town-hall meetings showed that when scientists come to communities not as experts about local conditions, and without a blueprint for local development, stakeholders and local actors tend to be much more receptive to provide local knowledge to address results based on scientific modeling. At all six of our town-hall meetings, we could not leave enough copies of our research results. As the case of Pine Bluff showed, once trust was established between experts and local actors, the likelihood would increase that there would be a successful outcome of a chosen effort (which in that case would be an improvement in race relations).

Our recommendations for applied research projects aimed at various aspects of development thus are as follows:

1. Given the difficulty that lay persons often have to be included in program designs, efforts should be made to apply managerial knowledge (on the part of the funding agency) to assure that research projects on development include local actors.
2. Local actors should be included in the early phases of anticipated program planning.
3. Scientists should tailor programs to specific communities, where appropriate, and to specific demographic target groups. Our comparative research on poverty has shown that the mechanisms of poverty differ by region (Delta-Borderland), race/ethnicity (non-Hispanic whites-blacks-Latinos), and family type (dual parent-single parent families). Without such tailor-made design, programs run the risk of by-passing specific demographic target groups.

Acknowledgements We gratefully acknowledge the financial support by the U.S. Department of Agriculture which, through its National Research Initiative, funded our 3-year research project entitled "Race and Place: Patterns and Dynamics of Poverty in the Texas Borderland and the Lower Mississippi Delta" (Rural Development Program Grant #2006-35401-17432). We also thank the LSU Agricultural Center for its support for graphic design and travel to the Delta town-hall meetings. The project is a collaboration of Louisiana State University and Texas A&M University.

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N. Hoque and D.A. Swanson (eds.), *Opportunities and Challenges for Applied Demography in the 21st Century*, Applied Demography Series 2,
DOI 10.1007/978-94-007-2297-2, © Springer Science+Business Media B.V. 2012