Social Security, Household, and Family Dynamics in Ageing Societies

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Social Security, Household, and Family Dynamics in Ageing Societies

by

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with contributions by

Tommy Bengtsson, Agneta Kruse and Evert van Imhoff

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PREFACE

The consequences for the social security system of the process of the ageing population have been studied extensively in many industrialized countries in recent years. However, these studies have concentrated mostly on the changing age structure of these societies, but have given almost no attention to changes in living arrangements of the elderly, although they form an important aspect of the ageing process. This volume reports the findings of an international comparative study on ageing and changes in living arrangements in twelve industrialized countries, and their possible impact on future social security spending. Regarding living arrangements, the focus has been on marital status, but we have also given some attention to family dynamics and developments in household structures.

The first plans for this study were developed in 1987 by Nico Keilman of the Netherlands Interdisciplinary Demographic Institute (NIDI) and Henk Heeren in the Netherlands, and Douglas Wolf of the International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Austria. In subsequent years, Jean-Pierre Gonnot and Christopher Prinz were able to work on the project at IIASA, with partial support from the Sloan Foundation and the Netherlands Ministry of Social Affairs and Employment. The last calculations were done in 1992, and many results have been reported in a series of working papers distributed by IIASA. A complete list is contained in the appendix to this volume. This book constitutes the completion of the project.

We have witnessed dramatic political, social, and economic developments in Central and Eastern Europe during the years over which the project stretched. In case a project like this would have to be planned today, a number of pension parameters that we used would have to be updated. But it is our feeling that the scenario approach which we followed, and which is explained and discussed in more detail in chapters 1, 3, and 7, is less vulnerable to unexpected events than one might think at first sight. The demographic, labour market, and pension scenarios which have been formulated define a rather broad range of 'possible futures' for the period 1985-2050, and it is not unreasonable to expect that the majority of recent developments falls within this range, or is close to its extremes.

In various stages of the project, the research team was supported by national researchers in the twelve participating countries: Tommy Bengtsson, Helge Brunborg, Thomas Büttner, Tomas Fiala, Peter Findl, Ewa Fratczak, Heinz Galler, Richard Gisser, Jerzy Holzer, Evert van Imhoff, Janina Jozwiak, Irena Kotowska, Agneta Kruse, Jacques Ledent, Jarl Lindgren, Notburga Ott, Petr Pavlik, Antonella Pinelli, Jean-Louis Rallu, Alessandra de Rose, Vladimir Roubicek, Kalman Szabo, and Gabriella Vukovich. Three Task Force Meetings have been organized: one at IIASA in March 1989, the second one at the NIDI in October 1989, whereas the final meeting was hosted by Antonella Pinelli of the Department of Demography, University of Rome "La Sapienza", in May 1990. Tonny Nieuwstraten and Joan Vrind of the NIDI did a wonderful job in the final stage of the production of a camera-ready text. We also benefitted from numerous helpful comments made by Gijs Beets, the Editorial Secretary of the NIDI CBGS Publications series, and by two anonymous referees. We gratefully acknowledge the personal and financial assistance that we received from the persons and institutions mentioned above.

New York	Jean-Pierre Gonnot
Oslo	Nico Keilman
Laxenburg	Christopher Prinz

1994

TABLE OF CONTENTS

1. INTRODUCTION

Nico KEILMAN and Christopher PRINZ

1.1 | Background

The consequences for social security expenditures of the process of population ageing have been studied extensively in many societies. However, these studies have concentrated mostly on the changing age structure of these societies, but have given almost no attention to changes in living arrangements of the elderly, although they form an important aspect of the ageing process. As an example, consider the international comparative studies carried out in the 1980s in which the demographic impact on future public expenditures was investigated, for instance those of the IMF (Heller *et al.*, 1986) and the OECD (e.g. Holzmann, 1987). On the basis of an assumed increase of two years in average life expectancies at birth until 2050, Holzmann concluded that (real) public expenditures to old age pensions in the OECD would rise by 35 per cent in the period 1985-2010, and by 87 per cent during the years 1985-2030. The results of the IMF-study point out even stronger growth rates for public expenditures for old age pensions, for instance 89 per cent for Canada for the period 1980-2010, and no less than 185 per cent for Italy during that period.

The methodology chosen for these comparative studies was rather straightforward. Projections for the population broken down by age and sex were combined with age profiles concerning public expenditures. Hence the demographic impact was limited to effects of mortality and fertility, and links between expenditures on the one hand, and contributions from the working population on the other, were not explicitly made. The implication was that the answers which were found to the original problem formulations were necessarily crude.

J.-P. Gonnot et al. (eds.), Social Security, Household, and Family Dynamics in Ageing Societies, 1-20.

However, during the 1980s, several developments took place in the modelling and projection of demographic and public expenditure developments. More realistic pension models than the simple age profile approach were developed. Existing models for the projection of fertility and mortality were supplemented with algorithms which describe married couples, families, and households. These new methods facilitated, by the end of the 1980s, an update and extension of the pioneering studies carried out by the OECD and the IMF.

This book reports the results of an international comparative study into the impact of dynamics in living arrangements on future public pension expenditures in industrialized countries. It presents various demographic and pension scenarios for pension costs until the year 2050 for 12 countries: Austria, Canada, Czechoslovakia[1], Finland, France, Germany[1], Hungary, Italy, the Netherlands, Norway, Poland, and Sweden. It extends earlier comparative studies into future costs associated with public pensions into several directions.

1. In contrast with the studies carried out by the OECD and the IMF, the current project also includes countries from *Central and Eastern Europe*. Demographic developments in these countries in the past have been different from those in western countries, with higher fertility and mortality levels. But above all, recent changes in their socioeconomic structure, imply that the policy relevance of our results should be beyond any doubt.

2. A pension cost model is used in which *individual pension benefits are endogenized*. These depend explicitly on the number of years worked. This provides a direct link between labour market variables and pension costs.

3. The demographic aspects of fertility and mortality are supplemented with *living arrangement*, a general notion which covers the demographic elements of marital status, family type, and household situation. In many

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[1] The project was planned in 1988, and the majority of the analyses were carried out before the two Germanies were unified (1990) and hence also before the Czech Republic and Slovakia came into existence (1993). Thus, we have only results for Czechoslovakia as a whole. Furthermore, the calculations were carried out for the former FRG and GDR separately, and the results were combined.

countries there are large discrepancies in female labour force participation with respect to marital status. For some countries, this extends to family type and household situation. Moreover, the determination of future survivor pensions is clearly served by including marital status aspects in the demographic model.

4. *Demographic as well as labour market scenarios* are formulated, in order to trace the range of possible future developments. We included not only variations in fertility, mortality, marriage, divorce, and (for some countries) international migration, but we also investigated the consequences of changes in female labour force participation, and of a rise in retirement ages.

1.2 | Problem formulation and scope

The research project which this book reports on was called 'Social security, household, and family dynamics in ageing societies'. It was carried out at the International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Austria. Jean-Pierre Gonnot and Christopher Prinz of IIASA's Population Program were responsible for the project in which there was close collaboration with Nico Keilman at the Netherlands Interdisciplinary Demographic Institute.
The problems taken up in the project can be formulated as follows:

what is the impact of dynamics in living arrangements and age structures on future public pensions expenditures in industrialized countries?

Two sub-models were used to investigate the problem. A demographic model projects the population broken down by age, sex, marital status, and work status (whether or not in the labour force). Next, a pension model determines the benefits from and the contributions to state pensions. Contributions are related to wages and work status, and benefits are determined by the work history and demographic parameters of the individual. Three arrangements were selected: old age pensions, survivor pensions for widows over 55, and disability pensions.

Marital status was chosen as the key variable to operationalize the concept of living arrangement. Although more complex forms of living arrangements would certainly facilitate deeper analyses, data on for instance families or households were not sufficiently available in the countries participating in the project to make an international comparison possible starting from a common data base. Nevertheless, for Austria and for the Netherlands, we were able to go one step further. For each of these two countries the book includes a case study, in which aspects of family formation (Austria) and household dynamics (the Netherlands), and the impact on future pension expenditures, are taken up. However, taking marital status as a common denominator for the concept of living arrangement is somewhat unsatisfactory and, therefore, the book also includes a review of family and household models, as well as some suggestions as to how to cope with situations in which the data relative to the model are scarce.

Old age pensions, survivor pensions, and disability pensions were selected from a wide range of social security schemes because these three are extremely sensitive to demographic changes, much more so than, for example, expenditures to unemployment benefits, in which short term economic influences play an important part. Children's allowances are clearly linked to demographic developments, too, but new marital status projection models provide little insight beyond that already gained from traditional cohort component models. Moreover, the focus of the project is on aspects of ageing. Therefore, social welfare benefits payed to lone parents are not included either, although these are clearly linked to marital status and family developments.

The scenarios which were formulated sketch a *possible* future for each of the countries concerned, not necessarily the most *probable* one. It is next to impossible to draw up a plausible demographic trajectory for any industrialized country for a period which extends the first 10-20 years. (For labour market developments the uncertainties involved are even larger.) The scenarios we chose are *not impossible*, because they reflect (sometimes rather extreme) observed levels for fertility, mortality, nuptiality, or labour force participation in a particular country. When considering the range of possible future developments as a result of various scenarios, some trends are rather insensitive for a particular scenario specification. For instance, as will be argued in Chapter 3, ageing is certain in the 12 countries, and variations in fertility levels (within reasonable bounds) have very little impact here.

1.3 | Outline of this book

The broader demographic context of the project is sketched in the final section of this introductory chapter, which contains a summary view of recent developments in living arrangements in industrialized countries. Next, Nico Keilman and Christopher Prinz formulate in Chapter 2 the methodological considerations which were relevant at the start of the project. How do we operationalize the concept of living arrangement? How can it be included in a projection model? We argue that three types of models are appropriate: marital status models, family models, and household models. Arguments are given why the models should focus on individuals, and why these should be dynamic. With this we mean that the models simulate the events that individuals experience as they move from one type of living arrangement (for instance, living with parents, or married, or being a lone parent, or living with a partner in consensual union) to another. The marital status was chosen as the key aspect of the common demographic sub-model for all 12 countries. For some countries, marriage, divorce, and widowhood cover most probably the key aspects of changes in living arrangements rather well — for other countries more complex notions such as family type and household structure would serve the purposes of the current project better. However, as was argued before, because we wanted to start from a common base regarding methodology and data, we decided to restrict demographic aspects to marital status dynamics (in addition to fertility, mortality, and migration). Chapter 2 concludes with a review of the type of data which are most often used for fitting models for the projection of living arrangements, and the characteristics of the marital status data and other demographic data from the 12 countries.

Chapter 3 reports the main findings of the project. Jean-Pierre Gonnot discusses the four scenarios which are common for all participating countries, as well as an additional number of country-specific scenarios. Projections of the age structure, the marital composition, and the size of the labour force are presented for the period 1985-2050. An important conclusion is that ageing is certain, to the extent that scenarios representing unreasonably high levels for fertility, mortality (i.e. low life expectancies), and immigration are excluded. The tremendous rises in public pension expenditures, given current country-specific schemes, are documented and the negative impact of an assumed constant contribution rate per head in the labour force is analysed. Finally, Gonnot investigates the consequences of possible policy reactions and social developments regarding the pension system and the structure of the labour force: increased female labour force participation, raising retirement age, increasing contribution rates, and complementary capital-funded pensions. These changes in the labour force and in the pension system all help to alleviate the burden for the contribution side to a certain extent. Thus, the most important conclusion from this project is substantiated using various perspectives: although the countries show some diversity regarding future developments, modifying demographic trends generally has little impact on future state pension expenditures. Possible solutions should be sought in the pension systems themselves, and in the size and structure of the labour force.

The emphasis in this book is on how demographic factors affect public pension expenditures. This implies that, unless stated otherwise, economic factors are kept constant. Although Gonnot in Chapter 3 briefly discusses the impacts of labour force variables (participation, productivity, retirement age), one important economic factor has not been discussed explicitly, i.e economic growth. In Chapter 4, Tommy Bengtsson and Agneta Kruse explore the consequences of demographic change on a pension system which is sensitive to economic growth. In a theoretical discussion they first show that pay-as-you-go systems are in general more sensitive to changes in population growth and age structure than are funded systems. Next, Bengtsson and Kruse investigate in an empirical application related to the pension system in Sweden what one will lose by disregarding economic growth in analysing demographic effects on a pay-as-you-go system which is dependent on economic growth. Because of differences in indexation between contributions (which depend on wages that follow real economic growth) and benefits (indexed for inflation only), positive real growth is beneficial for the performance of the Swedish pension system, although it increases the gap between wage earners and pensioners.

A second case study is that of Christopher Prinz for Austria (Chapter 5). He investigates the consequences of a pension scheme in which entitlements for an individual woman also depend on the number of children she gave birth to, and not only on her labour market history. Although Paul Demeny took a pronatalist view when he originally proposed such a pension policy, Prinz argues that it serves an emancipatory purpose as well: with respect to pension entitlements, mothers with a short working history are no longer discriminated against childless women with a long career. Assuming five years of insurance for each additional child, Prinz concludes on the basis of his simulations that there is a strong incentive for a mother to have one or more additional children, but a much more modest one for a nulliparous woman to have a first child. A further conclusion is that the performance of this pronatalist/emancipatory pension scheme improves (compared with the current Austrian scheme), provided that fertility increases.

Evert van Imhoff presents in Chapter 6 a case study for the Netherlands in which the notion of living arrangement is extended to the actual household situation of the individual, rather than his or her marital status. A household classification with 11 distinct positions that an individual person may occupy at a certain point in time is used, and projections are carried out with the LIPRO model. Six different demographic scenarios and three social security arrangements are investigated. Van Imhoff uses age profiles to extrapolate social security expenditures. The rise of the number of persons living alone is the most important result of the study. Such a trend cannot be made visible unless one explicitly includes the actual household situation of the population. Van Imhoff also demonstrates how the growth in social security expenditures decomposes into effects caused by the size of the population, its age structure, and its household composition. Compared with the simple age profile approach used in earlier studies, the addition of household situation leads to much more accurate projections for survivor pensions and social welfare. Developments in old age state pensions are dominated by age effects.

The main conclusions of the book are summarized in Chapter 7 by Keilman, Gonnot, and Prinz. They discuss substantive as well as methodological findings regarding the impact of changes in living arrangements and age structures on public pension expenditures. Strategies for dealing with issues unresolved so far are also addressed briefly.

Finally, the appendix contains a list of the papers that have been written to report separate country case studies.

1.4 | A synopsis of recent trends in living arrangements in industrialized countries

This section presents a descriptive overview of trends in living arrangements in countries participating in this project since 1960. Summarizing an earlier paper written within the framework of the project (Gonnot and Vukovich, 1989), it depicts demographic patterns without inferring any sociological or economic explanation. It is only aimed at documenting general trends and regional contrasts in order to situate every country in the overall picture.

The synopsis successively addresses the marital composition of the population, the family structure, and the household structure as they correspond to the three levels of modelling proposed under this project. A larger part of this section is, however, devoted to the changes in the marital status composition and in the underlying demographic processes. The first reason for this bias is, besides the de facto predominance of traditional living arrangements, that only in the case of marital status the parallel analysis of stock and flow data is possible. The second reason is that because of the frequent lack of using standard definitions in collecting and/or tabulating family and household statistics, international comparisons covering at least a large part of the countries participating in this project are extremely difficult. Finally, trends in family and household structures in a number of countries have recently been reviewed by several authors, for example by Höpflinger (1990), Schwarz (1988), Hoffmann-Nowotny (1987) and Keilman (1987).

The major part of the data used in this section stem from the computerized data bank of the Population Activities Unit of the UN Economic Commission for Europe. Further details about the data are provided by Gonnot and Vukovich (1989, p. 35).

1.4.1. Marital status

The first part of this sub-section describes the major changes in the stock of the population of various marital statuses. In the second part, these findings are confronted with the analysis of marriage and divorce flows.

Marital status distribution

Broadly speaking, the main changes in the marital composition of the total population over the whole period 1960-85 were the following:

- There was a decrease in the proportion married and an increase in the proportion divorced for both sexes;
- Opposite trends in the proportion widowed among the male and female populations were observed: a decrease for males and an increase for females;
- The proportion single among males rose, while a marked regional contrast between Central Eastern and non-Eastern European countries exists with respect to both the level and the trend in the proportion single among women. In Central Eastern European countries it is low and it generally decreased, while it increased in other countries.

However, these changes have not been regular during the period considered and conceal many different national patterns. Moreover, both changes over time and national discrepancies can be behavioural and/or compositional. In the case of European countries, a main source for compositional differences is to be found in the differential impact of the two World Wars on national populations. Changes can result from differences in intensities of marriage, divorce, and to a certain extent, death, or they can be due to changes in sex and age structure of the population. Consequently, a conclusion drawn from aggregate measures can only be temptable.

Table 1.1 gives the marital composition of the population aged 15 and over for each sex around 1960, 1970, 1980, and 1985. Over the whole period, Central Eastern European countries showed the lowest percentage of males and females who are single: between 15 and 20 per cent among females and between 19 and 28 per cent among males. At the other end of the scale, the highest proportion single around 1960 is observed in Italy (34.4 per cent among males and 29.1 per cent among females), in Scandinavian countries, and in the Netherlands. Italy's position in this comparison is accounted for by the traditional nuptiality patterns which, in the 1960s, still prevailed in most Southern European countries. After the 1960s, the proportions single clearly decreased in Italy, while in other countries with high initial proportions, these have increased among men, whereas there was no uniformity in the direction of changes among women. The highest proportions single ever observed in Europe are in Sweden: 38.7 per cent of men and 30.0 per cent of women in 1985. More generally, the increase in the proportion single among males and the absence of a clear pattern of evolution for females during the period 1960-85 in non-Central Eastern European countries has led to a widening gap between sexes.

The proportion of married men decreased from between about two-thirds and three-fourths around 1960 to between one-half and two-thirds around 1985. Changes in both level and range have been more limited for females and the proportion married has remained between about one-half and two-thirds. The only exceptions to this general trend are Italy, which experienced an increase in the proportion married among both sexes, and Poland, with an increase among females since 1970.

In most of the countries considered, the proportion divorced among both sexes has grown substantially over the period 1960-85 with generally an acceleration after 1980. Around 1960, it ranged from about 0 per cent in countries where divorce was illegal or extremely difficult to obtain (Italy and

Table 1.1. Marital composition of the population aged 15 and over for each sex around 1960, 1970, 1980, and 1985 (percentages, 100 per cent for each sex)

		Males				Females			
		S[1]	M[1]	W[1]	D[1]	S[1]	M[1]	W[1]	D[1]
Austria	1961	29.1	64.4	4.0	2.4	24.9	53.5	18.1	3.5
	1971	27.4	66.1	3.8	2.7	21.9	55.4	18.7	4.0
	1980	31.7	61.4	3.4	3.4	24.5	52.9	17.8	4.8
	1985	32.3	61.1	3.3	3.3	24.6	53.2	17.5	4.7
Canada	1961	29.9	66.4	3.3	0.4	23.0	66.8	9.7	0.5
	1971	31.6	64.9	2.5	1.0	25.0	63.9	9.8	1.3
	1980	31.5	64.3	2.2	2.0	24.7	62.5	9.9	2.9
	1985	30.0	61.5	2.4	6.0	22.7	57.1	11.9	8.2
CSFR	1961	24.9	69.8	3.5	1.7	18.0	64.3	15.2	2.5
	1970	26.5	67.7	3.4	2.4	18.8	62.5	15.3	3.3
	1980	24.4	68.5	3.4	3.6	15.9	63.2	16.0	4.8
	1985	24.5	67.9	3.2	4.5	15.7	62.6	16.0	5.7
Finland	1961	33.6	62.0	3.1	1.5	29.2	55.2	13.2	2.4
	1970	34.3	60.9	2.8	2.0	28.7	55.1	13.0	3.2
	1980	35.0	57.9	2.7	4.4	27.8	52.9	13.7	5.7
	1985	35.8	56.2	2.7	5.3	28.1	51.5	13.7	6.6
France	1960	27.3	66.4	4.3	1.9	20.7	60.3	16.6	2.5
	1970	29.6	64.7	3.6	2.1	22.2	59.6	15.4	2.7
	1980	29.4	64.9	3.2	2.5	22.6	59.2	14.7	3.5
FRG	1961	26.8	67.9	3.9	1.5	22.7	57.7	17.0	2.6
	1970	24.3	70.4	3.5	1.8	18.9	60.3	17.8	3.0
	1980	30.4	63.7	3.3	2.7	22.2	56.8	17.4	3.7
	1985	33.5	59.8	3.2	3.5	24.4	54.3	16.9	4.4
GDR	1964	18.5	75.6	4.2	1.7	16.1	59.9	19.5	4.5
	1970	21.3	72.6	4.0	2.1	17.2	59.0	19.0	4.9
	1980	24.6	67.8	3.6	4.0	18.3	57.5	17.6	6.5
	1985	25.9	65.3	3.4	5.3	19.0	56.7	16.7	7.7

Table 1.1. (continued)

		Males				Females			
		S[1]	M[1]	W[1]	D[1]	S[1]	M[1]	W[1]	D[1]
Hungary	1960	23.7	71.5	3.4	1.4	17.3	64.4	15.7	2.6
	1970	24.8	69.7	3.2	2.3	17.3	63.7	15.2	3.8
	1980	22.0	70.6	3.5	3.9	13.7	64.1	16.5	5.7
	1985	23.1	68.0	3.8	5.0	14.2	61.5	17.4	6.9
Italy	1961	34.4	62.1	3.5	0.0	29.1	58.0	12.9	0.0
	1971	32.3	64.2	3.4	0.1	26.1	60.5	13.4	0.1
	1981	30.8	65.8	3.1	0.3	24.5	61.1	14.0	0.4
Netherlands	1960	30.7	64.9	3.6	0.8	26.9	63.0	8.8	1.3
	1970	29.7	66.3	3.1	1.0	24.2	64.3	10.0	1.5
	1980	31.3	63.4	2.7	2.6	24.4	61.3	10.9	3.4
	1985	33.5	60.0	2.6	3.9	26.4	57.6	11.2	4.8
Norway	1960	31.0	63.9	4.0	1.1	26.0	62.2	10.1	1.7
	1970	30.7	64.3	3.5	1.5	24.3	62.4	11.2	2.1
	1980	31.5	62.2	3.4	2.9	24.0	59.8	12.6	3.6
	1985	34.3	58.5	3.3	3.9	26.2	56.1	13.0	4.7
Poland	1960	24.9	71.7	2.5	0.8	21.1	62.5	14.8	1.5
	1970	31.3	65.3	2.2	1.3	24.7	59.7	13.4	2.2
	1980	28.1	67.6	2.5	1.8	20.6	62.6	14.0	2.8
	1984	26.6	68.9	2.7	1.8	18.8	63.7	14.7	2.9
Sweden	1960	31.6	61.9	4.3	2.3	26.2	60.7	10.1	3.0
	1970	32.0	61.0	3.8	3.2	24.9	59.9	11.1	4.1
	1980	35.9	54.3	3.6	6.2	27.6	52.5	12.5	7.4
	1985	38.7	50.4	3.5	7.3	30.0	48.4	12.9	8.7
Average	1960	27.9	67.0	3.8	1.3	22.9	61.0	14.0	2.1
	1970	28.6	66.2	3.4	1.7	22.4	60.8	14.1	2.7
	1980	29.5	64.2	3.2	3.0	22.2	59.2	14.5	4.1
	1985	30.7	61.6	3.1	4.5	22.7	56.6	14.7	5.9

[1] S=single (never-married), M=currently married, D=divorced, W=widow(er).
Source: Data bank of the Population Activities Unit of the ECE.

Canada) to 2.4 per cent for males in Sweden and Austria, and even 4.5 for females in the GDR. In 1985, the lowest proportion is observed in Poland, respectively 1.8 and 2.9 per cent among males and females, and the highest in Sweden where 7.3 per cent of males and 8.7 per cent of females are divorced. No regional pattern appears but three countries depart from the general trend: Italy where the proportion divorced is still very low, and Austria and Poland which show a stabilization after 1980. It is also worth noting that in all countries the proportion divorced is higher among females than among males. In 1985 the difference ranges from 0.8 percentage points in Norway to 2.4 in the GDR. One possible explanation here is that men generally have relatively high remarriage rates, compared with women (Hoffmann-Nowotny, 1987, p. 156; Höpflinger, 1991, p. 322). It should be kept in mind, however, that possible sex differences in mortality among divorcees may distort the picture.

With respect to the proportions widowed, the most striking feature is obviously the difference between men and women, which is mostly due to the combined effect of sex differentials in mortality and the traditional male seniority in couples. Around 1960, between 2.5 and 5.0 per cent of men were widowers, while the proportion among women was between 8.8 and 19.5 per cent. The highest proportions of widows are to be found in some of the Central European countries (in Austria, the FRG, and the GDR), and the lowest percentages in the Netherlands and in Canada. The proportion of widowers decreased in all but two countries (it increased in Hungary and Poland), while the general tendency is the opposite among women, especially after 1970.

Marital status dynamics

Table 1.2 shows the development of the Crude Marriage Rate in the different countries included in this study between 1960 and 1985. Although this index cannot correct for changes in the age structure of the population and, therefore, can possibly give a distorted picture of nuptiality trends, its interpretation remains straightforward.

Table 1.2 suggests the distinction of two periods. First, during the 1960s, nuptiality increased in the majority of countries. The exceptions were Austria, the FRG, the GDR, Italy, and Sweden. During the second period, after 1970, crude marriage rates decreased in most countries, except for an increase in the GDR, a stagnation in Poland between 1970 and 1980, a stagnation in Czechoslovakia, and a slight increase in the FRG and Sweden between 1980 and 1985. Sweden had the lowest crude marriage rates throughout the periods

Table 1.2. Crude marriage rates, 1960-85 (per 1000 population)

	1960	1970	1980	1985
Austria	8.3	7.1	6.2	5.9
Canada	7.0	8.9	7.8	7.3
CSFR	7.8	8.8	7.7	7.7
Finland	7.4	8.8	6.1	5.3
France	7.0	7.8	6.2	4.9
FRG	9.4	7.3	5.9	6.0
GDR	9.7	7.7	8.0	7.9
Hungary	8.9	9.4	7.5	6.9
Italy	7.7	7.4	5.7	5.2
Netherlands	7.6	9.3	6.4	5.7
Norway	6.6	7.6	5.4	4.9
Poland	8.3	8.6	8.6	7.2
Sweden	6.7	5.4	4.5	4.6

Source: Gonnot and Vukovich (1989).

investigated: 6.7 per thousand in 1960 and 4.5 per thousand in 1980. While in 1960 only national specificities could be found and regional patterns could not be established, in 1985 the four Central Eastern European countries included in the study had clearly higher crude marriage rates than any of the other countries (except Canada), with a maximum rate of 7.9 per thousand in the GDR.

The overall impact of age and sex differentials in nuptiality trends is reflected in the development of the mean age at first marriage. Between 1960 and 1970, this age has continued a long-term downward trend in all countries. Then, the period 1970-80 appears as a turning point: either a smooth decrease in the mean age at first marriage is observed, or a stagnation, or a slight rise. Once again, only Sweden indicates a strong rise. Since 1980, the increase has been strong and general, exceptions being Hungary and Italy. However, it should be noted that in many countries the age at first marriage for both males and females is still lower than it was in 1960. In 1985, the mean age at first marriage ranged from 21.3 years for Hungarian women to 30.1 for Swedish men.

Parallel to the drop in first marriage, remarriage rates of divorced persons have also declined since the early 1970s. Like first marriage rates, remarriage rates are considerably higher in Central Eastern European countries, and in Canada today.

Following a period of relative stability, divorce trends have shown a striking upturn in the second half of the sixties. After a moderate rise, the increase in the number of divorces has accelerated and led to a divorce boom practically everywhere (see *Table 1.3*). In countries where divorces were fairly low in the sixties, the rise between 1960 and 1985 has reached impressive levels: 350 per cent in the Netherlands and over 600 per cent in Canada. A consequence of this fast and strong evolution is that the gap between the different countries has narrowed: among countries in this sample, only Poland still shows a more limited incidence of divorces and in Italy divorce is still almost not existent.

Although, in the long term, widowhood is also influenced by changes in intensity of marriage and divorce, it mostly depends on the sex differentials in age at marriage and mortality. This is due to the fact that in most of the low mortality countries widowhood mainly occurs at old ages at which remarriage plays a very limited role for males and is negligible for females. Owing to the lower age at marriage and the lower mortality of women, widowhood is essentially a female phenomenon: in 1985 a ratio of around 2.5-3.0 new widows per new widower was observed in the countries included in this study. Already in the 1960s, life expectancy at age 65 was 2-3 years higher for women than for men. Since then, it has hardly changed for men while it has increased by up to three years for women. This suggests that

Table 1.3. Number of divorces per 1000 married women, 1960-85

	1960	1970	1980	1985
Austria	5.0	5.9	7.9	8.8
Canada	1.6	6.0	10.5	11.4
CSFR	4.9	7.0	8.9	10.0
Finland	4.3	6.0	9.0	8.5
France	2.8	3.4	7.1	8.3
FRG	3.6	5.1	6.4	8.6
GDR	6.3	6.4	10.7	
Hungary	6.6	8.4	9.9	10.9
Italy	1.5	1.0	1.1	
Netherlands	2.2	3.3	7.5	9.9
Norway	2.8	3.7	6.8	8.6
Poland	2.3	4.6	4.5	5.3
Sweden	5.0	6.7	11.1	11.7

Source: Gonnot and Vukovich (1989).

the excess female increase in life expectancy at age 65 is likely to be responsible for the decrease in the proportion widowed among men.

1.4.2. Families and households

The fall of marriages, the increase in age at marriage, and the divorce boom have not only considerable impacts on the marital composition of the population but also on the size and structure of families and households. As may be seen from *Table 1.4*, a main consequence has been a more rapid increase in the number of households than in the total population. The largest growth differentials are found in Canada and the Netherlands (more than 40 percentage points), followed by the Scandinavian countries and Italy. The consequence of the faster increase in the number of households than in population is a decrease in the average household size.

A smaller part of the decline in average household size between 1960 and 1980 results from changes in the age structure of the population: estimated on the basis of 1960-headship rates combined with changes in the population aged 20 and over, changes in the age structure accounted for less than ten per cent of changes in the number of households in Austria and the FRG.

Table 1.4. *Percentage changes in the number of households, total population and population aged 20 and over between 1960 and 1980, and contribution of changes in age structure to changes in numbers of households*

	Total population	Population aged 20+	All households	Due to age structure (%)
Austria	7	7	16	1.4
Canada	34	52	82	38.6
CSFR	12	17	26	35.7
FRG	11	12	27	6.5
Finland	8	25	35	60.4
France	18	21	30	28.2
Hungary	7	16	21	61.2
Italy	12	15	36	12.8
Netherlands	23	37	63	33.3
Norway	14	19	34	27.3
Poland	20	39	33	149.3
Sweden	11	17	35	23.7

Source: Gonnot and Vukovich (1989).

The corresponding figure is between 20 and 35 per cent for most of the countries and around 60 per cent in Finland and Hungary. For most countries, increases in the number of households are explained by changes in family formation, size, and structure and by the increase in one-person households. For Poland, Table 1.4 suggests that there was a tendency to form larger households, opposite to the trend in the other countries.

Family structure

Two factors have recently played an important role in the development of the family: changes in fertility and changes in living arrangements. Changes in fertility have been widely documented in several studies and can be summarized as follows. Firstly, since the early 1960s a substantial drop is observed in Central Eastern European countries, the region which had the highest fertility levels in the mid-1980s. Secondly, this lower fertility has led to a sharp reduction in the number of births at higher parities. Thirdly, since the early 1970s, the frequency of childbearing outside legal marriage has grown in most countries. On average, within fifteen years —between 1970 and 1985— the proportion of births to unmarried mothers has been multiplied by more than two among the countries included in this study but marked national discrepancies can be seen with respect to intensity.

Table 1.5. Total fertility rates in 1960-65, 1970-75, and 1980-85

	1960-65	1970-75	1980-85	Changes 1960-85
Austria	2.8	2.0	1.6	-1.2
Canada	3.6	2.0	1.7	-1.9
CSFR	2.4	2.3	2.1	-0.3
Finland	2.6	1.6	1.7	-0.9
France	2.9	2.3	1.9	-1.0
FRG	2.5	1.6	1.4	-1.1
GDR	2.5	1.7	1.8	-0.7
Hungary	1.8	2.1	1.8	-0.0
Italy	2.6	2.3	1.6	-1.0
Netherlands	3.1	2.0	1.5	-1.6
Norway	2.9	2.3	1.7	-1.2
Poland	2.0	2.6	2.3	+0.3
Sweden	2.3	1.9	1.7	-0.6
Average	2.6	2.1	1.8	-0.8

Source: Gonnot and Vukovich (1989).

Broadly speaking, there are three groups of countries with respect to births outside marriage.A first group includes the countries which indicate a very high ratio such as Sweden where —since 1988— more than half of the births occur out of wedlock, the GDR, and Norway. A second group is composed of countries with a ratio of roughly 20 per cent: Austria, France, Finland, and Canada. The third group of countries shows ratios between five and ten per cent and includes Hungary, the Netherlands, the FRG, Czechoslovakia, and —at the lower end— Poland and Italy.

Related to the increase in births outside wedlock, a major change in living arrangements has been the upsurge of consensual unions. Although straightforward comparison is extremely difficult due to international differences in definition, measurement, and coverage, tentative conclusions are suggested by *Table 1.6.*

In four of the six countries included in this table, consensual unions represent —around 1985— less than ten per cent of the total number of unions: in Italy (1.3 per cent), in the Netherlands (7.4 per cent), in Austria (4.2 per cent), and in France. This range of values is probably widely valid. Only Scandinavian countries (and especially Sweden, where the cohabitation uptrend has started much earlier than in other countries) show cohabitation rates above ten per cent: 11.4 per cent in Norway and almost 20 per cent in Sweden. Consensual unions are extremely frequent below age 20: except for Italy, between about 45 and 95 per cent of girls under 20 living in unions are cohabiting. After this age, the proportion drops sharply but several countries still indicate a considerable proportion of more than 14 per cent among women aged 25-29. Therefore, the fall in marriage and the rise in the proportion single at young ages partly hide a shift from legal to informal

Table 1.6. Consensual unions as a percentage of all unions around 1985 by age of women

	15-19	20-24	25-29	30-34	35-39	40-44	All ages
Austria	45.4	18.7	5.9	3.9	3.2	2.9	4.2
France		35.8	14.0	10.1	6.0	5.5	
Italy	4.0	2.4	1.6	1.8	1.0	1.1	1.3
Netherlands	63.0	36.3	15.9	6.7	4.0	2.2	7.4
Norway	75.0	47.0	23.0	12.0	7.0	7.0	11.4
Sweden	92.7	77.1	48.1	29.6	19.2	13.0	19.9

Source: Gonnot and Vukovich (1989).

marriage. This is also and especially true for remarriages. To which extent this has led to a compensation and whether this change affects the pattern of formation and dissolution of unions is difficult to say and seems to greatly vary from one country to another. Evidence of discrepancies between countries is partly found in the fact that no one-to-one relation exists between the intensity of cohabitation and the proportion of births outside marriage. For instance, although the level of cohabitation is fairly similar in France, Austria, and the Netherlands, the proportion of births to unmarried mothers is more than twice as big in France and Austria than it is in the Netherlands.

The decline of fertility and nuptiality together with the rise in cohabitation have led to a decrease in the proportion of households which are families. Secondly, as a result of the drop in fertility, the average number of children per family and the average family size have declined. This decline has been especially strong in countries where fertility was high in the sixties.

One-person households

Besides changes in family structure, a major factor behind the decrease in average household size is the sharp increase in the number and the proportion of one-person households. *Table 1.7* shows that the proportion of one-person households has increased, on average, by 50 per cent between 1960 and 1980 in the countries included in the table. The increase was much larger in Canada and in the Netherlands: the percentage of one-person households has roughly doubled in these two countries between 1960 and 1980. The highest proportions of one-person households are to be found in the FRG and in Sweden (around one-third of all households), and the lowest ones in Italy.

Around 1985, the marital composition of one-person households was dominated by three groups of more or less equal sizes: single women, single men, and widows. While the large number of single households is a consequence of decreasing marriage rates, the proportion of one-person households headed by widows is heavily influenced by the substantial increase in the proportion of widowed persons living alone during the last decades.

The increasing proportion of widowed persons who form their own household is also consistent with a more general tendency towards a disappearance of multi-generational households.

The question whether these trends will continue or not in the future cannot be answered directly because of the complexity of the dynamics of living arrangements. Much uncertainty arises from the future evolution of nuptiality

Table 1.7. One-person households as a percentage of all households around 1960, 1970, 1980, and 1985 by country

	Around 1960	Around 1970	Around 1980	Around 1985
Austria	20	25	26	
Canada	9	13	20	
CSFR	14	18	22	22
Finland	22	24	27	28
France	20	22	25	
FRG	21	25	31	34
GDR		26	27	
Hungary	14	18	20	20
Italy	11	13	14	13
Netherlands	12	17	22	28
Norway	18	21	28	
Poland	16	16	17	
Sweden	20	25	33	
Average	16	20	24	

Source: Gonnot and Vukovich (1989).

and divorce. On the one hand, the possibility of a stabilization of both nuptiality and divorce in the near future in 'more advanced countries' is suggested by the most recent data. First marriage rates over age 25 seem to stabilize in many countries and sometimes even slightly increase, while under 25 the rapid fall continues. In parallel, a stagnation in divorce rates at certain ages is indicated in a number of countries —especially those where divorce is high— although upward trends still prevail. On the other hand, the future of nuptiality is strongly dependent on future developments in consensual unions. In a number of countries, falling marriage propensities and rising mean ages at marriage are obviously related to the increasing prevalence of consensual unions among young adults. A somewhat similar parallel can be drawn between the decline in remarriage of divorcees and the increase, although more limited than below 25, in the proportion of consensual unions at higher ages. But time-trends and national differences in fertility and nuptiality behaviours of cohabiting people are poorly documented at present. Therefore, it is still very difficult to assess to which extent cohabitation can be seen as a transitory stage before or after legal marriage or as an alternative to legal marriage and, consequently, to anticipate the future.

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2. MODELLING THE DYNAMICS OF LIVING ARRANGEMENTS

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2.1 | Options for living arrangements

A particular living arrangement can be operationalized in several quite distinct ways. We discuss three options here. Living arrangements will be defined as either marital status, family type, or household type. The choice to be made between these three forms of arrangements in the context of a particular case study depends on various theoretical and practical factors, including data availability and model complexity. The key question, however, is to what extent the option chosen is a good predictor of the relevant behaviour of the individuals under consideration. For instance, in some countries, the number of divorced females aged 20-50, say, will be a key variable to assess the amount of welfare to be spent to support single mothers. Hence, in this example marital status would be an appropriate choice for living arrangement. But in some other countries, including Sweden and the Netherlands, marital status is a much less accurate description of living arrangement. Therefore, in the case study for the Netherlands reported by Van Imhoff in Chapter 6, household status was included in the living arrangement dimension, using the one-parent family and consensual union as two possible household types.

An illustration of the bias caused by merely regarding formal marital status is provided by comparing the results of a recent study carried out by one of the authors of this volume on the basis of Swedish data (Prinz, forthcoming), with those of Chapter 3. A model distinguishing between single persons (not

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living as a couple), cohabiting persons (living in consensual unions), and married persons (living together or separated) projects a decline in the number of married men aged 15+ of around 15 per cent together with an increase in the number of cohabiting men of around 42 per cent for the period 1985-2020. Taken the two opposite trends together this implies that the proportion of singles would only increase by some six per cent. However, the legal marital status projection model used in Chapter 3 projects for Sweden a much stronger decline in the number of married men, namely around 25 per cent. At the same time, the proportion of never married men is projected to rise by about 24 per cent. The conclusion of this comparison is that not only the number of couples, but even the number of married couples is underestimated in the model which only considers formal marital status, and which disregards de facto living arrangement. The underestimation is caused by the fact that marriage rates are around three times higher among cohabitants as compared with singles, together with a rising share of cohabitants in the Swedish population.

The trichotomy marital status, family type, and household type runs parallel to Ryder's distinction between the conjugal dimension, the consanguineous dimension, and the co-residence dimension of family demography (see for instance Ryder, 1985, 1987). In this order, these alternative operationalizations describe living arrangements from a less to a more complex type of structure. Firstly, the conjugal and the marital status perspective explore the formation and dissolution of marital unions. Secondly, the consanguineous and the family relationship explore links between parents and children. Finally, we consider the household, that is a group of individuals, familial and nonfamilial, which is at least identified by a co-residence criterion ('household-dwelling' concept), and possibly by other criteria as well (for instance common food provision, which is the case for the 'housekeeping-unit' concept. (More formal definitions of the household concept may be found in UN, 1989, p. 4.)

Households are the most complex type of primary units, embracing all the aspects of the less complex dimensions of the above classification. A nuclear family with children living as an isolated co-resident group can be viewed as one of the subsets of households. This would agree with our household dimension. Such a family is also of interest as such, and this perspective agrees with the family approach to living arrangements. Other subsets of households, for instance isolated co-resident conjugal units (childless couples), may also be included in more than one of three operationalizations of living arrangements.

2.2 | Existing models for living arrangements

In this section we review existing models that are able to project living arrangements forward in time. As before, living arrangement is interpreted in either of the following three senses: marital status, family (status), and household (status). Given the abundance of literature on these types of models, a selection had to be made. We focus primarily on *dynamic* models in which *individuals* (living in a couple, a family, or a household) are simulated.

The emphasis on *dynamic living arrangements models* may be argued for as follows. A dynamic model recognizes transitions between (marital, family, household) states. In other words, it relates the living arrangement structure at time t+1 to that at time t (Murphy, 1991, p. 890). Such a model is capable of simulating events which result in changes in living arrangements (in addition to those in age structures). This contrasts with static living arrangements models in which the living arrangement dimension is based solely on headship rates, or on a breakdown by living arrangement type, or approaches starting from a reference person. Static models usually rely on descriptions of the situation with respect to living arrangements at specific points in time.[1]

The value of the headship rate is the result of dynamic processes in the past, these processes themselves remaining a black box. Like the labour force participation rate, the headship rate is not a rate in the demographic ('occurrence/exposure') sense, since it focuses on changes in stocks, and not on flows. Although widely used for many practical reasons, such a comparative static approach is neither satisfactory from a substantive nor from a methodological point of view. A dynamic model can answer questions such as: 'If children would leave the parental home two years later than is the case presently, how would this influence household structures?', or 'How would a 25 per cent increase in divorce rates affect the one-parent family?'. Traditional static living arrangements models say little about such matters.

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[1] The dynamic-static distinction applied here should not be confused with the distinction, frequently made in statistics, between a model which describes a stationary process (with time constant exogenous parameters) and non-stationary models (with time dependent parameter values). Both dynamic and static models in the sense used here may either have time constant or time dependent parameter values.

In the discussion above, we have used the notion of dynamic models only with respect to living arrangement aspects. Many of the models that are static in that sense, explicitly treat the dynamics of processes other than living arrangements, for instance childbearing (fertility) and death (mortality). The headship rate model is a case in point here.

It should be noted that in between a purely dynamic and a purely static description of the living arrangement definition, we have what could be called a *'hybrid' perspective*, which combines both dynamic and static aspects of the living arrangement definition. Examples are the models developed by Prinz (1991) and the Netherlands Central Bureau of Statistics (De Beer, forthcoming; De Beer *et al.*, 1992; Latten, 1992), in which full marital status dynamics are explored on the basis of marriage formation and dissolution, and a household dimension is added in a static way. Prinz uses age, sex, and marital status specific headship rates, and the NCBS model breaks the population in each marital status category down into several household states. Such a hybrid model may often serve as a practical alternative for a theoretically more attractive fully dynamic model for which, however, data demands are relatively high (cf. below). Both dynamic and hybrid models will be discussed in the remainder of this chapter.

The examples on dynamic, static, and hybrid living arrangements models reviewed here illustrate the fact that the distinction between dynamic and static models is not a clear-cut one. The latter two types of models represent the extremes on a continuous scale, with the hybrid type of model located somewhere in between these two. The model developed by Möller (see subsection 2.2.3) contains only one household event, i.e. home-leaving of young adults. Other household aspects are modelled by means of a static ratio approach. In that sense, the model is less dynamic than the hybrid models of Prinz and the NCBS. The LIPRO model discussed in subsection 2.2.3 is almost entirely dynamic.

For methodological and theoretical reasons, the description of dynamics in living arrangements at the level of *individuals* is to be preferred over that at the level of *groups* (couples, families, or households). See, for instance, Ledent *et al.* (1986, p. 155), Willekens (1988, p. 88) and Keilman and Keyfitz (1988, p. 275). One reason is that within the context of dynamic models for living arrangements, the concept of the longitudinal household (or family, for that matter) cannot be defined unambiguously (McMillan and Herriot, 1985; Duncan and Hill, 1985). Although the definition of the existence of a particular household at a specific point in time is straightforward, there is no satisfactory definition of the point at which a particular household starts and ends its existence (Murphy, 1991, p. 895).

We shall now give a description of projection models for each of the three options of living arrangements in turn. This review integrates to a large extent existing ones (Keilman, 1985; Ledent *et al.*, 1986, Chapter 2; De Vos and Palloni, 1989; Van Imhoff and Keilman, 1991, Chapter 2), to which new models (for instance Kuijsten, 1988; Latten, 1992; Murphy, 1991; Prinz, 1991; De Beer, forthcoming) were added.

2.2.1. Dynamic marital status projection models

During the 1970s some countries (Denmark, Sweden, Norway, Great Britain, and the Netherlands) produced official population forecasts in which individuals were not only classified by age and sex, but by marital status as well. Still today, a breakdown by marital status of such demographic behaviour as childbearing and death displays large differentials — however, given one's marital status, much of an individual's demographic behaviour remains unexplained. This is perhaps the main reason why in most of these countries (all five except for the Netherlands) the marital status projection models are no longer in use. In Norway it has not been employed since 1981, and in the remaining countries the marital status model was only applied during the 1970s. Yet these models are relevant for this review because they explicitly deal with changes of individuals in marital status, that is marriage, divorce, and widowhood.

The modellers in each of the five countries mentioned above had to deal in some way or another with the two-sex problem: for a particular period of time, the predicted number of male marriages must be equal to the predicted number of female marriages. Similar constraints apply to divorce, and to the transition to widowhood in combination with mortality of married persons. Whereas the general structure of the five models is that of the cohort-component approach, they differ primarily in their treatment of the two-sex problem (Keilman, 1985). Hence we will only discuss the latter aspect.

In the models for Great Britain, the Netherlands, and Sweden, the approach chosen to solve the two-sex problem is as follows. For each unit projection interval, initial age-specific nuptiality rates for males and females separately result in initial numbers of marriages for each sex, added up over all relevant ages and previous marital statuses (never married, widowed, divorced). The number of male marriages does not equal that of females. Then, an adjustment algorithm corrects these two numbers and translates adjusted total marriages back into adjusted age- and sex-specific marriages, which finally lead to adjusted marriage rates. The British model reconciles initial inconsistent numbers of marriages by taking the simple arithmetic mean, whereas the harmonic mean is used in the model for the Netherlands. The Swedish model is male-dominant: the final number of marriages equals the initial number for males, and marriages (and marriage rates) are only adjusted for females. Divorce and widowhood are treated the same way as marriage in the British and the Swedish model. This is also the case for divorce in the Dutch model, whereas widowhood is 'mortality-dominant': the algorithm starts from death rates and 'widowhood rates' for married persons of both sexes, and it adjusts the latter rates such that the total numbers of new widowers and new widows are equal to the numbers of married females and males who die. Death rates are left unchanged.

The models for Norway and Denmark are identical. Male marriage rates are applied to half the unmarried males, and the marrying males are assigned to marrying females in conformity with a two-dimensional distribution of marriages by age combination of the spouses. A similar procedure is used for half the number of unmarried females. The total number of marriages is found by adding up the results of the two calculations. Divorce is treated in the same way, and new widowers and widows are determined by means of age- and sex-specific death rates for married persons in combination with a variable describing the couple's age distribution at transition to widowhood.

It should be noted that the two computer programs used in the present project, namely DIALOG and LIPRO are based on the concepts sketched here. DIALOG (see Scherbov and Grechucha, 1988) follows the Dutch model (four marital states, harmonic averaging procedure), and in LIPRO (see Van Imhoff and Keilman, 1991) the British, the Dutch, or the Swedish model can be selected from a wide range of model specifications (up to 60 states to be chosen by the user; harmonic, arithmetic, or dominant averaging procedure).

Other marital status projection models than those mentioned above are less suited for the purposes of the current project. Many of those models consider only marriages, and not divorce or widowhood. This is typically the case for the 'harmonic means' model of Schoen (1981) and for the 'generalized harmonic means' model of Pollard (1975, 1977). Moreover, models such as that of Shah and Giesbrecht (1969), that of Henry (1968, 1972) based on panmictic circles, and that of McFarland (1975) based on iterative adjustments have relatively unattractive features when compared with the requirements that any realistic nuptiality model should fulfil (Pollard, 1977; Keilman, 1985). The most difficult requirements are those of competition and substitution. Because of competition mechanisms in the marriage market, the number of marriages between males aged x and females aged y should go down when there is an additional supply of eligible males at age x' (≠x), and likewise for females. But the substitution requirement says that the decrease should be smaller the closer x' is to x. Thus the negative effect of an additional supply of 30 year old unmarried males on marriages between males aged 25 and females aged 23 is stronger than that of an extra number of 35 year old males. Pollard's 'generalized harmonic means' model fulfils these and other requirements, but its parameters are difficult to estimate (Wijewickrema, 1980). The Dutch model, when compared with the requirements, comes out as next best.

2.2.2. Dynamic family projection models

A minium requirement for a family projection model is that it connects adults and children living in the same household. Hence the approach often taken in such models is to describe the behaviour of females by age, marital status, and number of children present in the household of the woman. We briefly discuss the models constructed by Kuijsten, Rallu, and Bongaarts, all stemming from the 1980s. For reasons of comparison, the model used by Prinz in Chapter 5 is also summarized here.

Kuijsten (1986, 1988) developed a model for the projection of women by age and family life cycle stage. It deals with marital status changes of these women and it attaches marital births to them using birth-order-specific birth interval distributions. This results in projected numbers of 15-49-year-old women broken down by five-year age group, marital status, and number of 0-14-year-old children ever born, who are all supposed to live in their mothers' household. Although Kuijsten's model contains many useful elements for the construction of a dynamic family projection model, its drawbacks should be mentioned:

- it relies on females only;
- extramarital fertility is not taken into account;
- it sets an upper age limit of 50 years to the women in question;
- children who survive beyond the age limit of 14 years are not followed in the model. Consequently, except for mortality, these children do not display any demographic behaviour (marriage, childbearing).

Rallu (1985), and Festy and Rallu (1981) report on a family model constructed at INED, Paris. This model projects families by marital status of the female, number of children in the household, as well as the ages of those children. Essentially, it consists of two sub-models. The first one projects the numbers of mothers by age, marital status, and number of children ever born. As in Kuijsten's model, fertility is treated by means of birth intervals. The second sub-model projects the number of children present, as well as their ages, broken down by age of the mother.
A few peculiarities of Rallu's model should be noted (see also Ledent *et al.*, 1986, p. 64, p. 68):

- marriage formation and marriage dissolution are modelled in a strictly hierarchical manner ('decrements-only'). Hence remarriage of divorcees and of widows is not taken into account;
- Rallu assumes that all children leave the parental household between their 16th and the 17th birthday. This is obviously a very crude approximation of the home-leaving process, both in terms of quantum and, particularly, tempo.

Ledent's (1986, p. 68) suggestion to relax this strict assumption by applying age-specific proportions of children present to numbers of children alive involves essentially a static perspective: it fails to take into account explicitly the events of home leaving and return to the parental household.

Bongaarts' (1981, 1987) family projection model bears similarity to that of Rallu. A first sub-model seeks to project women by age, marital status, and number of children ever born (supplemented by fecundability status —sterile or fecund— a characteristic that will not be discussed further here). However, unlike Rallu's model, Bongaarts recognizes entries into as well as exits from each marital status. The aim of the second sub-model is to project the number of children present, as well as their ages, by age of the mother. Similar to Ledent's suggestion to extend Rallu's model, Bongaarts transforms surviving children into children present by using age-specific ratios. As noted earlier, this is a static approach. A second point, similar to Rallu's model, is that the Bongaarts model only takes into account the formal marital status of the woman, and not a possible presence of a (male) partner in the household. Finally, a minor point is that Bongaarts assumes, for every unit projection interval, that deaths and changes in marital status only occur at one point in time, halfway during that interval. In case intervals of five years are employed, these assumptions cannot be regarded as being realistic.

For reasons of comparison, we also present briefly the family model which is used by Prinz in Chapter 5. It is less complete than the models discussed earlier, but it serves the purposes of the problem taken up in Chapter 5: what would be the impact on state pension expenditures in case the pension rights that a woman is entitled to would be linked directly to the number of children she gave birth to? The model considers women only, and it breaks them down according to three dimensions: age, marital status (single, married, widow, and divorced), and number of children (of both sexes) ever born (0, 1, 2, and 3 or more). For each age group, there are 12 combinations of marital status and number of children: for single women, first and subsequent children are taken together, and for widows and divorced women, the same is done for second and subsequent children. The model is perhaps not so much a family model (since it does not have to consider numbers of children living with their mother), but rather an extended marital status model. Because it describes females only, Prinz was not confronted with the two-sex problem (although there is a link between numbers of mothers who increase their parity by one and the number of children born in the model). The one-sex version of the DIALOG simulation program was used for the projections.

This subsection has deliberately omitted family models that are not developed for projection purposes. For instance, the family model of Brown, proposed for the United Kingdom as early as 1951, heavily relies on the notion of a marital status life table, and it does not really contain any projection algorithm. Similar objections can be raised against the family life tables for the Federal Republic of Germany constructed by Schwarz (Statistisches Bundesamt, 1969) and Höhn (1982).

2.2.3. Dynamic household projection models

Household models describe more complex aspects of reality than family models or marital status models do. For, a household model often includes one or more family types to be projected, for instance a two-parent family household and a one-parent family household. In a proper household model, these family households are supplemented with non-family households, such as one-person households and, more recently, consensual unions.

This subsection contains a review of dynamic household models only — hence static models will not be discussed. This rules out headship rate models and their many extensions. Recent overviews of the latter type of models were given by Kono (1987) and Linke (1988). We will not discuss static approaches relying on household composition matrices (Akkerman, 1980) or household contribution matrices (Murphy, 1986), or models for which, to the best of our knowledge, no operational version exists, for instance those suggested by Muhsam (1985) and Webber (1983).

Ledent combined attractive properties of the Rallu model and the Bongaarts model, both discussed in subsection 2.2.2 (Ledent *et al.*, 1986, Chapter 4). He used the aspects of marital status transitions and parity-specific fertility by duration since last birth to construct a household model for the Bureau of Statistics of Québec. At the time of this writing, no operational version of the model is known of, however.

We shall look at a number of operational dynamic household models: the model developed by Möller for the FRG, the Swedish model constructed by Hårsman, Snickars, Holmberg, and others, two models described by Murphy for England and Wales, and the model recently developed at the NIDI, the Netherlands. We also discuss the hybrid model of Prinz and that of the Netherlands Central Bureau of Statistics.

Möller (1979, 1982) describes a household projection model which was developed at the 'Institut für Angewandte Systemforschung und Prognose' (ISP) in Hanover, Federal Republic of Germany. It starts from results of a population projection model which simulates future population structures by age and sex. Then the model further breaks down the population into dependent children, married adults, and unmarried adults. Using an assumption on headship rates, the number of households is calculated on the basis of male adults and unmarried female adults. This means that adult males and unmarried adult females are always considered as the head of a household. Given the number of households, the model finally determines their distribution by number of children present using parity-specific fertility curves by age of the mother and 'home leaving' curves by age of the child. The dynamic character of the ISP model is very limited as it relies on only one household event: leaving home by young adults. Other household aspects are introduced by means of static ratio and headship rate methods.

During the late 1970s and early 1980s, a dynamic household model was constructed by Hårsman, Snickars, Holmberg, and others in Sweden. Initially, the project was aimed at projecting regional housing requirements for Stockholm. To date, several versions and applications of the model exist and the original ideas have been updated many times. We shall discuss the model version described in a comprehensive report by Dellgran *et al.* (1984), as well as in Holmberg (1987). Hårsman and Snickars (1983) provide a useful summary of the model.

The Swedish model follows individuals, classified by household status, over a discrete time interval. Its key instrument is a matrix of transitions in household status that individuals experience between the beginning and the end of the time interval. Household status is defined as household size (1, 2, ..., 5+) and whether or not a household contains dependent children, that is, children under 15 years of age. This yields a total of nine household types.

The model starts with an observed transition matrix, obtained by linking two successive population censuses (with an interval of five years) at the individual level. Then, this matrix is adjusted to a number of external and internal constraints. Next, the population is projected forward in time over one interval, on the basis of the adjusted transition matrix. This procedure is repeated for the whole projection period.

An example of the constraints which the transition matrix has to satisfy is that at each point in time the number of dependent children in a two-person household with children must be equal to the number of adults in such a household. Furthermore, the adjusted transition matrix should resemble the original matrix as closely as possible.

Murphy (1991), in his discussion of the advantage that dynamic models have over static ones, presents two dynamic household models for England and Wales. The first model may be considered a straightforward extension of the static headship rate model into a dynamic model. It centres around the concept of marker, or reference person. There are various possibilities for the identification of such a marker in a specific household: it could be the head, or the senior female, or the first adult listed on the household questionnaire. The population (in private households) was broken into markers and non-markers (in addition to five-year age groups). Probabilities for entering ('promotion') and leaving ('demotion') the marker state were calculated from the Office of Population Censuses and Surveys 1 per cent Longitudinal Study (LS, see subsection 2.4.3), which contains linked information on some 500,000 people in the 1971 and 1981 England and Wales Census of Population. In an illustrative projection, Murphy obtains numbers of households for the year 1991, based on an application of the 1971-81 observed transition probabilities to the period 1981-91.

In a second dynamic household model, Murphy (1991) introduces six household states for individuals. At a particular point in time, a person belongs to one of the following categories: non-married, aged 16+, no dependent children; lone parent; couple without children; couple with child(ren); visitor; in institution. Transitions between these six household states were estimated from LS-data for ages 30-65 during the period 1971-81, and the resulting transition probabilities were used to project the 1981 household structure to 1991.

The last dynamic household model to be discussed is LIPRO (LIfe style PROjections), which was recently developed at the Netherlands Interdisciplinary Demographic Institute. Van Imhoff presents an application of the model in Chapter 6, whereas a complete account of methodological, empirical, and software aspects of LIPRO is given in a recent book (Van Imhoff and Keilman, 1991), which also contains a diskette with the LIPRO program. Righi and Sorvillo (1992) have applied LIPRO to data on Italian families. In the LIPRO application which is described in Chapter 6, the population in private households is broken down according to age, sex, and household position. For the latter characteristic, 11 positions are used: three for children, four for persons who live with a partner, one for persons who live alone (one-person households), one for heads of a one-parent family, and two for other household positions. These 11 household positions identify 69 possible household events that individuals may experience as they move from one household position to another. Besides household events, the model describes birth, death, emigration, and immigration. An event is expressed in LIPRO in terms of an occurrence-exposure rate (for each relevant combination of age and sex), representing the intensity with which the event occurs to an individual.

An important part of LIPRO is the so-called consistency algorithm. The purpose of this algorithm is to guarantee consistency in the numbers of events which members of the same household experience. The consistency algorithm generalizes the two-sex algorithm discussed earlier in connection with marital status models: we do not only have the requirement that the number of males who marry during a certain period must equal the number of marrying females, but there is a similar one for new consensual unions. And when a married man with children dies, both his wife and his children must be moved to a new household status, as they will become member of a one-parent family (head and child, respectively).

De Beer (forthcoming) presents a hybrid household projection model developed at the Netherlands Central Bureau of Statistics (NCBS), see also Latten (1992) and De Beer *et al.* (1992). It is hybrid in the sense that part of the changes in living arrangements (the marital status component) are modelled in a dynamic manner, and the remaining part in a static way. The marital status component of the model is the one which is described for the NCBS in subsection 2.2.1. Next, to each of the categories defined by a particular combination of age, sex, and marital status, a set of six household position proportions is applied. There is one household position for children, and five for adults. The six positions are: dependent child, living with a partner, living alone, head of one-parent family, living in an institution, and other. (Latten's paper describes a preliminary version of the model in which 'head of one-parent family' is contained in 'other'.) Data for marital status changes are taken from the civil registration system, and those for the household positions from several surveys (Fertility Surveys of 1982 and 1988, and Housing Demand Surveys of 1981, 1985, and 1989), and from a partial enumeration of the population registers in 1987.

The last model to be described in this section is the hybrid model developed by Prinz (1991). The dynamic part is similar to that of the Dutch hybrid model, as it projects the population broken down by age, sex, and marital status. The static part centres around headship rates specific for age, sex and marital status. (In this respect it differs from the Dutch hybrid model, which uses a set of five household position proportions to the population defined by a particular combination of age, sex and marital status). Prinz applied his model to three countries: Austria, Canada, and Norway, using data from vital registration for marital status changes, and data from the 1980 round of Population Censuses for headship rates.

2.3 | General aspects of the demographic models used in the project

The three demographic models which have been used in the international comparative project, namely the marital status model of Chapter 3, the 'marital status/children ever born model' of Chapter 5 by Prinz, and the household model of Chapter 6 by Van Imhoff, belong to the class of multidimensional models (also known as multistate models). Several authors have stressed the potential of this type of model, for instance Tuma and Hannan (1984, p. 21), Murphy (1986, p. 26), Ledent (1986, p. 78, p. 158), Ermisch (1988, p. 29, p. 30), and De Vos and Palloni (1989, p. 189). Advantages of the multidimensional approach are the following.

Firstly, the concept is very general — different categorizations of the state space permit entirely different applications of the model. In addition to marital status models and household models, the approach has been used in fertility models including parity, in multiregional models to study migration, and in labour force models, too.

Secondly, its methodology is well understood and the model, once written in matrix-form, is relatively simple.

Thirdly, the approach has been studied and applied in various disciplines, for instance in systems engineering (linear dynamic models), and in mathematical statistics and stochastic processes (first order Markov processes).

Fourthly, data of a widely different nature, whenever available (for instance panel survey data, retrospective survey data, repeated cross-sectional snapshots, aggregate population data on events) can be used to estimate the parameters of the model.

Of course, the multidimensional approach also has its limitations. Firstly, since it relies on the concept of a state space and on categories, it can only include a small number of 'explanatory' variables. For instance, the marital status model used in Chapter 3 has three demographic dimensions ('independent' variables): age, sex, and marital status. With some 17 age classes, two sexes and four marital states, this results in about 100 parameters to be estimated. So it would not be attractive to include in the model more explanatory variables than the three just mentioned.

A second drawback which is related to the former point is that the cross-table set up of the multidimensional model requires large data sets to estimate the parameters. Demographers have traditionally used the 'method of moments', that is they equated model moment parameters to corresponding observed variables. Hence, to estimate the parameters of the marital status model described above, one would need about 100 observed occurrence/exposure rates when working with five-year age groups.

Multidimensional models which describe changes in living arrangements may require more data than are actually available. This has been a major methodological problem in the international comparative project. In fact, it was the most important reason why, given the fact that we wanted to start from a common data base, only marital status models could be run for all countries, and not more complicated family, or household models. Yet, as will be argued in Chapter 7, there are prospects for improvement of the situation of a shortage of statistical data on living arrangements.

Thirdly, multidimensional models for living arrangements are based, either implicitly or explicitly, on the Markov-assumption. That is, the model supposes that future behaviour only depends on current status, and not on the path via which this status was reached. In many cases this is obviously too crude an approximation of reality, and extensions of these so-called first-order Markov models have been proposed, e.g. semi-Markov models. But, to the best of our knowledge, none of these more realistic approaches has resulted in an operational model for the projection of living arrangements.

2.4 | Data for living arrangements models

An important aspect of the modelling and projection of living arrangements is the type of data that are available. Below, we first discuss an ideal data situation. This discussion is relevant in the light of the data situations that were encountered in practice, which could be located within one of the various data types that are discussed next. Finally, the types of demographic data that are actually used in Chapters 3, 5, and 6 are presented.

2.4.1. The ideal situation

Generally speaking, the ideal situation with respect to the data for a particular living arrangements model would be such that all model parameters may be estimated without additional assumptions. For instance, a household model which breaks individuals down into n household positions results in n(n-1) possible intra-household events which these individuals may experience (some of which may not be possible in reality). Fertility, mortality, emigration, and immigration give rise to an additional number of events which is at most equal to 4n (most likely it will be less, for instance because births usually take place in only a limited number of the n households). The (n^2+3n) household events apply to members of each age class, males as well as females. Suppose we have w age classes in the model, then the total number of events would theoretically be $N = 2w(n^2+3n)$. Fortunately, the total number of events which are possible in practice is smaller than N. Fertility is usually linked to females at childbearing ages only, and other phenomena (for instance leaving the parental household, or entering an institution) are also restricted to persons in certain age classes. For instance, in Van Imhoff's model in Chapter 6 (having 11 types of households and 19 age groups), the number of events is 4,249, or 73 per cent of the theoretical number of 5,852. Now, the ideal data situation would be to have, for a recent period, the numbers of each of the 4,249 events (occurrences) as well as the numbers of years of exposure in each of the 2.w.n = 418 population subgroups. With such ideal-type data, one may assume that the observations were generated by a first-order time-homogeneous Markov process. Observed occurrence/exposure rates could then serve as Maximum Likelihood estimators of the parameters of the model, being the transition intensities (Aalen and Hoem, 1978). Even if we only know the events, but not the exposures, a straightforward estimation of the model parameters can be applied. For instance, when events and an initial population structure are available, we could employ the approximate linear estimator widely used in multidimensional demography (see, for instance, Rogers and Ledent, 1976), or alternatively, the exponential estimator proposed by Gill (1986). However, much more often the data on *events* are defective in one way or another. Therefore, we describe in the following subsections some data situations that provide us with less than ideal, but still useful, information on events. These data situations may apply equally well to marital status events, to family events, and to household events. Moreover, they may be generated by a sample survey, or by a wholecount (population census, or population registration system). Unless otherwise stated we shall not discuss these characteristics of the data source. Instead, we distinguish between continuous registration, a panel study, a retrospective survey, a system of repeated cross-sectional surveys, and finally the situation of one cross-sectional snapshot only. Hence, these situations range from the most to the least ideal, and from the least to the most defective.

2.4.2. Continuous registration data

In a continuous registration system, individuals are followed over time and the events they experience are recorded. In such a registration, both the type of each event and its time of occurrence are known. If this information would be available at the individual level, we would have the ideal situation sketched in the previous subsection (provided that sampling errors would be small). In that case we would have complete life-histories or event-histories of individuals, with the timing of all moves in a sequence (Tuma and Hannan, 1984, p. 20). However, more frequently one encounters the situation of a population registration system, where a statistical agency collects and processes the data, and publishes tables of events over a certain period. Hence the original individual data are aggregated over individuals and over time. This is the type of information which was used most often in the project, in order to fit the parameters of the marital status models.

Registration systems for family or household events exist in Denmark (Noordhoek and Petersen, 1984; Petersen, 1985; Noordhoek, 1989), but not in any other country we know of.

2.4.3. Panel data

Panel data record state occupancy of sample members at two or more points in time. Most often the panel is prospective, first selecting a sample or a population and next following its members forward in time. Retrospective panels work backwards in time, giving only information conditional on survival. These are discussed in subsection 2.4.4.

Usually, a panel comes in the form of a sample survey, but the sample size varies a great deal. For instance, in the panel investigation on changing fertility, parenthood, and family formation in Nordrhein-Westfalen, organized by the university of Bielefeld (FRG), 2620 women aged 18 to 30 years were interviewed in late 1981/early 1982 (Kaufmann *et al.*, 1982). In the second round, two years later, only 1472 panel respondents remained. In contrast, a large-scale panel is the 1 per cent Longitudinal Study organized by the Office of Population Censuses and Surveys which contains longitudinal data on a 1 per cent sample of the population of England and Wales (Murphy *et al.*, 1988). The population covered in 1971 amounted to 513,000 persons. Of these, an estimated 444,000 may have been alive and resident in Great Britain in 1981. In any case, a 91 per cent success rate is claimed for tracing these members in the 1981 Census of England, Wales, and Scotland. Murphy (1991) gives an illustration of household modelling on the basis of the 1 per cent Longitudinal Study, complemented with information from the 1981 Census, see subsection 2.2.3.

A specific type of panel data is that which is obtained by linking the records of successive Censuses. Data of this type have been used in the Swedish household model described in subsection 2.3.3: transition probabilities between various household types were computed for the period 1975-80 by matching individual records in the censuses of 1975 and 1980 (Dellgran *et al.*, 1984, p. 82). This information was supplemented with data on mortality, fertility, and migration.

2.4.4. Retrospective survey data

A retrospective survey records the respondents' current situation as well as their situation in the past. When historical information is confined to one particular moment in the past we speak of a retrospective panel. For instance, respondents may be asked to state their current household situation and their household situation five years ago. A retrospective life-history (event-history) survey gives all the events of interest as well as their timing. Both types of retrospective surveys presuppose that timing and type of events may be recalled accurately. Moreover, they can give information over the period covered by the questionnaire for survivors only. Mortality and emigration cannot be captured by such data collection system.

An example of a retrospective life-history survey is the 1984 Lifestyle Survey for the Netherlands. In early 1984 some 1600 individuals aged 18-54 years were retrospectively interviewed about their household histories of the past seven years (Klijzing, 1988). Data from this survey were used for fitting a prototype of the LIPRO-household model described in Chapter 6, see Keilman and Van Dam (1987). (The present version was fitted using a much larger data set, see subsection 2.4.7 and Chapter 6.)

2.4.5. Repeated cross-sectional data

There are numerous cross-sectional sample surveys repeated on a regular basis that routinely collect past and present household information. The main difference with a multi-round panel survey is, of course, that links between the household situation between two subsequent interview dates can only be given for the aggregate, not for individuals. Klijzing (1988) noted that few trend studies attempt to link up the differences in household composition, as observed between subsequent rounds. Part of the problem is that, from round to round, sample designs are frequently adapted to changing research objectives.

A repeated cross-sectional survey for which the household data are certainly not underutilized is the General Household Survey (GHS) in Great Britain. Established in 1971, the GHS has a standard sample size of around 15,000 private households each year (Barnes, 1979). Originally, the GHS primarily produced stock data on household composition, but since 1979 questions on family formation were included as well. These questions covered aspects such as length of current cohabitation and type of pre-marital cohabitation (Brown and Kiernan, 1981). Hence, since 1979 the GHS may be typified as a multiround retrospective survey.

2.4.6. One-time cross-section

The most defective data, but at the same time the data most frequently encountered, are those stemming from a single cross-section, without any retrospective element. This is typically the case for a census which includes questions on current household status. There is no longitudinal perspective, and fitting a dynamic model to data of this kind is, at first sight, impossible. Yet in Chapter 7 we propose an approach which can be followed in such a situation.

2.4.7. Demographic data used in Chapters 3, 5, and 6

The data used in the comparative study (see Chapter 3 by Gonnot) generally stem from continuous population registration systems. All twelve countries included in the study publish population structures by age, sex, and (legal) marital status. For nine countries the projections are based on the average population for the year 1985 (1986 for Canada). For Italy, Poland, and Czechoslovakia population structures by age, sex, and marital status are only available for census years — thus information from the most recent census was used (see *Table 2.1*).

Likewise, all countries publish tables on annual numbers of births (by mother's age), numbers of deaths (by age and sex), numbers of marriages (by age, sex, and previous marital status), and numbers of divorces (by age and sex). These events, taken from vital statistics and civil registration have been used to calculate period occurrence/exposure rates, whenever possible

Table 2.1. Period of reference for data used in Chapter 3

	Population data	Occurrence/exposure rates
Austria	1985	1980-84
Canada	1986	1981-86
Czechoslovakia	1980	1980-84
Finland	1985	1981-85
France	1985	1980-84
Germany	1985	1985
Hungary	1985	1980-84
Italy	1981	1981
Netherlands	1985	1980-84
Norway	1985	1985
Poland	1984	1984-85
Sweden	1985	1980-85

for the period 1980-85. Czechoslovakia is an exception, in the sense that period-cohort estimates have been used here.

Averages over several years have been used to eliminate irregular year-to-year fluctuations. Thus, occurrence/exposure rates are less sensitive for outliers, but they may over- or underestimate rates actually observed in 1985.

Fertility and mortality rates have originally been used broken down by marital status. Since this information is not available for all countries, and since there is no reason to support the opinion that marital status differentials in fertility and mortality will stay at their present levels, it was finally decided not to use marital status specific rates. This assumes, in fact, that fertility and mortality are independent of marital status. In Chapter 7 we will come back to this assumption.

Civil registration systems usually give information on legal marital status only. Actual living arrangements ('de facto marital status') are not registered, since already the initial event for a partner union, or its time of occurrence, is not unambiguous. Thus such de facto marital status data have to be taken from other sources.

The data used in the Austrian study (see Chapter 5 by Prinz) stem from the June 1986 Microcensus. The Austrian microcensus is a quarterly survey carried out by the Austrian Statistical Office and covering 0.9 per cent of the Austrian population or about 70,000 respondents. The basic program of the microcensus covers basic questions concerning characteristics of the population, the labour force and its working hours, private and institutional households, families, and housing conditions. In addition, special programs supplement the questionnaire on a non-regular basis. Within a special program of the June 1986 Microcensus, some 16,000 women between ages 20 and 59 were retrospectively interviewed about their complete nuptiality and fertility biography. After running through a labourious plausibility control, 15,060 cases with complete biographies have been used to prepare the data required for the model in Chapter 5.

Firstly, the microcensus information was used to construct the initial population as per 31 December 1985 for the simulation, i.e. the female population by age, marital status, and parity. Secondly, the number of jumps between statuses (events) were estimated on a monthly basis for the years 1981-86 to calculate monthly occurrence/exposure rates. To eliminate random fluctuations, average monthly rates for this period have been converted into yearly occurrence/exposure rates. The same data set has already been used in a study undertaken by the Demographic Institute of the Austrian Academy of Sciences (Aufhauser and Lutz, 1987). Part of the data adjustment procedure is taken from this study. For external events (births and deaths) data from the official database of the Austrian Statistical Office broken down by age and status were used.

The data used in the Dutch study (see Chapter 6 by Van Imhoff, in particular Section 6.3) stem mainly from the so-called 'Woningbehoeftenonderzoek 1985/1986' ('Housing Demand Survey 1985/1986'). The survey was carried out during the last few months of 1985 and the first few months of 1986. The data set covers 46,730 households, and it contains detailed information on, among other things, the household situation of the respondents at the time the survey was taken, and their household situation one year earlier.

The Housing Demand Survey 1985/1986 gives the household position of all individuals in the sampled private households at survey date. This information was used to construct the *initial population* as per 31 December 1985 for the simulation. By using additional information on numbers of persons living in institutions (broken down by sex, age, and marital status), the data stemming from the survey were adjusted so as to be in line with statistics on the population by age, sex, and marital status. Regarding *events*, Van Imhoff first computed for each combination of age and sex transition probabilities (i.e. probabilities to be in household position j at time t given one was in position i at time t-1), on the basis of the information on current household position and household position one year earlier. Each probability was next transformed into a jump intensity (reflecting the expected number of jumps from i to j per person year of exposure in state i). This procedure resulted in model parameters for internal events (i.e. events which do not cause an individual to leave the set of private households) only. For external events (death and migration), data from official statistics for the period 1981-85 broken down by age, sex, and marital status were used a proxy for the required information by age, sex, and household position. All age-specific intensities were calculated for five-year age groups. Further details are to be found in Section 6.3, and in the references of Chapter 6.

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3. DEMOGRAPHIC CHANGES AND THE PENSION PROBLEM: evidence from twelve countries

Jean-Pierre GONNOT

3.1 | Introduction

In all industrialized countries, there have been growing fears that the future ageing of the population challenges existing public pension systems. This has led to a heated debate with demography in the foreground, and to numerous and controversial reform proposals. This chapter reports on an international comparative study carried out at IIASA which addresses the major demographic aspects of the pension problem in a systematic way. Is ageing certain? Are fertility or migration a possible demographic answer to ageing? What will be the impact of ageing on average benefits? How much would it cost to maintain pensions at the present level? Would an increase in women's activity help solving the problem? Is a rise in age at retirement the key variable? Would a saving-type pension system perform better than the existing pay-as-you-go? What can be gained from burden-sharing between actives and retirees? Is an increase in productivity the miracle solution? These are the main questions to which quantitative answers are given.

The core of the study consists of a simulation of national state pension systems under a common set of demographic and labour force participation scenarios up to the year 2050. It includes 12 countries: Austria, Canada, the Czech and Slovak Republic, Finland, France, Germany, Hungary, Italy, the

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Netherlands, Norway, Poland, and Sweden.[1] For some of those countries, additional projections under alternative pension schemes and country-specific demographic and labour force participation scenarios were also prepared.

The comparison between countries and groups of countries (Eastern European versus Western European countries) offers an interesting international perspective and allows to gauge the responses of the different national pension systems to demographic ageing. The demographic and labour force participation scenarios have been designed according to a sequence which permits to estimate the respective influence of demographic changes and of changes in the age pattern of activity.

The methodology of this research is original in two respects. First, it makes use of dynamic projections of the population by marital status while previous works were only based on population projections by sex and age. The present approach allows for investigating social and distributional aspects which have largely been neglected —e.g., changes in the living arrangements of the elderly. It also significantly improves the accuracy of the modelling of survivor pensions as current changes in nuptiality and mortality no longer permit to estimate proportions widowed by simply using fixed ratios. Moreover, in many Western countries, marital status is relevant for contributions and old-age benefits because female participation in the labour force varies with marital status — it is much higher among unmarried women than among married or cohabiting women, and among the latter it decreases with the number of children. Different birth and marital histories result in different benefit entitlement and the marital histories are reflected in the marital composition of the elderly population. Modelling pensions therefore requires modelling family dynamics. This would preferably be done on the basis of de facto living arrangements which, at least in most Western countries, tend to substantially differ from the marital composition of the population. Unfortunately, as was stated in Chapter 1, very few countries can make the necessary information available.[2] It would also be desirable to keep track of the children living with the mother, but the demographic model which is needed is too complex for use in the context of an international comparative

[1] Since the project started in 1988, results for Germany are based on separate calculations for the former FRG and GDR.

[2] A description of a dynamic projection model of living arrangements and of the results of its application to the population of the Netherlands is presented in Chapter 6.

study. Consequently, family dynamics is reduced here to marital status changes.[3]

A second original feature of this work is that pension projections are country-based rather than scheme-based. In many countries, the state pension system does not consist of a unique scheme but encompasses several large schemes —blue- and white-collar workers, civil servants, self-employed, farmers, etc.— and possibly tens of small activity-based schemes. Each retiree may and usually does receive more than one pension from different schemes. As scheme-information systems are not linked at present, scheme-specific data only provide a partial view on pensions and cannot be aggregated to obtain statistics on retirees. Relevant information is thus extremely poor: in those countries with such a system, the total number of retirees, the average old-age benefits or the average number of years worked by the new retirees are not known. Obviously, scheme-based pension projections face the same limits. In addition, results of these projections are often difficult to interpret when both substantial sociodemographic changes and changes in the respective share of the different schemes occur. National projections were therefore preferred, assuming the entire population benefits in all countries from one single scheme and using indirect estimates of work-histories based on cohort/life-cycle rearrangement of labour force participation rates.

The demographic setting and the results of demographic projections are presented in the first part of this paper with emphasis on ageing and changes in the marital composition of the elderly population. The second part deals with pensions. It includes a comparison of state pension systems as well as labour and retirement patterns, a description of the pension model, and a discussion of the results of pension projections. The third part is devoted to assessing the possible impact of different pension reforms.

3.2 | Ageing and changes in living arrangements

3.2.1. Demographic setting

Since 1960, demographic developments of considerable social and economic significance have been observed in developed countries. The secular downward trend in fertility, observed since the end of the 19th century, which

[3] In Chapter 5, an application to the population of Austria, the dimension 'number of children born' was added to the dimensions age and marital status.

stopped or even reversed during the 1930s, resumed and fertility dropped to unprecedented low levels. Unparalleled changes have also occurred in the pattern of family formation. Nuptiality rates have markedly fallen and, in most countries, marriage has been increasingly delayed. Consensual union has often become common among young adults as either a transition to and from, or an alternative to, marriage. Divorce has strongly risen. And the proportion of births out of wedlock has strikingly enlarged. Mortality has substantially declined in Western countries —to the point where length of life for women has already gone beyond the 80-year mark in a few countries— while it has levelled off, especially for males, in most Eastern European countries.

Although industrialized countries have certainly become more homogeneous in vital rates, they still present a great deal of diversity. *Tables 3.1* and *3.2*, which give the basic demographic characteristics of the 12 countries included in the study for the period 1980-85, show that there exists no one-to-one relationship between levels of fertility, illegitimacy, and nuptiality.

Fertility was still above replacement level in Czechoslovakia and Poland in the first half of the 1980s —2.17 and 2.32 children per woman, respectively— while the total fertility rate was down to about 1.50 in Austria, Italy, and the Netherlands, and reached 1.40 in Germany. Sweden, an outlier in almost all respects, singles out with 44 per cent of births out of wedlock. Relatively high figures (between 13 and 20 per cent) were also observed in Austria, Canada, Finland, France, Germany, and Norway. On the contrary, the Central European countries as well as Italy and the Netherlands indicated much lower levels of illegitimacy (five to eight per cent). Nuptiality is high in Czechoslovakia, Hungary, and Poland, where more than 90 per cent of the women get married, much lower in Finland and Norway (less than 80 per cent) and in Sweden where only two-thirds of women were ever married. Correspondingly, age at first marriage is low in Eastern Europe —with a minimum of 21.3 years for women in Hungary— and maximum in Scandinavian countries (27.7 for women in Sweden in 1985). The difference in the mean age at first marriage between men and women lies between about two and three years. Divorce is nonexistent in Italy, still relatively low in Poland (17 per cent of those marrying in 1984-85, on the basis of marriage and marriage dissolution rates observed in these years), but concerns about one-third of marriages in Sweden.

During the period 1980-85, life expectancy at birth ranged from 64.7 years for men and 73 years for women in Hungary to respectively 73.8 and 80.2

Table 3.1. Demographic settings around 1980-85

	Population in 1985 (million)	Total fertility rate	Births to unmarried women per 100 total births	Proportion women ever married[d] (%)	Mean age at first marriage (1985)			Marriages ending in divorce[d] (%)
					Males	Females	Difference	
Austria	7.6	1.54	20	81	26.4	24.0	2.4	25
Canada	25.3	1.67	15	85	26.7	24.6	2.1	31
Czechoslovakia	15.2	2.17	6	95	24.3	21.9	2.4	26
Finland	4.9	1.69	14	78	27.5	25.4	2.1	26
France	55.2	1.88	14	83	26.4	24.3	2.1	22
Germany[a]	77.7	1.40	13	80	26.6	24.1	2.5	27
Hungary	10.6	1.84	8	93	24.3	21.3	3.0	30
Italy[b]	57.1	1.56	5	88	27.1	24.0	3.1	1
Netherlands	14.5	1.53	6	82	26.3	24.0	2.3	25
Norway	4.2	1.66	18	77	27.5	24.8	2.7	26
Poland[c]	37.2	2.32	5	94	25.0	22.6	2.4	17
Sweden	8.4	1.70	44	67	30.1	27.7	2.4	34

[a] FRG + GDR; 1985-86.
[b] 1981.
[c] 1984-85.
[d] Marital-status life-table statistics.

Table 3.2. Life expectancy at birth and at age 60, around 1980-85

	At birth			At age 60		
	Males	Females	Difference	Males	Females	Difference
Austria	69.1	76.8	7.7	16.7	20.7	4.0
Canada	73.1	79.8	6.7	18.4	23.2	4.8
Czechoslovakia	67.0	74.3	7.3	14.7	18.7	4.0
Finland	69.2	78.7	9.5	15.9	21.2	5.2
France	70.1	79.0	8.9	17.6	22.7	5.1
Germany[a]	70.0	77.0	7.0	17.0	21.2	4.2
Hungary	64.7	73.0	8.3	14.8	18.8	4.0
Italy[b]	71.3	78.3	7.0	17.2	21.5	4.3
Netherlands	72.2	79.7	7.5	17.7	22.9	5.2
Norway	71.7	79.3	7.2	18.0	22.6	4.6
Poland[c]	66.0	74.4	8.4	15.3	19.9	4.6
Sweden	73.8	80.2	6.4	18.1	22.4	4.3

[a] FRG + GDR; 1985-86.
[b] 1981.
[c] 1985-86.

years in Sweden. At age 60, the lowest life expectancy was observed in Hungary (14.8 years for men and 18.8 years for women) and the highest in Canada (18.4 years for men and 23.2 years for women). Although sex differentials in life expectancy are, in absolute terms, much lower at age 60, they dramatically affect the last phases of the life-cycle. On the basis of nuptiality and mortality rates observed for the period 1980-85 it was estimated that in Austria married women spend nine years widowed out of the 21 years they live beyond age 60 while corresponding figures for men are two years and 17 years, respectively.

3.2.2. Demographic scenarios

Intensity, timing, and sometimes direction of future demographic trends are uncertain. In most low fertility countries fertility has remained relatively stable in the recent past. Nobody really believes in a new baby boom, but some expect or desire fertility to return to replacement level. In other countries, a further drop is very likely but no one is able to suggest a lower limit. This is perhaps even more acute for mortality, which is decreasing rapidly at older ages in all Western countries and will play a major role in the future of ageing. It is also hard to imagine how mortality will change in countries such as Hungary and Poland. Worsening is not unlikely in the short term, but no one can believe that no improvement will occur in the long term. The future of nuptiality also bears a good deal of uncertainty. Will the fall in marriage and the rise in divorce continue, and how will this affect fertility? And last, the outlook for international migration is widely open. On the one hand, the potential for migration towards high income countries is enormous. On the other hand, restrictive migration policies are most favoured at present.

Two types of answers to these questions are proposed. First, a common set of demographic scenarios was designed. They are not aimed at producing realistic forecasts but rather at investigating the range of possible demographic changes and to study their impact in terms of ageing and changes in the marital composition of the elderly. Those common scenarios are also designed to allow international comparison and to bring a better understanding of the demographic processes. After different trials, four common demographic scenarios were selected:

1. A *Constant Rates Scenario* with rates remaining constant at their 1980-85 level which shows how much change is already embodied in the age and marital status structure of the population and serves as a basis for comparison.
2. A *Replacement Fertility Scenario* which assumes that fertility will gradually reach replacement level. Thus, for ten countries, it is a high fertility scenario while it corresponds to slightly decreasing fertility in Czechoslovakia and Poland, respectively.
3. A *Low Mortality Scenario* under which age specific mortality rates are decreased by 30 percent for women and 45 per cent for men. In terms of life expectancy at birth, it is roughly equivalent to an increase of 8-10 years for males and 4-5 years for females, so that the sex differentials are approximately reduced by one-half.
4. A *Western Low Rates Scenario* which combines the most extreme demographic rates observed in the period 1980-85 in Western Europe: West German fertility (1.28 children per woman), Swedish marriage and divorce (one-third never married, mean age at first marriage of 28 for women and 30 for men, one-third of all marriages ending in divorce), Swiss mortality (life expectation 74 for men and 81 for women).

All changes gradually take place over a transition period of 20 years, 1985-2005.[4] Mortality and fertility are assumed to be independent of marital status, an assumption which is aimed at neutralizing the impact of changes in the marital composition on overall mortality and fertility in order to control for these two variables.[5] In all four scenarios, net migration is set to zero.

The second type of answers to the questions asked above is the preparation, for nine countries, of country-specific scenarios, see *Table 3.3*. Country-specific scenarios can be seen as 'realistic' scenarios as far as the medium-term future is concerned, say till 2010. Based on assumptions which are very similar to those of the medium variant of the official national projections, they are aimed at depicting a most probable future.

For six countries, those national scenarios also provide an assessment of the demographic impact of international migration. In Austria and Canada, net migration is assumed to be twice the current level. In Germany, it is assumed that the country receives the 2.1 million Germans living in Eastern Europe between 1985 and 2000 in addition to the 520,000 migrants reported during the period 1985-90. A second scenario is based on the assumption of an additional 200,000 net migrants annually beyond the year 1990. In France net migration is assumed to remain at its estimated current level. In the Netherlands a decrease is expected from 25,000 annual net immigrants in 1985 to 20,000 in 1995. In Sweden the decline in the net number of immigrants is assumed to be steeper from 29,000 in 1988 to 10,000 in 2010.

National scenarios prepared for France and for Sweden also allow to assess the consequence of a continuous long-term decline in mortality. Under those scenarios, life expectancy at birth should reach 80.6 years for men and 88.6 years for women in France in 2050 and 78 years for men and 84.9 years for women in Sweden in 2025.

3.2.3. Ageing

Ageing is certain. But how much ageing? The scenarios' impact on ageing is summarized in *Table 3.4*, which shows countries according to changes in

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4 There exists no rationale for choosing a transition period of twenty years except it looks believable. However, calculations made using different transition periods show that conclusions are fairly robust and therefore depend only little on this assumption.

5 Arguments for and effects of this assumption are discussed in more detail in Chapter 7.

Table 3.3. National scenarios

	Date	Total Fertility rate	Life expectancy at birth: Males	Life expectancy at birth: Females	Marriage rates	Divorce rates	Average annual net migration
Austria	2005	1.61	76.1	81.7	constant	constant	15,000
Canada	2011	constant	77.2	84.0	constant	constant	148,000
Czechoslovakia	1995	1.63			2005: -50%	constant	0
	2030		75.1	78.8			
France	2050 I)	1.80	80.6	88.6	constant	constant	0
	II)	1.80	80.6	88.6	constant	constant	100,000
Germany	2005 I)	E: 1.50	73.0	79.0	-20%	120% FRG	85-90: 244,000
		W: 1.43	75.1	79.0	-20%	120% FRG	90-00: 140,000
	II)	E: 1.50	73.0	79.0	-20%	120% FRG	85-90: 244,000
		W: 1.43	75.1	79.0	-20%	120% FRG	90-50: 200,000
Hungary	2005 I)	constant	constant	constant	-15%	+20%	0
	II)	constant	71.0	77.0	-15%	+20%	0
Netherlands	2010	1.65	75.0	81.6	marriage -30%	+30%	85-95: 25,000
					remarr.: -20%		95-50: 20,000
Poland	2005	1.60	constant	constant	constant	constant	0
Sweden	2010 I)	1.90	75.7	82.2	constant	constant	85-10: 19,500
							10-50: 10,000
	2025 II)	1.80	78.0	84.9	constant	constant	85-10: 19,500
							10-50: 10,000

Table 3.4. Changes in the old-age dependency ratio between 1985 and 2030 (percentage points)

	Scenario				
	Constant Rates	Replacement Fertility	Low Mortality	Western Low Rates	National
30+			Germany Netherlands Canada		
25-30			Finland Italy Austria	Germany Canada Netherlands Finland	
20-25	Netherlands Canada Germany		France Norway Sweden	Italy Austria Hungary	Netherlands Canada Germany I France I
15-20	Finland Italy	Canada Netherlands	Norway	Poland France France II	Austria Germany II
10-15	Austria France Norway France	Germany Finland Italy	Poland Hungary	Sweden CSFR	Hungary II CSFR
5-10	Sweden Poland Hungary	Austria Norway Sweden Poland Hungary	CSFR		Poland Hungary I Sweden
0-5	CSFR	CSFR			

old-age dependency ratio (OADR) over the period 1985-2030 for each of the scenarios.[6]

Regarding the four common scenarios, four main conclusions arise from this table. Firstly, ageing is certain for all countries and scenarios, the only

[6] Number of persons 65 and over per 100 persons between 15 and 64 years.

exception being Czechoslovakia under the Constant Rates and Replacement Fertility Scenarios. However, sharp differences between countries and a marked dispersion can be noted. Canada, Germany, and the Netherlands are top-ranking countries and will see their OADR doubling and possibly tripling, reaching a level situated between 35 and 55 in 2030, while at the other end of the spectrum Czechoslovakia, Hungary, Poland, and Sweden will experience a more limited ageing (see also *Table 3.5*). Secondly, an increase in fertility will be of little help to prevent ageing until 2030 —the rise in the OADR will be between one and five points weaker than that in the Constant Rates Scenario— unless fertility jumps far beyond replacement level. Thirdly, further mortality improvements would lead to dramatic levels of ageing, especially for Western countries: the OADR is about one-third higher under the Low Mortality Scenario as compared with the Constant Rates Scenario, but it is impossible to tell if this is an upper limit. Fourthly, ageing in Eastern European countries could be as strong as in Western European countries, if fertility and mortality drop substantially and simultaneously as exemplified by the Western Low Rates Scenario.

Results from national scenarios mainly reflect the assumption made with respect to mortality. When moderate mortality changes are speculated, results are very close to that of the Constant Rates Scenario. This is the case for Canada, Germany, Hungary 1, the Netherlands, Poland, and Sweden. When mortality is expected to decline substantially —France 1 and Hungary 2— results are similar to that of the Low Mortality Scenario. Finally, when a strong decrease is assumed for both fertility and mortality, as for Czechoslovakia, results are analogous to that of the Western Low Rates Scenario.

A second important finding arising from national scenarios is that the impact of immigration on ageing is limited: minus three points in the OADR for Canada, minus four points for France and for Austria. Calculations for Austria (results not presented here) also showed that the effect of immigration on the OADR depends very much on the age pattern of migrants. If migrants to and from Austria would have an age pattern similar to that of migrants to and from Canada —i.e., an average age of about 31 years instead of 25 years— it would require an annual net number of migrants of 28,000 instead of the expected 15,000 to lower the OADR by five points by the year 2030.

Not only ageing but also the timing of ageing is certain. Typically, under constant rates assumptions maximum ageing will occur between 2015 and 2030. Between 2030 and 2045, changes in the OADR will be very limited,

Table 3.5. Old age dependency ratio, 1985 and 2030 (age group 65+ as a percentage of age group 15-64)

	1985	2030					
		Scenario					
		Constant Rates	Replacement Fertility	Low Mortality	Western Low Rates	Nat. I	Nat. II
Austria	21.2	35.6	32.0	46.1	44.7	39.6	
Canada[a]	15.7	37.6	35.2	47.3	43.4	36.5	
Czechoslovakia	17.1	20.9	20.9	28.2	33.8	29.4	
Finland	18.4	35.1	32.5	46.0	43.4		
France	19.7	31.6	30.4	40.2	39.1	40.0	36.1
Germany	21.1	41.1	36.0	53.2	49.0	41.5	38.4
Hungary	18.7	23.8	22.7	32.9	39.4	23.8	30.2
Italy	19.0	34.7	31.4	45.0	41.2		
Netherlands	17.6	40.6	36.3	41.3	43.7	38.5	
Norway	24.5	35.0	32.3	44.8	39.9		
Poland	14.5	21.2	22.1	28.2	34.6	24.2	
Sweden	22.9	30.9	28.1	38.5	35.0	29.7	32.1

[a] 2031.

ranging from a small additional ageing to a slight rejuvenation. This pattern is also observed under the high fertility and Low Mortality Scenarios. On the contrary, a fertility drop, as assumed in the Western Low Rates Scenario, implies that ageing will continue in all countries beyond 2030.

Table 3.6 shows that a great variety of changes in the size of the elderly population will be associated with ageing. In the three top ranking countries for ageing —Canada, the Netherlands, and Germany— the size of the elderly population would respectively double, increase by 84 per cent, and by 25 per cent in between 1985 and 2030 under the Constant Rates Scenario. Hungary would experience neither an ageing nor an increase in the size of its elderly population. Poland would experience a limited ageing while its elderly population would increase by a substantial 59 per cent — this apparent contradiction may be explained by a growth in the population of working ages which is only a little under that in the elderly population.

Sweden indicates both a limited ageing and a limited growth of the elderly population. If only a moderate decline in mortality occurs in the future (Low Mortality Scenario), the maximum growth of the elderly population will take place in most countries between 2000 and 2015 while if there is a strong decline in mortality (which is the case under the Western Low Rates Scenario for many countries) the elderly population will continue to grow rapidly beyond 2015. Over the period 1985-2030, the average growth rate of the population aged 60 and over would lie between about 0.5 and 1.5 per cent, depending on the country, under constant mortality, and between about one and two per cent under the Low Mortality Scenario.

Of great relevance to the pension issue are developments in the size of the labour force. Under the different demographic scenarios it was assumed that activity rates will remain constant at their 1985 levels. *Figure 3.1* displays changes in the size of the labour force between 1985 and 2030. It shows much variety in both direction and size among the different countries. Under constant demographic conditions, by 2030 the size of the labour force would increase by 23 per cent in Poland and by 13 per cent in Czechoslovakia, remain constant in France, and decrease in all other countries by between four per cent in Canada up to a dramatic 37 per cent in Germany. If fertility progressively returns to replacement level by 2005, it would only make a difference of about five to ten percentage points in the size of the labour force by the year 2030 (a longer projection period, e.g. until 2050, would have resulted in a larger effect of high fertility). Gains from a further decline

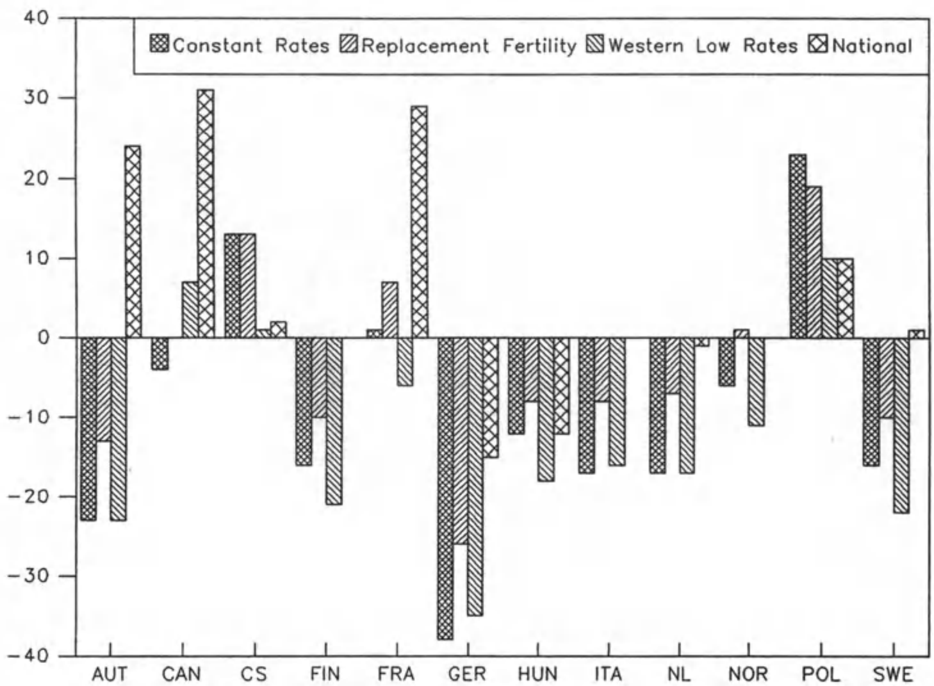
Table 3.6. Population aged 60 and over, 1985-2050. Constant Rates Scenario (constant mortality, constant fertility, no migration)

	1985	2000	2015	2030	2050
			Absolute (1000s)		
Austria	1,508	1,539	1,665	1,940	1,579
Canada	3,823	4,751	6,576	7,859	7,048
Czechoslovakia	2,536	2,558	3,127	3,190	3,364
Finland	861	968	1,228	1,278	1,102
France	9,973	11,309	13,219	14,935	14,098
Germany	16,050	17,676	18,124	20,087	14,789
Hungary	1,930	1,973	2,150	2,016	1,914
Italy	10,607	12,702	13,382	15,103	12,894
Netherlands	2,434	2,869	3,747	4,467	3,970
Norway	882	838	995	1,149	1,027
Poland	5,212	6,268	7,670	8,262	8,946
Sweden	1,930	1,872	2,175	2,217	1,934
			Index (1985 = 100)		
Austria	100	102	110	129	105
Canada	100	124	172	206	184
Czechoslovakia	100	101	123	126	133
Finland	100	112	143	148	128
France	100	113	133	150	141
Germany	100	110	113	125	92
Hungary	100	102	111	104	99
Italy	100	120	126	142	122
Netherlands	100	118	154	184	163
Norway	100	95	113	130	116
Poland	100	120	147	159	172
Sweden	100	97	113	115	100

in mortality would also be limited to a few percentage points, since mortality is relatively low at working ages.

As compared with the Constant Rates Scenario, the Western Low Rates Scenario implies an additional decrease of five to eight percentage points in Finland, France, and Hungary and of 12-13 points in Czechoslovakia and Poland. This contrasts with low fertility countries (Austria, Germany, the Netherlands, and Italy) where no additional changes are observed. Largest differences with the Constant Rates Scenario are observed in national

Figure 3.1. Change in the total labour force, 1985-2030 (percentage)



scenarios assuming a net inflow of migrants — plus 48 percentage points in Austria, plus 35 in Canada, 28 in France, 20 in Sweden, and 16 in the Netherlands.

3.2.4. Major potential changes in living arrangements

The current marital composition of the population aged 60 and over mostly reflects sex differentials in mortality and is characterized by a strong contrast between the high proportion of males married (between 69 and 82 per cent in our sample) and the much lower proportion of females married (between 35 and 49 per cent). Also, the percentage of single and divorced for both sexes is low, between 2.7 and 13.4 per cent single, the proportion being slightly higher for women than for men, and between 2.7 and 7.4 per cent divorced, Italy excluded (see *Table 3.7*).

Figures in Table 3.7 indicate that this pattern will change substantially. A main future demographic trend is definitely the strong increase in the

Table 3.7. Marital composition of the population aged 60 and over, 1985 and 2030 (percentage, total equals 100 for each sex)

	Males				Females				Sex
	Single	Married	Divorced	Widowed	Single	Married	Divorced	Widowed	Ratio[a]
Austria									
1985	5.8	77.4	3.4	13.4	11.0	34.7	5.1	49.2	56.9
2030									
constant rates	16.1	65.1	7.1	11.6	13.8	35.7	11.0	39.5	74.4
low mortality	15.1	65.1	7.1	12.7	13.2	43.9	11.0	31.8	88.1
western low rates	18.1	54.5	12.2	15.2	13.6	37.1	16.4	33.0	77.3
national	16.2	62.2	7.6	14.0	12.5	39.8	10.5	37.1	80.7
Canada									
1985	7.5	79.2	2.7	10.5	7.9	49.0	2.8	40.3	77.1
2030									
constant rates	12.1	65.4	9.0	13.5	9.0	39.7	12.1	39.3	76.2
low mortality	11.3	65.1	9.6	14.0	8.7	47.1	12.9	31.3	88.6
western low rates	15.9	56.4	13.8	13.9	10.5	35.4	16.1	37.9	74.5
national	10.5	68.0	9.1	12.4	8.2	43.5	11.7	36.6	77.2
Czechoslovakia									
1985	4.3	77.6	3.6	14.5	5.2	38.6	4.6	51.6	68.2
2030									
constant rates	9.0	66.3	7.9	16.8	4.6	31.5	11.3	52.6	69.8
low mortality	8.6	65.3	7.9	18.2	4.5	42.0	11.4	42.2	86.4
western low rates	10.3	56.7	17.3	15.7	5.0	34.2	18.7	42.1	77.0
national	11.5	59.7	11.4	17.4	5.8	36.5	14.0	43.7	80.8

Finland									
1985	8.5	73.6	4.8	13.2	13.4	36.1	6.2	44.2	59.5
2030									
constant rates	24.0	51.7	11.6	12.7	16.5	28.6	14.6	40.3	69.0
low mortality	22.4	51.4	11.8	14.3	15.8	36.4	14.8	33.0	84.4
western low rates	23.5	48.7	14.1	13.8	16.1	30.8	17.5	35.5	77.1
France									
1985	7.9	76.2	2.8	13.1	8.6	42.3	3.6	45.5	68.9
2030									
constant rates	16.1	63.4	7.4	13.1	11.8	35.7	10.3	42.3	71.5
low mortality	15.1	62.9	7.3	14.7	11.3	44.1	10.2	34.4	85.3
western low rates	17.2	56.8	12.7	13.3	12.5	35.4	14.8	37.3	76.5
national I	15.4	64.9	7.4	12.4	11.2	40.4	10.2	38.2	76.1
national II	15.4	65.1	7.4	12.0	11.2	41.1	10.2	37.6	77.3
Germany									
1985	3.7	78.2	3.1	15.0	8.3	37.8	5.2	48.6	58.9
2030									
constant rates	21.3	59.0	7.2	12.5	13.1	35.9	9.8	41.2	78.4
low mortality	19.5	58.6	7.0	14.9	12.4	43.8	9.8	34.0	92.1
western low rates	22.5	52.5	12.8	12.1	13.0	33.7	15.9	37.4	78.6
national I	19.4	59.9	7.9	12.8	10.4	38.6	10.4	40.6	79.8
national II	18.4	60.5	8.0	13.1	9.9	39.2	10.6	40.3	79.7

Table 3.7. *(continued)*

	Males				Females				
	Single	Married	Divorced	Widowed	Single	Married	Divorced	Widowed	Sex Ratio[a]
Hungary									
1985	3.7	77.3	3.4	15.7	5.7	37.1	5.2	52.1	68.2
2030									
constant rates	10.6	64.2	9.0	16.2	4.4	28.0	13.8	53.8	67.6
low mortality	9.9	63.5	8.9	17.7	4.3	37.9	13.9	43.9	84.9
western low rates	11.6	56.1	16.5	15.8	4.8	32.2	19.3	43.7	76.1
national I	12.1	60.7	11.6	15.6	4.4	29.9	15.7	49.9	67.6
national II	11.5	57.8	11.3	19.4	4.4	27.5	15.4	52.7	77.4
Italy									
1985	6.8	79.4	0.3	13.5	12.4	41.9	0.3	45.4	72.2
2030									
constant rates	11.3	72.8	0.9	15.0	8.3	42.0	1.6	48.0	75.4
low mortality	10.7	71.3	0.9	17.1	8.3	42.0	1.6	48.0	72.2
western low rates	15.2	61.1	10.0	13.7	10.0	38.1	9.6	42.2	76.5
Netherlands									
1985	6.0	78.2	3.3	12.5	9.6	46.2	3.9	40.4	73.9
2030									
constant rates	18.7	60.8	9.3	11.2	12.4	37.7	13.0	36.8	76.1
low mortality	17.3	61.1	9.3	12.3	11.8	45.3	13.0	29.9	88.4
western low rates	19.6	55.3	12.2	12.9	12.9	36.3	16.0	34.9	78.3
national	21.3	54.9	12.1	11.7	13.3	36.6	14.9	35.2	80.1

Norway									
1985	11.1	73.4	3.1	12.4	11.9	45.7	3.7	38.7	77.2
2030									
constant rates	21.9	54.0	11.7	12.4	14.3	34.7	14.2	36.8	78.0
low mortality	20.1	53.9	11.8	14.2	13.5	41.8	14.1	30.6	91.1
western low rates	23.2	50.9	13.7	12.1	15.0	34.1	16.0	34.9	79.7
Poland									
1985	2.7	82.0	2.1	13.2	6.9	39.8	2.7	50.6	64.7
2030									
constant rates	9.1	71.2	3.8	15.9	4.9	32.8	7.9	54.5	68.2
low mortality	8.7	70.8	3.7	16.8	4.8	43.7	8.2	43.3	85.0
western low rates	11.3	58.3	14.0	16.4	5.8	35.5	16.1	42.6	77.6
national I	9.4	73.8	3.9	12.8	4.8	38.1	7.9	49.2	68.2
Sweden									
1985	11.8	69.1	6.8	12.3	10.4	45.0	7.4	37.3	79.3
2030									
constant rates	33.2	41.5	14.7	10.6	24.4	27.0	17.6	30.9	78.6
low mortality	30.8	41.5	15.0	12.7	22.9	32.5	17.8	26.8	91.2
western low rates	32.7	41.3	15.5	10.5	24.3	27.0	17.4	31.2	77.1
national I	32.0	42.5	15.0	10.6	23.0	29.5	17.6	29.8	80.7
national II	35.5	40.0	14.2	10.3	27.8	28.0	16.6	27.5	81.4

[a] number of men per 100 women.

proportion of single and divorced old men.[7] While today they together represent no more than ten per cent (except in the Scandinavian countries), they would be between 20 and 30 per cent in 2030 in Austria, Canada, France, Germany, Hungary, and the Netherlands, between 30 and 35 per cent in Finland and Norway and almost 50 per cent in Sweden under constant demographic conditions. Czechoslovakia, Italy, and Poland show lower values but will still experience a marked rise. While the Western Low Rates Scenario adds an additional four to ten points to the percentage divorced, scenarios make little difference on the percentage single — about two to three percentage points, with the exception of the Western Low Rates Scenario for Canada and Italy. As very limited changes in the proportion of widowed among males aged 60 and over are expected (between 10 and 15 per cent of elderly men are widowed under all scenarios) the increase in the proportion of single and divorced will result in a sharp drop in the proportion of males married.[8]

Trends in the marital composition of the female elderly population are more complex to picture. The change in the percentage of elderly females who are single is likely to be limited in most countries —plus or minus four points— with the noticeable exception of Sweden where 23 to 28 per cent of women aged 60 and over will be single in 2030. On the contrary, the increase in the percentage divorced will be slightly steeper for females than for males because of their lower probability to remarry (remarrying males relatively often marry a never-married female). The magnitude and, sometimes, the direction of change in the proportion of widowed women —ranging at present from about 40 to 50 per cent— are somewhat uncertain. Under constant conditions, the percentage of widows would decrease by nine percentage points in Germany between 1985 and 2030, by six percentage points in Austria and in Sweden, and by three to four points in France and the Netherlands. It will increase by four points in Poland while little change would be observed in other countries (see *Figure 3.2*). Under the Low Mortality Scenario, the percentage of widows would decrease in all countries by a

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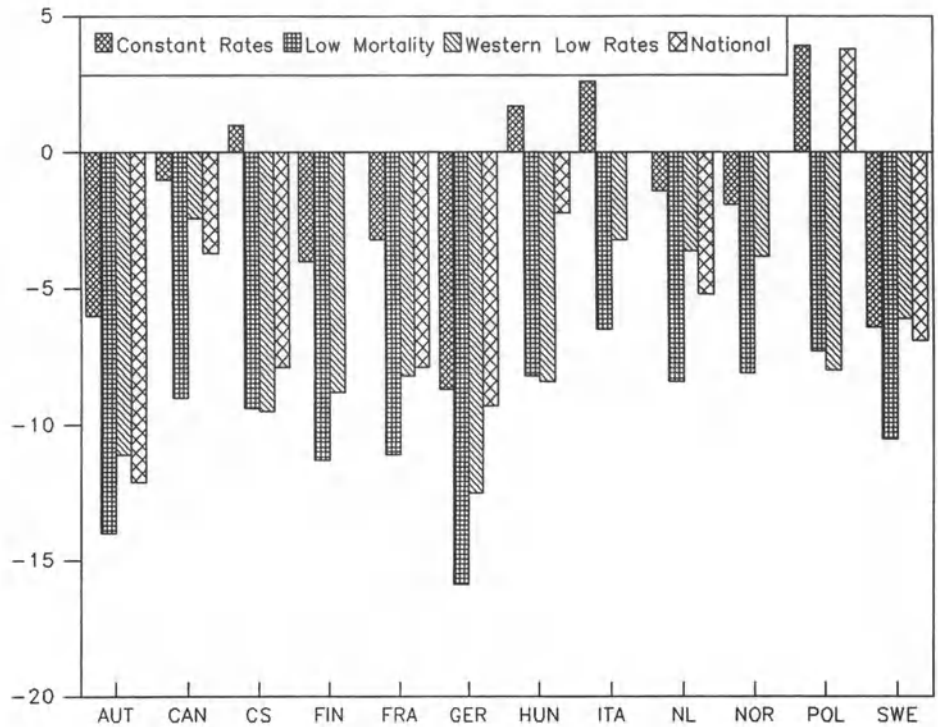
7 Results from de facto living arrangements projections for the Netherlands suggest the same trend for elderly men living alone (but also for elderly lone women). See Chapter 6 by Van Imhoff.

8 Under all scenarios, mortality is assumed to be independent of marital status. Since the risk of death for single and divorced males is markedly higher than for married males, this could, every other thing being equal, moderate somewhat the rise in the proportion single. For a quantitative assessment of this effect, see Chapter 4, and the paper by Bengtsson and Kruse on Sweden (listed in the appendix to this volume).

Figure 3.2. Changes in the proportion widowed, 1985-2030. Women aged 60 and over



minimum of 6.5 percentage points in Italy to a maximum of 17.5 percentage points in Austria between 1985 and 2030.

At the same time, with the sex gap in mortality progressively reduced to one-half of its 1985 level, the sex ratio would increase to values over 80 in 2030. Under the Western Low Rates Scenario, the percentage of widows would also fall in all countries. However, the decline would be more limited than that under the Low Mortality Scenario. Under national scenarios, declines of various magnitude in the percentage of widows are to be expected in Czechoslovakia, France, Germany, the Netherlands, and Sweden while little change would occur in Hungary and Poland. As a consequence of the uncertainty regarding trends in the percentage of widows, changes in the percentage of older women who are married appear to be rather unpredictable for all countries but Sweden where a strong fall is to be expected.

3.3 | Sociodemographic changes and the future of state pension systems

3.3.1. State pension systems

A simplified synopsis of the different national pension systems is presented in *Table 3.8*. These systems comprise four types of income maintenance programs: old-age, early retirement, and survivor pensions. Five countries have universal flat-rate old-age pensions: Canada, Finland, the Netherlands, Norway, and Sweden. Under such a system, everybody receives a pension of the same basic amount. In Canada and in the three Scandinavian countries, the public pension system is two-tiered and also provides a supplementary earnings-related old-age pension based on past work income. All other countries included in this study have pure earnings-related public pension systems. The Netherlands single out as being one of the few countries in the world which offers only flat-rate benefits to its elderly.

All countries in this study allow early retirement under either disability or another program as well as provide pensions to widows. Widows' benefits represent a fixed share of the earnings-related old-age pension of the deceased husband. Consequently, in countries with universal pensions this concerns only the earnings-related part, and no survivor's pension is paid in the Netherlands above pensionable age. In Czechoslovakia, Hungary, and Poland widows can chose between their own old-age pension, if any, or the widow's

Table 3.8. Simplified national pension schemes

	Old-age		Early retirement		Survivors	
	Universal	Employment-related	Disability	Other	Males	Females
Austria		x	x	x	x	x
Canada	x	x	x		x	x
Czechoslovakia		x	x			x
Finland	x	x	x	x		x
France		x	x	x	x	x
Germany		x	x	x	x	x
Hungary		x	x		x	x
Italy		x	x	x		x
Netherlands	x		x	x		x
Norway	x	x	x		x	x
Poland		x	x			x
Sweden	x	x	x	x	x	x

pension but these two pensions cannot be added. Seven countries have recently taken general provisions to pay survivor pensions to widowers: Austria, Canada, Czechoslovakia, France, Germany, Norway, and Sweden. All countries with a pure earnings-related system, with the exception of Germany, have also programs aimed at providing minimum income to no- or low-income elderly. This is also the case in Canada where the rate of the universal pension is relatively low and where, at present, only less than six in ten elderly aged 65 and over receive an employment-related pension.

The employment-related component in the state pension system widely differs in organizational complexity from one country to another. This ranges from a unique scheme under which the entire working population is enrolled —like in Hungary— to about one hundred of activity-based schemes — like in France. Main schemes usually encompass that of salaried workers— possibly, blue-collar, white-collar and private sector employees, civil servants, self-employed and farmers/agricultural workers and typically differ as regards to both contribution and benefits rules. In what follows, comparisons are based on the characteristics of national salaried workers pension schemes.

Typically, earnings-related benefits are calculated using the formula:

yearly benefit rate * number of years insured * salary

Table 3.9 displays the value of the parameters used in the calculation of benefits in the different national pension systems. Years of enrolment in the pension scheme are accounted for at rates from 1.33 per cent (France) up to 2.75 per cent (Poland).

The number of years of enrolment in the program corresponding to full pension varies from 20 years for women and 25 years for men in Poland —the only country where requirements differ according to the sex of the retiring person— to 45 years in Austria. *Figure 3.3* shows how the national systems differ in terms of old-age benefits granted according to the number of years worked. Countries can be classified into three groups. First are the countries with pure earnings-related systems: Austria, Czechoslovakia, France, Germany, Hungary, Italy, and Poland. Among these countries, benefits are the highest in Italy: 80 per cent of the salary for 40 years worked and the lowest in France and Poland: 53 and 55 per cent respectively of the salary for 40 years worked. Secondly, there are the countries with two-tiered systems: Finland, Norway, and Sweden. Minimum benefits for those who have never worked are equal to the universal pension and represents

Table 3.9. Main components of earnings-related pension benefits. Salaried workers scheme

	Yearly benefits rate	Years of contribution for full pension	Full pension as percentage of earnings basis	Income basis (years)	Indexing provisions
Austria	1.9+1.5	30+15	79.5	last 10	wage
Canada	—	—	25	average	price
Czechoslovakia[a]	2.0+1.0	25+10	60	last 5/10	
Finland	1.50	40	60	average	wage & price
France	1.33	37.5	50	highest 10	wage
Germany	1.50	45	67.5	average	wage
Hungary	1.78	42	75	last 3	partly price
Italy	2.00	40	80	last 5	wage
Norway	1.125	40	45	best 20	wage & price
Poland	2.75	20[b]	55	last	partly price
Sweden	2.00	30	60	best 15	price

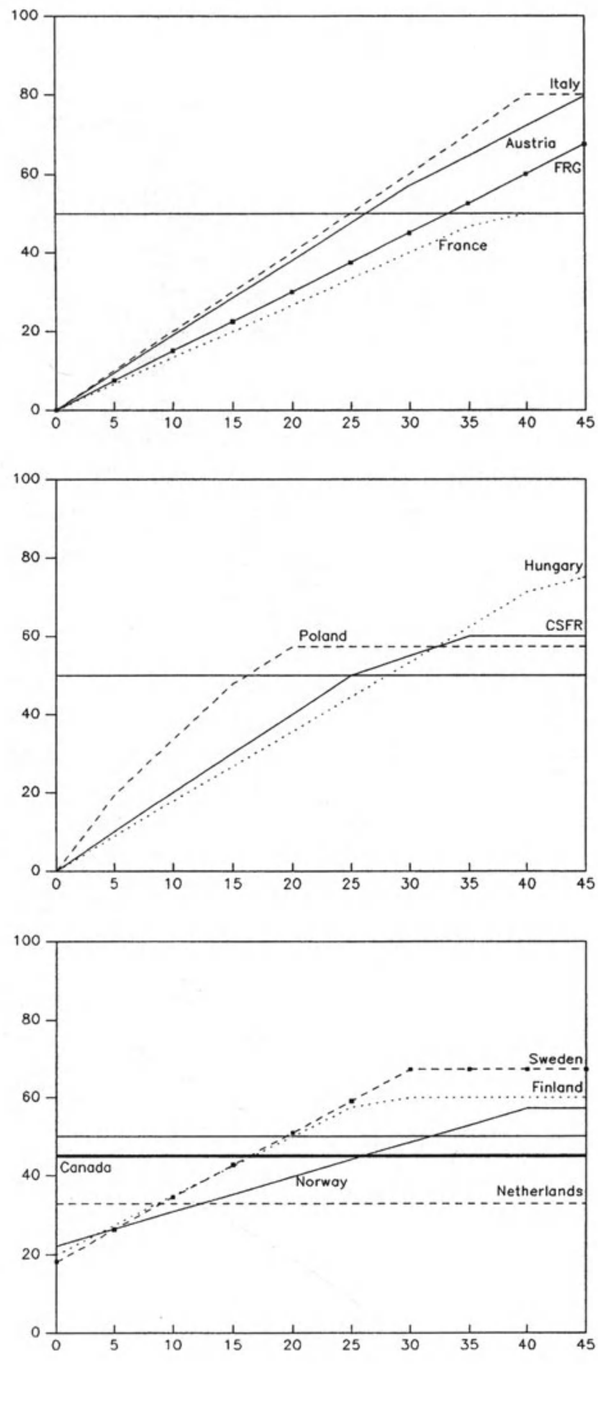
[a] Salaried workers in category 3 (non-arduous work).
[b] Women: 20 years; men: 25 years.

approximately 20 per cent of the average salary while total benefits —i.e. universal pension plus employment-related benefits— amount to 60, 57, and 67 per cent respectively in Finland, Norway, and Sweden.

Therefore, for low and medium numbers of years worked, benefits are likely to be higher in countries with two-tiered systems. However, an exception is Poland where the benefits first increase with duration and remain constant after 20 years worked. Similar ceilings are indicated in Czechoslovakia, Finland, Germany, Norway, and Sweden, but only at high duration. It should also be noted that, in all countries, there exists a 'ceiling' for earnings-related benefits and thus, those figures do not apply to high salaries. Thirdly, there are countries with pure or quasi-pure universal pension systems: Canada and the Netherlands. Benefits represent about 33 per cent of the average earnings for single retirees in the Netherlands and 45 per cent in Canada, and only 25 per cent for those who have never worked.

A great deal of variety is observed with respect to the income basis for calculating benefits (see Table 3.9): last year, last three, five, or ten years, best 10, 15, or 20 years, and the whole working life. In all Western countries included in this study, benefits are automatically indexed for either wage

Figure 3.3. Benefits as a percentage of salary according to the number of years worked



increase —in Austria, France, Germany, Italy, for price increase— in Canada and Sweden —or for price and wage increase— in Finland and Norway. On the contrary, only limited provisions for price increase were indicated in Hungary and Poland and no provisions in Czechoslovakia. Survivors pension benefits often represent between 50 to 60 per cent —minimum of 40 per cent in Sweden and maximum of 80 per cent in Poland— of the earnings-related pension of the deceased spouse (see *Table 3.10*). Survivor pension benefits in the Netherlands are a fixed amount.

Marked differences are also observed in the funding resources of pension schemes. In Czechoslovakia, Hungary, and Poland, as well as in Norway, no specific contribution exists for pension programs and pensions are financed out of the overall Social Security contribution of employees and employers. In Canada, the contribution rate is very low —3.6 per cent— and pensions are primarily financed out of the budget of the State and other public bodies. In countries with pension contributions, rates vary greatly between employees and employers and in total value (see *Table 3.11*). There is no employee contribution in Sweden, whereas it amounts to approximately 27 per cent of the so-called premium salary in the Netherlands.[9]

Table 3.10. Survivors benefits (per cent of earnings-related pension of deceased spouse)

Austria	60
Canada	60
Czechoslovakia	60
Finland	50
France	52
Germany	60
Hungary	50
Italy	60
Norway	55
Poland	80
Sweden	40

[9] The premium income is equal to the annual tax income decreased by an amount which varies according to the household situation of the individual. Calculations were made assuming a contribution rate of 16.66 per cent (estimated on the basis of total contributions relative to the total gross wage sum as of 1985).

Table 3.11. Contribution rates to pension programs: old-age, survivors, invalidity, and death (per cent of gross salary)

	Employee	Employer	Total
Austria	10.25	12.45	22.70
Canada	1.80	1.80	3.60
Finland	2.05	16.60	18.65
France	5.80	8.20	14.00
Germany	9.35	9.35	18.70
Italy	7.15	17.06	24.21
Netherlands	27.75[a]	5.75[a]	33.50[a]
Sweden	—	19.45	19.45

[a] Per cent of 'premium' income, see footnote 9.

On the other hand, the contribution of Swedish employers represents about 20 per cent of the salary while those in the Netherlands pay less than six per cent. Germany and Canada have opted for equal contributions. Overall pension contribution rates range from 14 per cent in France to 24 per cent in Italy.

3.3.2. A simplified projection model for pensions[10]

Projecting pension expenditures under a universal pension scheme is straightforward as per capita benefits vary only with marital status. Under an earnings-related or a two-tiered system calculations of benefits are more complex. As already mentioned, earnings-related benefits received by an individual can be expressed as the product:

yearly benefits rate * number of years insured * premium salary

If the upper limit on taxable income is ignored, this formula also holds at the aggregate level:

benefits = yearly benefit rate * average number of years insured * average past gross salary * population retired

If we assume that past salaries are re-evaluated according to the increase in average salary between the different years of activity and the retirement date

[10] This model is an extension of the one proposed by Malabouche (1987).

and that benefits are indexed for wage increase, the formula for benefits at the aggregate level becomes:

benefits = yearly benefit rate * average number of years insured * average gross salary * population retired

where only knowledge of the current average salary is needed to calculate the overall benefits served.

As mentioned in Section 3.1 of this chapter, female work histories depend on marital histories. The average numbers of years worked for females in the different marital statuses were therefore estimated from a cohort/life-cycle rearrangement of period sex-, age-, and marital status-specific activity-rates — for men, except for Canada, no difference in activity by marital status is assumed despite the fact that in some countries there exist marked discrepancies. The rationale for a cohort rearrangement of period activity rates is that an activity rate of 80 per cent at age 40 in 1970 is equivalent to an average of 0.8 years worked for the members of the cohort 1930. A main simplifying assumption of the model is that within a cohort, all retirees have the same number of years worked, measured at the mean age at retirement even if they retire before this age. It is also assumed that all women who get married do so at the mean age at marriage, all those who get divorced do so at the mean age at divorce, and all widows who become widowed before the mean age at retirement do so at the same mean age at widowhood. Women who become widowed after retirement age are considered married with respect to work history. As the classical marital status projection model does not distinguish between these two types of widows, it was decided to distribute them according to the proportion observed in the stationary population associated with the marital status life table (observed widowhood versus no widowhood beyond retirement age).

The number of retirees by sex and age is generally not available from social security sources. Attempts were made to estimate the proportion retired by sex and age from labour surveys and micro-census. Results were disappointing and suggest large sampling errors. In two countries, the estimated number of male retirees between age 70 and 80 turned out to be greater than the total population of that age group. In five countries, the estimated proportion retired did not follow any regular age pattern. Therefore, the proportion retired by sex and age was estimated from the age pattern of the new retirees observed in 1985, assuming it depicts the behaviour of a hypothetical cohort. Average survivor's pension benefits were simply assumed to be equal to the product of the average old-age pension of the other sex and the proportion paid to the survivor. It is important to note that benefits calculated using this method are per capita pension benefits and not per beneficiary benefits.

Contributions are easily calculated as the product of the labour force by the payroll tax rate and the average gross salary, once labour force is estimated using sex-, age-, and marital status-specific activity rates.

This pension model has been developed to account for the impact of changes in the sex, age, and marital composition of the population on earnings-related pension schemes, and thus is designed to be used in connection with projections of population by marital status. It is aimed at picturing the behaviour of the key demographic and socioeconomic variables involved in the dynamics of changes. However, due to simplifying assumptions and difficulties to give a rational basis to the behaviour of some variables, estimates of benefits can differ somewhat from observed data.

3.3.3. Retirement, work, gender, and marital history

Table 3.12 gives the pensionable age (old-age) for men and women as well as an estimate of the mean age at retirement in 1985 in the different countries included in this study.[11] Figures in this table largely illustrate the importance of early retirement practices, especially for males, and the gap between legal provisions and reality. Males are eligible for pension at age 60 in Czechoslovakia, France, Hungary, and Italy, and at age 65 in the other countries with the exception of Norway where pensionable age is 67.

Pensionable age for females shows much variety: from 53–57 years in Czechoslovakia —depending on the number of children born to the woman— and 55 years in Hungary and Italy up to 67 years in Norway. Males and females are eligible for old-age pension at the same age in Canada, Finland, France, Germany, the Netherlands, Norway, and Sweden while in the other countries females are usually eligible five years earlier than males. Estimates of the mean age at retirement in 1985 vary from 59.2 years in the Netherlands and Poland, for males, and from about 56 years in Hungary and Italy, for females, to 64.9 years for both males and females in Norway. In France and Italy, the mean age at retirement is higher than the pensionable age for both sexes while the reverse situation is observed in all other countries.

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[11] Mean age at retirement of new retirees 50 and above.

Table 3.12. Pensionable age and mean age at retirement in 1985[a]

	Pensionable age		Mean age at retirement	
	Males	Females	Males	Females
Austria	65	60	59.8	58.9
Canada[b]	65	65	63.1	63.4
Czechoslovakia[b]	60	53-57	59.3	56.4
Finland	65	65	62.7	63.4
France[b]	60	60	61.6	61.6
Germany[c]	65	65	60.5	61.6
Hungary	60	55	59.6	56.0
Italy [b,d]	60	55	60.6	56.1
Netherlands[b]	65	65	59.2	57.5
Norway	67	67	64.9	64.9
Poland	65	60	59.2	57.0
Sweden	65	65	63.0	63.0

[a] Old-age and disability pensions (claimants for disability pensions aged 50 and over).
[b] Mean ages estimated.
[c] Former FRG.
[d] 1988.

Females retire on average at older age than males in Canada, Finland, and Germany, —respectively, 0.3, 0.7, and 1.1 years older— at the same age in France, Norway, and Sweden, and at lower age in the other countries included in this study, the maximum difference observed being 4.5 years in Italy.

Although men and women retire at quite similar ages they have very different working histories (see *Table 3.13*[12]). Male work patterns differ only slightly from one country to another. In 1985, the average number of years worked at mean age at retirement can be estimated at 40/43 years for men.

On the contrary, there exist wide discrepancies in women's economic activity which are reflected in the average number of years worked; from 13 years in the Netherlands to about 29 years in Finland. However, working behaviour

[12] In this and subsequent tables, all social security related calculations for Germany refer to the FRG only. Re-unification of the two Germanies made the old GDR pension system obsolete, and adding FRG and GDR results (as was done in the demographic part) would give irrelevant figures.

Table 3.13. Average number of years worked at mean age at retirement[a] (constant labour force participation rates)

	1985		Changes 1985/2030	
	Males	Females	Males	Females
Austria	40.3	22.6	-3.5	5.0
Canada	42.2	17.1	-2.5	14.1
Czechoslovakia	41.7	25.1	-2.3	8.8
Finland	42.1	29.1	-4.3	6.4
France	41.9	21.8	-3.1	5.0
Germany	42.0	24.2	-3.1	3.2
Hungary	40.3	18.3	-1.8	11.1
Italy	40.2	15.2	-2.6	4.3
Netherlands	40.6	13.0	-4.7	7.3
Norway	45.3	16.3	-2.7	14.4
Poland	40.4	27.5	-3.5	1.3
Sweden	43.2	21.0	-2.3	12.9

[a] Indirect estimate.

has recently changed tremendously (see *Figure 3.4*). In most if not all countries, and for both sexes, activity at older ages has decreased following early retirement which leads in turn to a lowering of or a larger variation in the actual age at retirement. Male activity has slightly decreased while female participation in the labour force has markedly increased, thus reducing the gap between men and women.

A similar pattern of activity for men and women is now observed in Czechoslovakia, Finland, and Sweden. On the other hand, in Italy and the Netherlands, female activity is still low. The changes in working behaviour will result in tremendous changes in the female average working life: even under ceteris paribus conditions it will be raised by 6.5 years on average by 2030 —plus 14 years in Canada and plus 11 years in Hungary— corresponding to an increase of one-third in benefit entitlement, while it will decrease by about three years on average for men, a fall of 5–7 per cent.

Among women, sharp discrepancies also result from different marital histories in certain countries. In 1985, the average number of years worked by married women was lower than that of single women by between 7.5 and

Figure 3.4. Labour force participation rates, females and males, 1970 and 1985

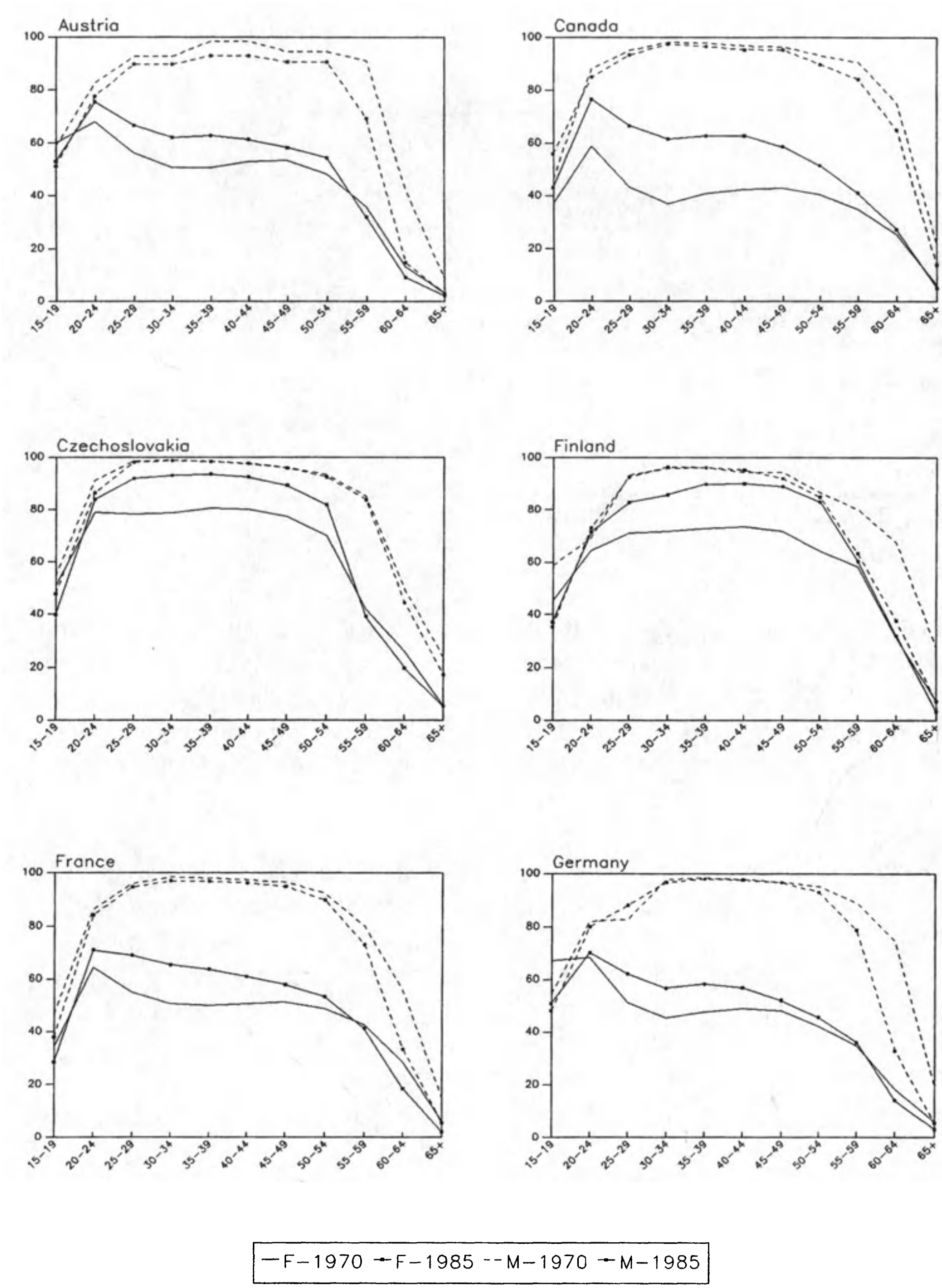

Figure 3.4. (continued)

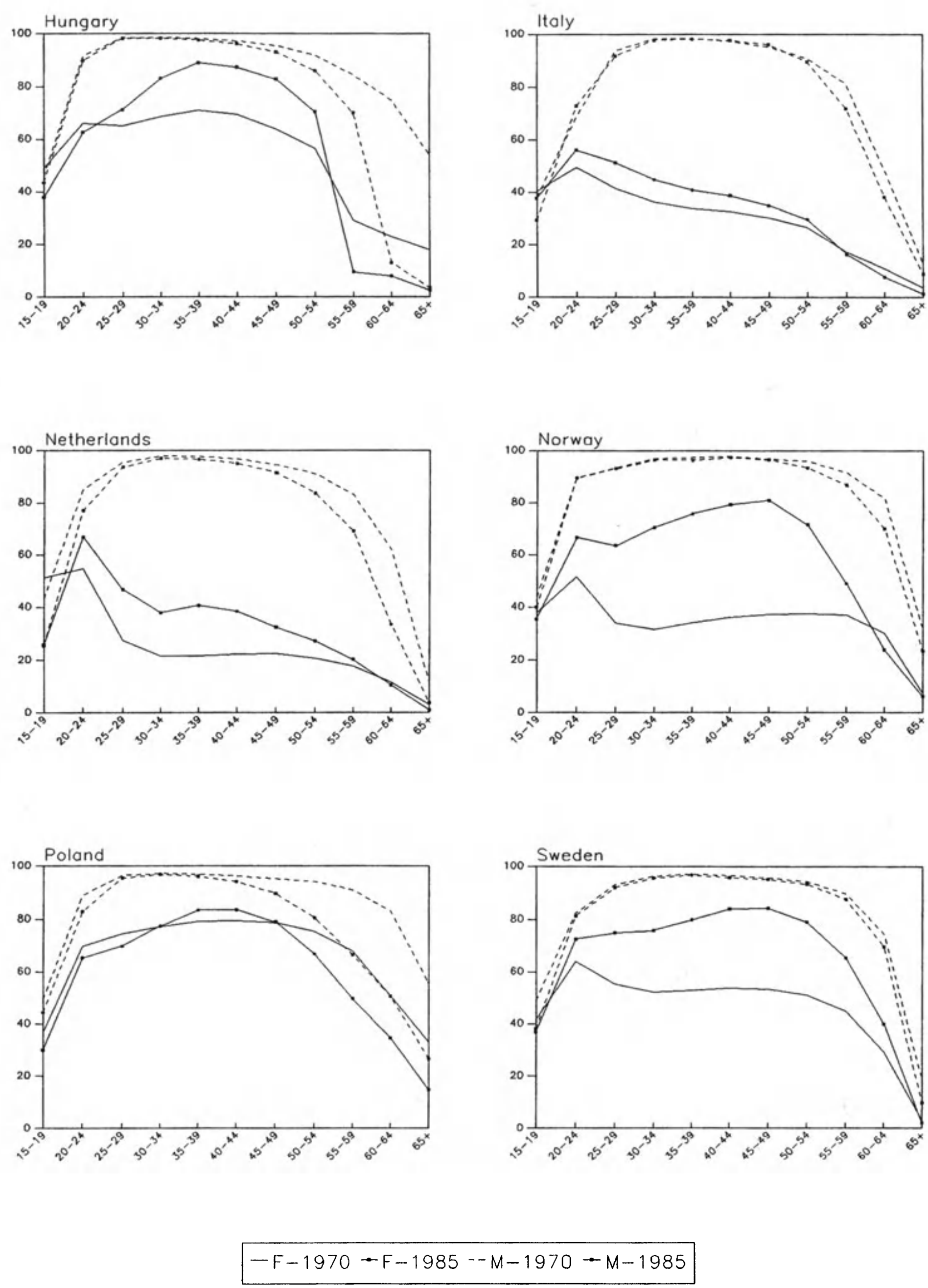

Table 3.14. Average number of years worked at mean age at retirement. Women by marital status, 1985 and 2030[a]

	1985				2030 (constant activity rates)			
	Single	Married	Divorced	Widowed	Single	Married	Divorced	Widowed
Years								
Austria	29.5	20.7	26.5	22.4	34.5	25.1	31.4	26.9
Canada	25.3	15.5	22.9	17.7	34.9	29.8	33.5	31.3
France	32.8	19.1	28.9	23.0	33.3	23.3	31.7	27.4
Germany	39.3	21.2	33.4	23.5	36.3	23.7	32.9	25.9
Italy	21.0	13.5	15.7	15.7	26.3	17.7	20.5	20.5
Index (single = 100)								
Austria	100	70	90	76	100	73	91	78
Canada	100	61	91	70	100	85	96	90
France	100	58	88	70	100	70	95	82
Germany[b]	100	54	85	60	100	65	91	71
Italy	100	64	75	75	100	67	78	78

[a] Indirect estimate.

18.1 years in the countries for which we had data (see *Table 3.14*).[13] It represented a percentage of the work record of single women of 54 in the former Federal Republic of Germany, 58 in France, 61 in Canada, 64 in Italy, and 70 in Austria. The difference in the work record of divorced women as compared with that of single women mainly reflects the average duration of marriage of divorcees —between two and six years, depending on the countries— as activity rates for divorcees are very similar to those of singles. Widowhood under age at retirement occurs, on average, when women are in their fifties, an age at which activity rates are relatively low, so that the impact in terms of average work record is relatively limited: plus about two to four years as compared with the work record of married women.

Assuming activity rates will remain constant at their 1985 level, the gap between single and married women would be reduced by 24 percentage points in Canada, 12 points in France, and 11 points in Germany by the year 2030.

Those countries would be approaching the situation already observed in former socialist countries and in Scandinavian countries where marital history has little influence on female work history. On the other hand, little change would be observed in Austria and Italy.

Another future consequence of these differentials is that the increasing proportion of single and divorced, and, possibly, the decreasing proportion of married in the elderly population will lead to a higher average number of years worked by women: under the Western Low Rates Scenario it brings an additional one or two years. Marital discrepancies are also marked with respect to the proportion of women who, partly because they do not qualify, partly for other complex reasons, do not claim for old-age pension. Among married women it represents, for instance, about one-third in France and Germany and one-half in Hungary. However, this phenomenon will progressively disappear with the improvement in working-life and entitlement, and will add to the increase in the number of retirees due to demographic changes.

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13 Assuming that all women who get married do so at the mean age at marriage, all those who get divorced do so at the mean age at divorce, and all widows who become widowed before age at retirement do so at the same mean age at widowhood.

Table 3.15. Indices of the growth in real pension expenditure (1985 = 100)

	Scenario	2000	2015	2030	2050
Austria	Constant Rates	105	115	128	105
	Low Mortality	110	135	157	140
	Western Low Rates	108	128	145	124
	National	101	126	155	153
Canada	Constant Rates	127	172	212	190
	Low Mortality	133	201	262	256
	Western Low Rates	129	179	222	202
	National	147	212	303	326
Czechoslovakia	Constant Rates	108	133	141	146
	Low Mortality	114	162	185	198
	Western Low Rates	116	164	187	199
	National	110	146	170	192
Finland	Constant Rates	116	143	153	131
	Low Mortality	122	171	200	184
	Western Low Rates	120	157	174	152
France	Constant Rates	115	138	160	152
	Low Mortality	120	162	198	200
	Western Low Rates	118	148	175	169
	National 2	119	143	176	209
Germany	Constant Rates	115	119	125	89
	Low Mortality	120	141	157	123
	Western Low Rates	118	130	139	101
Hungary	Constant Rates	110	127	121	112
	Low Mortality	117	156	163	158
	Western Low Rates	120	161	170	163
	National 1	243	279	266	247
Italy	Constant Rates	118	126	143	123
	Low Mortality	123	149	177	163
	Western Low Rates	120	135	155	136
Netherlands	Constant Rates	120	157	183	155
	Low Mortality	123	175	215	198
	Western Low Rates	120	159	188	162
	National	121	163	197	181
Norway	Constant Rates	104	132	160	147
	Low Mortality	111	160	206	205
	Western Low Rates	106	138	169	157
Poland	Constant Rates	115	145	155	166
	Low Mortality	121	172	198	218
	Western Low Rates	122	174	199	217
	National	115	145	155	164
Sweden	Constant Rates	148	168	172	151
	Low Mortality	156	201	221	206
	Western Low Rates	149	171	175	154
	National	152	178	198	197

3.3.4. The pension boom

Several demographic and social developments have been discussed in the preceding sections which are likely to result in a substantial increase in pension expenditures. Firstly, the number of elderly people will increase. Secondly, among the female elderly, a growing number will qualify for pension entitlement and therefore claim for it. Thirdly, the average female pension will be markedly higher in most of the countries. However, this increase will be offset to some extent by a general decrease in the average male pension. Fourthly, in several countries, average pension will increase as the pension system becomes more and, eventually, fully mature.

Table 3.15 reports indices of the growth in real total pension expenditures as projected under the Constant Rates, Low Mortality, Western Low Rates, and National Scenarios for the 12 countries included in the present study. In the absence of migration, pensions are projected to grow till around 2030 in most countries, exceptions being Czechoslovakia and Poland where the upward trend will continue beyond this date.

Highest pension expenditures are observed under the Low Mortality Scenario in Western European countries, under the Western Low Rates Scenario in Czechoslovakia and Poland, and under the national scenario in Canada and Hungary. Accordingly, pension expenditures would increase by about 60 per cent in Austria and the former FRG, and by between about 80 to 100 per cent in Czechoslovakia, Finland, and Italy. Pension expenditures would more than double in France, Hungary, the Netherlands, Norway, Poland, and Sweden, and more than triple in Canada.

Differences in indices between the Constant Rates Scenario on the one hand and the Low Mortality or the Western Low Rates Scenario on the other hand, show that a further improvement in mortality will add another 20 to 50 percentage points to the rise in pension expenditures. *Table 3.16* also shows that, parallel to the rise in pension expenditures, there will be a decrease in the relative share of survivors benefits in several countries. This development results from the increase in female average old-age benefits but is also driven by changes in nuptiality and mortality. The sharpest differences are observed in Czechoslovakia and Hungary where survivor pensions cannot be combined with old-age pensions. In future, survivor pensions will, on average, be lower than the primary old-age benefits for women and will therefore disappear. Austria and Germany also indicate a strong reduction —between 30 and 50 per cent depending on scenarios— which will mostly ensue from improvement in the extremely unbalanced sex structure of the elderly population.

Table 3.16. Share of survivor's benefits in total pension expenditures, 1985 and 2030 (percentage)

	1985	2030		
		Constant Rates	Western Low Rates	Low Mortality
Austria	20.7	14.9	12.5	11.3
Canada[a]	7.0	6.6	6.4	5.4
Czechoslovakia	12.3	0.0	0.0	0.0
Finland	12.4	10.3	8.5	7.4
France	14.6	10.9	9.2	8.1
Germany	25.5	17.1	15.6	13.1
Hungary	15.7	0.0	0.0	0.0
Italy	14.6	13.7	11.9	10.8
Norway	4.0	2.4	1.9	1.1
Poland	0.1	0.1	0.1	0.1
Sweden	7.3	5.6	5.6	4.1

[a] 1986 and 2031.

In most of the countries, maximum growth rates of pension expenditures —up to 3 per cent annually— will be observed between 2000 and 2015 (see *Table 3.17*). This is not surprising as a rapid increase in the elderly population is projected during this period. On the other hand, in the former FRG, Italy, and Sweden, the fastest growth in pension expenditures will be experienced during the period 1985-2000. In the absence of migration, pension expenditures will decrease after 2030 in all countries except Czechoslovakia and Poland, and possibly France and Canada under the national scenarios.

The model used for preparing these pension projections does not allow to assess the respective contribution of the different demographic and non-demographic factors to the increase in pension expenditures. This is due to the fact that in this model, contrary to more simple pension models, average pension is a dependent variable. However, it is possible to obtain a crude estimate of the impact of the growing elderly population on pension expenditures by comparing the growth of pension expenditure to that of the population aged 60 and over. The figures in *Table 3.18* show a great deal of variety across countries, in particular during the first period 1985-2000.

Table 3.17. Average annual growth rates of real pension expenditure in the period 1985–2050 (per cent)

	Scenario	1985-2000	2000-15	2015-30	2030-50
Austria	Constant Rates	0.3	0.6	0.7	-1.0
	Low Mortality	0.6	1.4	1.0	-0.6
	Western Low Rates	0.5	1.1	0.8	-0.8
	National	0.1	1.5	1.4	-0.1
Canada	Constant Rates	1.6	2.0	1.4	-0.5
	Low Mortality	1.9	2.8	1.8	-0.1
	Western Low Rates	1.7	2.2	1.4	-0.5
	National	2.6	2.4	2.4	0.4
CSFR	Constant Rates	0.5	1.4	0.4	0.2
	Low Mortality	0.9	2.3	0.9	0.3
	Western Low Rates	1.0	2.3	0.9	0.3
	National	0.6	1.9	1.0	0.6
Finland	Constant Rates	1.0	1.4	0.5	-0.8
	Low Mortality	1.3	2.3	1.0	-0.4
	Western Low Rates	1.2	1.8	0.7	-0.7
France	Constant Rates	0.9	1.2	1.0	-0.3
	Low Mortality	1.2	2.0	1.3	0.1
	Western Low Rates	1.1	1.5	1.1	-0.2
	National 2	1.2	1.2	1.4	0.9
Germany	Constant Rates	0.9	0.2	0.3	-1.7
	Low Mortality	1.2	1.1	0.7	-1.2
	Western Low Rates	1.1	0.6	0.4	-1.6
Hungary	Constant Rates	0.6	1.0	-0.3	-0.4
	Low Mortality	1.0	1.9	0.3	-0.2
	Western Low Rates	1.2	2.0	0.4	-0.2
	National 2	5.9	0.9	-0.3	-0.4
Italy	Constant Rates	1.1	0.4	0.8	-0.8
	Low Mortality	1.4	1.3	1.1	-0.4
	Western Low Rates	1.2	0.8	0.9	-0.7
Netherlands	Constant Rates	1.2	1.8	1.0	-0.8
	Low Mortality	1.4	2.4	1.4	-0.4
	Western Low Rates	1.2	1.9	1.1	-0.7
	National	1.3	2.0	1.3	-0.4
Norway	Constant Rates	0.3	1.6	1.3	-0.4
	Low Mortality	0.7	2.4	1.7	-0.0
	Western Low Rates	0.4	1.8	1.4	-0.4
Poland	Constant Rates	0.9	1.5	0.4	0.3
	Low Mortality	1.3	2.3	0.9	0.5
	Western Low Rates	1.3	2.4	0.9	0.4
	National	0.9	1.5	0.4	0.3
Sweden	Constant Rates	2.6	0.8	0.2	-0.7
	Low Mortality	3.0	1.7	0.6	-0.4
	Western Low Rates	2.7	0.9	0.2	-0.6
	National	2.8	1.1	0.7	-0.0

Table 3.18. Ratio of growth of pension expenditure to growth of elderly population (x 100), 1985–2050, Constant Rates Scenario

	1985-2000	2000-15	2015-30	2030-50
Austria	40	80	146	104
Canada	89	107	85	100
Czechoslovakia	13	88	38	140
Finland	75	115	50	91
France	87	87	77	113
Germany	67	75	200	92
Hungary	20	53	117	56
Italy	111	75	94	100
Netherlands	90	97	115	75
Norway	-125[a]	64	61	108
Poland	133	90	120	118
Sweden	-6[a]	80	50	71

[a] Minus sign indicates negative growth for population aged 60 years and over.

Between 1985 and 2000, factors other than the growth of the aged population will play a major role in the growth of pension expenditures in Austria, Czechoslovakia, Hungary, Norway, and Sweden. In Sweden, where the pension system will reach full maturity during this period, a very rapid growth of pension expenditures is anticipated —between 2.6 and 3.0 per cent annually— while the aged population will slightly decrease. On the other hand, in Poland and possibly in Italy, the pension expenditure growth will be slower than the growth of the elderly population. Between 2000 and 2015, it seems that ratios are more homogeneous and that the rapid growth of the elderly population will drive the rise in pension expenditures. Beyond 2015, figures indicate again much diversity. The picture becomes even more complex when other scenarios are considered. Indeed, a thoughtful discussion of factors influencing the growth of pension expenditures would require to consider each country separately and under the various scenarios. However, a main conclusion is that the growth of the elderly population is only one of the elements at stake and that it does not always play a major role.

It is worth noting that results from these projections compare well with projections made by the OECD (Holzmann, 1987) which lead to a doubling of pension expenditures across OECD countries in the period 1985–2040. On the contrary, there is much difference with results of projections prepared by the IMF (Heller *et al.*, 1986). According to the IMF, public expenditures for old age pensions are expected to increase in real terms by 200 per cent in FRG, 217 per cent in Canada, 225 per cent in France and almost 400 per cent in Italy between 1980 and 2025, assuming a moderate increase in life expectancy. Corresponding percentages under our Low Mortality Scenario are probably slightly above 60 in Germany, 70 in Canada, 100 in France, and 80 in Italy. However, it is unclear whether these IMF figures are comparable to those reported here. In the present study, it was assumed that pensions are indexed for wage increase. As a consequence, impacts of wage/ price differentials as well as those of increased productivity on pension levels have been neutralized. In the IMF study, pensions are indexed for according to actual provisions, that is, wages and/or prices. In addition, other things being equal, average wage and pension are projected to grow in real terms because productivity is assumed to increase.

3.3.5. Under-funded pensions: how much will be paid in 2030?

Under a pay-as-you-go system current benefits are eventually paid by the actives, either from general tax or from specific contributions to pension funds. Thus, the impact of demographic changes on the performance of such a system can easily be assessed by considering differences in the ratio benefits per active over time. *Table 3.19* shows the percentage changes in average benefits at different points in time within the period 1985 to 2050 which would be necessary, under the Constant Rates Scenario, in order to keep the ratio benefits per active at its 1985 levels.

During the period 1985–2000, little change is observed in Austria, Czechoslovakia, Italy, and Poland and benefits could be increased by five per cent in Norway and by eight in Hungary. On the contrary, non-trivial cuts in average benefits —between seven and 16 per cent— would be necessary in Canada, Finland, France, Germany, and the Netherlands. In Sweden, cuts in benefits would already amount to a dramatic 31 per cent by the year 2000. By the year 2015, benefits would have to be cut substantially in all countries — Hungary being the bottom-ranking country with a decrease of only 13 per cent while cuts in benefits would top off at 44 per cent in Sweden. Between 2015 and 2030, the situation continues to rapidly deteriorate in Western countries while limited change is indicated in former socialist countries and in Italy. As a result, by the year 2030, benefits would be lower than in 1985 by 15 per cent in Hungary, 20 per cent in Czechoslovakia, Italy, and Poland and by between 37 and 56 per cent in the other countries included in this study, the top-ranking countries being Canada and the Netherlands. These figures clearly suggest that without changes in the rules current pension schemes will collapse.

Table 3.19. Percentage changes in average benefits as compared with 1985. Constant Rates Scenario

	2000	2015	2030	2050
Austria	-3	-18	-39	-41
Canada[a]	-16	-39	-55	-55
Czechoslovakia	2	-16	-20	-22
Finland	-11	-34	-45	-44
France	-7	-23	-37	-38
Germany[b]	-8	-24	-46	-42
Hungary	8	-13	-15	-18
Italy	-4	-19	-20	-20
Netherlands[c]	-10	-36	-54	-56
Norway	5	20	-41	-45
Poland	-4	-19	-20	-20
Sweden	-31	-44	-51	-52

[a] 2001, 2016, 2031, 2051.
[b] 1990-2050.
[c] Assuming a 16.66 per cent contribution rate.

Table 3.20 shows how other scenarios depart from the Constant Rates Scenario in 2030. Fertility returning to replacement level in Western countries would have little effect on benefits. It would only limit the cut in average benefits by three to six percentage points, except in Austria and the former FRG where eight to nine percentage points could be gained.

On the contrary, the Low Mortality Scenario would subtract another six percentage points in Canada and the Netherlands, about ten points in Austria, Finland, France, Germany, Italy, Norway, and Sweden and about 15 points in Czechoslovakia, Hungary, and Poland. This would lead to a fall in the average benefits of about 60 per cent in Canada, Germany, the Netherlands, and Sweden. The Western European scenario would imply benefits cuts of 40 per cent and more in Czechoslovakia, Hungary, and Poland and just a little less than in the case of the Low Mortality Scenario in other countries.

3.4 | Assessing pension reforms

The figures discussed in the previous section look, in some respects, like the description of an inevitable catastrophe scenario. Indeed, the burden of the demographic fate is impressive and, given the fact that demographic develop-

Table 3.20. Changes in average benefits, 1985-2030. Differences with Constant Rates Scenario in percentage points

	Scenario		
	Replacement Fertility	Low Mortality	Western Low Rates
Austria	8	-10	-7
Canada[a]	3	-6	-6
Czechoslovakia	0	-15	-26
Finland	4	-11	-9
France	3	-11	-10
Germany	9	-9	-4
Hungary	4	-16	-24
Italy	6	-9	-4
Netherlands	6	-6	-2
Norway	4	-11	-6
Poland	-3	-14	-25
Sweden	4	-10	-4

[a] 1986-2031.

ments cannot contribute to a substantial relief of this burden, it inevitably leads to the question: is it possible to preserve the actual performance of state pension systems, and which reforms should be undertaken in order to do so?

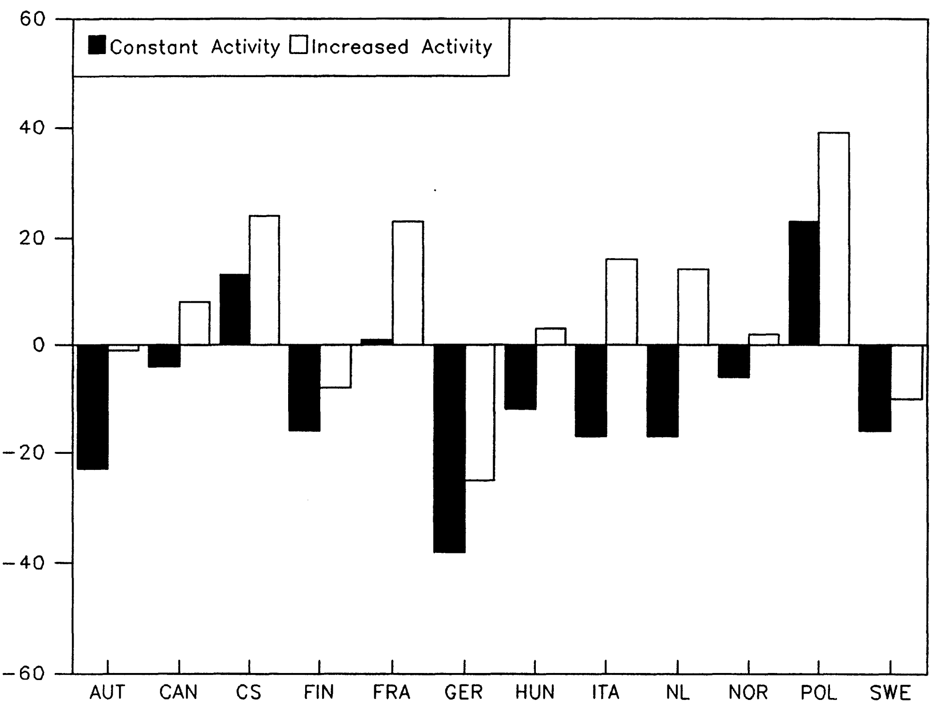
Within the framework of a pay-as-you-go system financial disequilibriums can be solved by either decreasing total and/or individual benefits or increasing total and/or individual contributions. Five possible measures were selected among the numerous existing proposals: an increase in female participation in the labour force, a rise in age at retirement, a burden-sharing between actives and retirees, an increase in contribution rate, and the creation of a complementary capital-funded pension scheme. All five proposals are those most frequently put forward and have a special long-term relevance as they are believed to be the ones which are likely to have the greatest quantitative impact.

3.4.1. Increasing women's economic activity

In order to assess the impact of an increase in the participation of women on pension systems, a High Activity Scenario was designed. It assumes that by the year 2005, both males and females would follow the highest pattern of activity observed in 1985 among the countries included in this study, namely that of the former GDR.[14]

Figure 3.5 shows the changes in the size of the labour force over the period 1985-2030, under constant demographic conditions, alternatively assuming constant and high activity rates. Compared with the Constant Rates Scenario, an increase in female activity either strongly limits the decrease or substantially adds to the growth in size of the labour force: plus 30 percentage points in Italy and the Netherlands, plus 20 in Austria and France, and still around 15 in other non-Scandinavian countries.

Figure 3.5. Percentage changes in the labour force, 1985-2030. Constant Rates Scenario with increased female economic activity, versus Constant Rates Scenario with constant activity



[14] Female labour force participation rates in the former GDR might be considered as artificially high due to hidden unemployment. However, it should be noted that rates observed in Finland in 1989 are even higher.

It is important to note that it is much more than that gained under the Replacement Fertility Scenario. On the other hand, an increase in female activity would also raise, sometimes dramatically, women's average benefit entitlement: by 68 per cent in Italy, 34 in France, 26 in Austria, and 12 in Hungary (see *Table 3.21*). In Czechoslovakia, a slight decrease is indicated due to a lower participation of women at higher age in the former GDR than in Czechoslovakia. In Poland, benefits would not change because maximum benefits corresponds to a work record of 25 years.

The overall scenario impact in terms of average benefits is shown in *Figure 3.6*. In most countries, it would limit benefit-cuts by about ten percentage points with a maximum of 15 points in the Netherlands, figures which are above the results of the Replacement Fertility Scenario except for Austria. In addition, in a context of high female economic activity, general provisions for survivor pensions do not seem any longer necessary. Waiving those provisions would give additional substantial help to the state pension system.

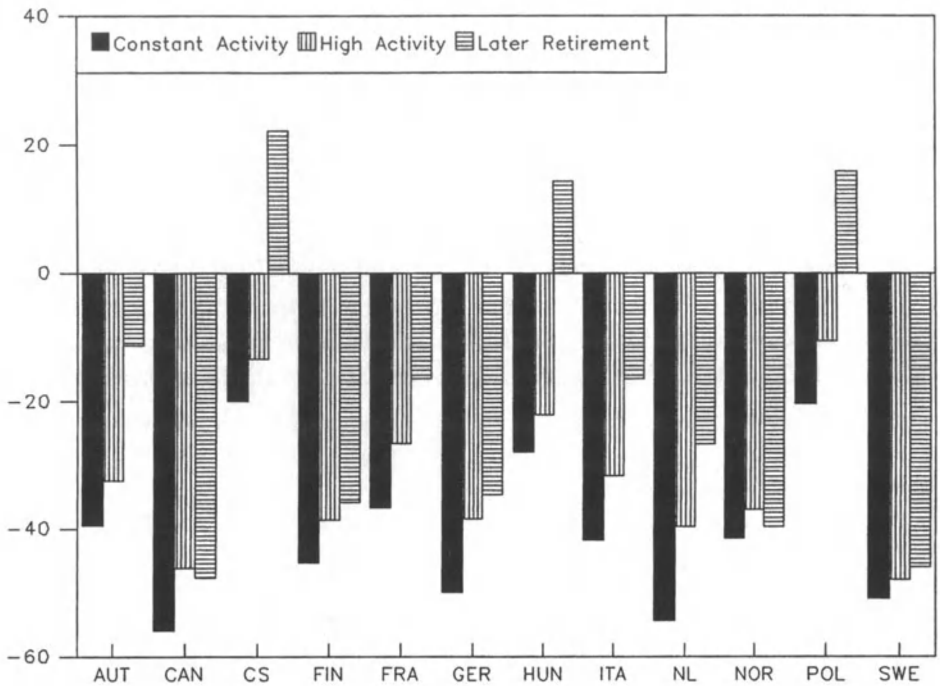
3.4.2. Raising the age at retirement

An often proposed solution to the pension problem is to raise the age at retirement. In the present scenario, we assume that the actual age at retirement is progressively raised to 65 years on average, for both males and females —still under constant demographic conditions— and that no survivor

Table 3.21. Percentage changes in average benefits per beneficiary. High Activity and Late Retirement Scenarios compared with Constant Rates Scenario, 2030. Countries with pure earnings-related pension

	'High activity' Scenario	Scenario '65'	
	Females	Males	Females
Austria	26	14	11
Czechoslovakia	-3	14	18
France	34	11	11
Hungary	12	13	16
Italy	68	12	19
Poland	0	0	0

Figure 3.6. Percentage changes in average benefits between 1985 and 2030. Constant activity versus high activity and later retirement

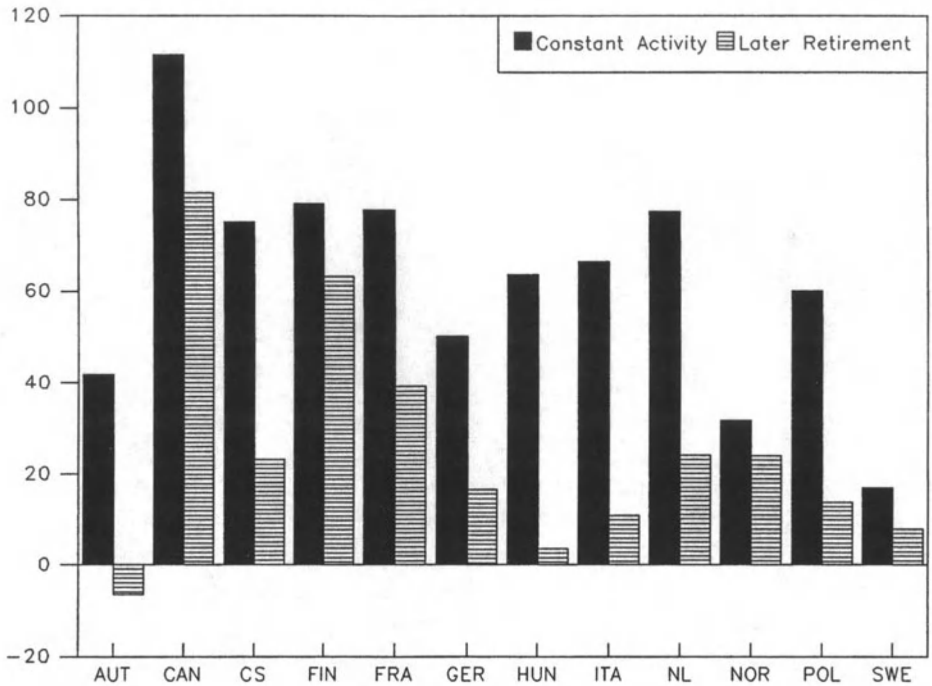


pensions are served under age 60.[15] As illustrated by *Figure 3.7* this would strongly limit the increase in the number of retirees in countries with low age at retirement: to less than 25 per cent in most cases, only five per cent in Hungary and even minus five per cent in Austria. In countries with high age at retirement, most importantly Canada, France, and Finland, the gain is still substantial but would not prevent the 'retiree boom'.

An increase in age at retirement lengthens the average working life and consequently results in increased benefit entitlement: between +11 and +14 percentage points for men and between +11 and +19 percentage points for women (see Table 3.21). In Austria, France, and Italy the increase in benefits entitlement would be much less than under the High Activity Scenario while,

[15] Activity rates for the age groups 55–59 and 60–64 were assumed to have a corresponding upward shift.

Figure 3.7. Percentage increase in the number of retirees between 1985 and 2030. Constant activity versus later retirement



again, in Poland no difference would be observed because of the 25-years rule.

The positive impact on average benefits is much more substantial than under the High Activity Scenario in a majority of countries (see Figure 3.6). No deterioration in average benefits would be experienced in Czechoslovakia, Hungary, and Poland, even under the Western Low Rates Scenario combined with a high age at retirement for Czechoslovakia and Poland (figures not shown here). Under the Late Retirement Scenario, cuts in benefits will be limited to less than ten per cent in Austria and less than 25 per cent in France, Italy, and the Netherlands. Still, cuts would amount to about 35 per cent in Finland and Germany, and to about 45 per cent in Canada.

3.4.3. Increasing the contribution rate

Actual payroll tax rates as well as balance rates for Western countries in 1985 and in 2030 under the Low Mortality Scenario are presented in *Table 3.22*. Only in Finland and Sweden, the pension funds are balanced in 1985.

Table 3.22. Actual and balanced contribution rates. Low Mortality Scenario

	Actual rate	Balanced rate	
		1985	2030
Austria	22.7	32.0	63.1
Canada	3.6	10.6	27.9
Finland	18.7	17.6	40.9
France	14.0	17.7	34.0
Germany[a]	18.7	20.7	48.0
Italy	24.2	30.6	62.5
Netherlands	17.7	12.6	31.7
Norway	-	16.1	34.3
Sweden	19.5	19.5	50.0

[a] 1990.

Small disequilibriums already exist in Austria, France, Germany, and Italy. In Canada where the payroll tax rate is extremely low —3.6 per cent— contributions fortunately do not represent the main source of income for state pensions. Although these figures probably closely reflect real situations, they should not be interpreted as an exact measure of the present financial position of national state pension funds because of the many simplifying assumptions on which the modelling is based. Under the Low Mortality Scenario —the worst case— the state pension fund would be balanced in 2030 in Canada if the contribution rate were set to 28 per cent of the gross earnings and in France and the Netherlands to about 32-34 per cent of gross earnings. Such levels of contribution are about a third higher than the highest actual rate (24 per cent in Italy) and might still be socially or economically affordable. On the contrary, this would not be the case in the other countries of this sample: 41 per cent in Finland, 48 in Germany, 50 in Sweden, and about 63 in Austria and Italy.

Similar calculations can be carried out for Norway and Central Eastern European countries in order to assess at which level to set the payroll tax rate in order to balance contributions and benefits when ageing is at a maximum. In Norway, the balance contribution rate is estimated to be about 16 per cent in 1985 and 34 in 2030 under the Low Mortality Scenario. *Table 3.23* presents estimates for 1985 as well as for 2030 under both the Low Mortality and the Western Low Rates Scenarios. In order to fully fund national pension schemes in 1985, contribution rates should have been set

Table 3.23. Balanced contribution rates. Former socialist countries

	1985	2030 Low Mortality Scenario	2030 Western Low Rates Scenario
Czechoslovakia	16.0	25.0	30.0
Hungary	22.1	39.4	45.6
Poland	19.0	29.1	34.7

to 16 per cent in Czechoslovakia, 19 in Poland, and 22 in Hungary in 1985 and respectively to 25, 29, and 39 per cent in 2030 under the Low Mortality Scenario. Under the Western Low Rates Scenario, contribution rates would have to be increased by an additional five percentage points. Compared with Western countries, Czechoslovakia and Poland belong in the lower corner while figures for Hungary indicate a more difficult situation.

Figures in *Table 3.24* show that, under prevailing mortality conditions, i.e. a life expectancy at age 60 of 17 years for males and of 23 years for females, the amount of benefits received by an individual retiring at age 60 in Austria, France, Germany, and Italy exceeds the amount of contributions he/she made during his/her active life irrespective of the insurance record. In other words, regardless of ageing, under current provisions, pay-as-you-go schemes cannot be balanced if people retire at age 60 because of their high life expectancy.[16] Balancing individual contribution and benefits in those four countries would require to set retirement age at 64–65 years.

3.4.4. Burden-sharing between actives and retirees

In all calculations, it was assumed that benefits are indexed for wage increase. In practice, this is achieved by linking benefits to gross income. However, under such a system, net income decreases if the contribution rate goes up while gross income and, consequently, benefits increase. In other words, the whole additional burden is with the actives. In a context of ageing, this might result in a situation where benefits are higher than net income. Under the Constant Rates Scenario, this would be the case beyond 2030 in Austria, Italy, and Sweden (see *Table 3.25*). In order to distribute

[16] Even when the contribution of those who die before reaching age 60 is taken into account, the schemes cannot be balanced.

Table 3.24. Cumulated contributions and benefits (in years of salary)

	Cumulated contribution	Cumulated benefits	Difference
Males: 40 years insured, retirement at age 60[a]			
Austria	9.1	12.2	-3.1
France	5.6	9.0	-3.4
Germany	7.5	10.2	-2.7
Italy	9.7	13.6	-3.9
Females: 20 years insured, retirement at age 60[a]			
Austria	4.5	6.5	-1.9
France	2.8	4.5	-1.7
Germany	3.7	5.1	-1.4
Italy	4.8	6.8	-2.0

[a] Life expectancy at age 60: 17 years for males and 23 years for females.

Table 3.25. Average benefits as a percentage of average net salary, balanced contribution rate, Constant Rates Scenario

	1985	2000	2015	2030	2050
Austria	74	70	80	99	111
Finland	69	71	78	84	84
France	45	47	51	56	57
Germany	54	63	69	87	83
Italy	70	75	82	105	112
Netherlands	31	32	35	39	40
Sweden	53	88	98	106	108

the pension burden more equally in the future, it has been proposed to link benefits to net income.

Results of the simulation for four countries are presented in *Table 3.26* and indicate that burden sharing makes a substantial difference in terms of contribution paid by the actives. By the year 2030, and under the Constant Rates Scenario, the contribution rate required to keep the ratio benefits/income constant at its 1985 level would be lower by about four percentage points in France and by nine to 12 points in Austria, Germany, and Italy if benefits were to be linked to net income instead of gross income.

Table 3.26. Contribution rates with and without burden sharing (ratios benefits/gross salary and benefits/net salary constant at their 1985 levels), Constant Rates Scenario

	1985	2030 No burden sharing	2030 Burden sharing	2030 Difference
Austria	22.7	47.3	35.4	11.9
France	14.0	26.9	22.6	4.3
Germany[a]	18.7	37.0	27.7	9.3
Italy	24.2	53.4	40.9	12.4

[a] 1990.

3.4.5. Capital-funded versus pay-as-you-go systems

If contributions are to be increased, would a complementary capital funded pension scheme perform better than the existing pay-as-you-go system? A capital-funded pension scheme is similar to a life-insurance except that annuities are paid instead of a lump sum. One saves money during activity and gets back interest and principal after retirement. Such a scheme is advantageous if the premium paid to the insurance company in order to keep benefits constant at their present level is less than the corresponding increase in contribution under the pay-as-you-go system. Calculations have been carried out for Western countries in the following way.

Firstly, we estimated the average contribution which would need to be paid by the actives in 2030 under a pure pay-as-you-go-system in order for the retirees to receive the average pension paid in 1985. Secondly, the average annuities to be paid in 2030 by the insurance company were simply calculated as the difference between the average pension paid in 1985 and the average pension which could be paid in 2030 under a pure pay-as-you-go system if the contribution rate would be kept constant at its present level. Thirdly, the annual premium necessary to generate those annuities was estimated from annuities tables assuming real interest rates of one and two per cent. It was also assumed that every active starts contributing in 1990.

Results are shown in *Table 3.27* for males and widowed females who usually have a work record not too different from the average female work record. In all countries with the exception of the Netherlands, the mixed system —pay-as-you-go plus complementary capital-funded scheme— performs much

Table 3.27. Contribution rates under a mixed pension scheme (pay-as-you-go + complementary capital-funded), 2030, Low Mortality Scenario

	Pay-as-you-go + complementary capital funded (rate of interest)		Difference with pure pay-as-you-go	
	1%	2%	1%	2%
Males				
Austria	39.0	34.9	-24.1	-28.2
Canada	10.1	8.4	-17.8	-19.5
Finland	29.1	26.6	-11.8	-14.3
France	25.9	22.9	-8.1	-11.1
Germany	29.8	26.9	-28.7	-31.6
Italy	41.2	36.9	-21.3	-25.6
Netherlands	39.2	37.8	7.5	6.1
Sweden	30.5	27.6	-19.5	-22.4
Widowed females				
Austria	43.3	39.0	-19.8	-24.1
Canada	13.4	11.0	-14.5	-16.9
Finland	31.9	28.6	-9.0	-12.3
France	29.3	26.0	-4.7	-8.0
Germany	31.3	28.8	-27.2	-29.7
Italy	46.8	42.5	-15.7	-20.0
Netherlands	51.7	48.0	11.2	8.0
Sweden	34.9	31.1	-15.1	-18.9

better than the pure pay-as-you-go system. Assuming a rate of interest of two per cent would allow to keep the contribution below or close to the 30 per cent mark in Finland, France, the former FRG, and Sweden.

In Canada, it would bring the contribution rate down to a low level — about ten per cent. On the other hand, it does not really bring a solution to Austria and Italy where it still requires a contribution rate between 35 and 40 per cent depending on the assumptions. Another negative aspect of this system is that it adds to sex inequalities as the returns depend on the number of years contributed but not linearly as in the pay-as-you-go system. This makes the system less attractive for people with low work records, especially women.[17]

[17] However, figures in Table 3.24 underestimate returns from a savings-type pension scheme for women as it was assumed in the calculations that the years worked by women were consecutive.

Alternatively, it provides a strong incentive to join or to remain in the labour force. This system is therefore consistent with policies aimed at increasing activity.

However, a mixed system calls for a number of remarks. First, the system can only bring a solution to the future decline of the returns of the pay-as-you-go system if it is implemented immediately. This also implies that, in the short- and medium-term, the sum of contributions paid to both the pay-as-you-go scheme and the capital-funded scheme will exceed the contribution needed to balance the pay-as-you-go scheme. As a consequence, every other thing being equal, average pensions will increase. *Table 3.28* shows that, by the year 2030 and under the Low Mortality Scenario, half of the benefits would be paid by the private scheme in Austria, France, and Italy and 40 per cent in the former FRG. Therefore, although the capital-funded scheme is initially viewed as a secondary scheme, the logic of capital accumulation and the deterioration of the return from the pay-as-you-go scheme would result in a mixed-system in which each scheme plays an equal role.

From a macro-economic point of view, a second important feature is that the stock of accumulated capital of the capital-funded system will rapidly represent a large share of the national wealth. Crude calculations indicate that, in 2030 and under the Low Mortality Scenario, the stock of capital would represent approximately five times the national income in Austria and Italy, about four times in France and would have represented 2.6 times the national income in the former FRG (see *Table 3.29*).[18] This raises a host of

Table 3.28. Percentage of total benefits paid by the pay-as-you-go system

	2000	2015	2030	2050
Austria	93	72	51	47
France	89	67	52	49
Germany	80	60	41	39
Italy	85	67	49	44

[18] A main reason for the capital stock to represent a markedly smaller share of national wealth in Germany than in other Western countries, is that, in Germany, ageing will be characterized by an unparalleled shrinkage of the working-age population while the elderly population will grow slower than in other Western countries.

Table 3.29. Accumulated capital stock as a percentage of national income

	2000	2015	2030	2050
Austria	208	447	524	439
France	145	325	408	386
Germany	96	224	260	159
Italy	213	400	480	371

policy issues ranging from management control and independence to investment strategy and profitability.

3.4.6. Is productivity the miracle solution?

In the absence of reforms of the pension system and of changes in the working and retirement behaviours, pensions could be kept constant in the future provided that the contribution rate is adjusted upward. This would result in a decrease in the real average income of the actives. However, it has been suggested that this would not necessarily be the case if productivity increases. Using the results presented in Section 3.4.3, one can easily estimate at what rate productivity should grow in order to maintain average income constant in real terms. Results of calculations for the Low Mortality Scenario are shown in *Table 3.30*. In Canada, Czechoslovakia, France, the Netherlands, Norway, and Poland this would require that productivity grows at an average rate of between 0.3 to 0.5 per cent annually. Obviously this is a mild requirement by historical standard. The figure for Finland is only slightly higher (0.7 per cent), while the situation is somewhat different in Germany and Sweden where growth rates of 0.9 and 1.1 per cent, respectively, would be necessary. Austria and Italy are far worse off: 1.4 points of growth would have to be devoted to income maintenance.

However, maintaining work income constant in real terms does not mean that the contribution rate would not increase dramatically. If one would like to keep the contribution rate at its current level, requirements on productivity would be much stronger. According to figures in the second column of Table 3.30, which are based on results presented in Section 3.3.4, productivity should grow at rates between 1.0 and 2.2 per cent annually.

Consequently, there is little doubt that a relatively small increase in productivity will allow to prevent a decline in real work income in many

Table 3.30. Average annual percentage increase in productivity necessary for maintaining constant the average net salary and contribution rate in the period 1985-2030 (Low Mortality Scenario)

	Net salary	Contribution rate
Austria	1.4	1.5
Canada	0.5	2.2
Czechoslovakia	0.3	1.0
Finland	0.7	1.9
France	0.5	1.4
Germany	0.9	2.0
Hungary	0.6	1.3
Italy	1.4	1.6
Netherlands	0.5	2.1
Norway	0.5	1.7
Poland	0.3	1.0
Sweden	1.1	2.1

countries. On the other hand, this would not solve the problem of the deterioration of the performance of public pension schemes.

3.5 | Conclusion: Ageing is certain but is the pension?

The ageing of the population is certain, and the pension question is common to all industrialized countries. However, results of simulations presented in this paper show that there will be noticeable differences between countries in the intensity of ageing, in the change in the size of the elderly population, and in the extent to which those developments will affect the public pension system. This, in turn, leads to marked national discrepancies with respect to the impact of the different measures aimed at reforming the pension system.

Most Western countries included in our sample have a strong 'ageing momentum'. Even if demographic conditions remain constant in the future, they will dramatically age and become very old because of past demographic changes. This ageing fate is maximal in Canada, Germany, and the Netherlands and minimal in Sweden. On the contrary, Czechoslovakia, Hungary, and Poland will only experience a limited ageing unless fertility and mortality drop substantially and simultaneously. At the horizon 2030, the intensity of ageing cannot be substantially limited by an increase in fertility and even less by an inflow of migrants. In Western countries, a further decrease in fertility would not strongly modify the path of ageing till 2030 but mainly result in an extension of ageing beyond this date. Therefore, the intensity of ageing —in addition to the ageing momentum— mostly depends on future mortality changes.

Besides future mortality development, changes in the size of the elderly population will reflect past population growth. Thus, similar ageing rates and levels may correspond to very different rates of increase of the elderly population.

It is also important to note that the future living arrangement structure of the elderly population will substantially differ from the present situation. The proportion of single and divorced old males will increase substantially while the proportion widowed is not likely to change under any scenario. As a result, there will be a tremendous increase in the proportion of old males who are not married. To which extent unmarried is and will be equivalent to living-alone is a question beyond the scope of this paper. However, calculations for the Netherlands based on de facto living arrangements suggest that there will really be a substantial rise in the proportion of the elderly living alone, see Chapter 5 by Van Imhoff. An increase in the proportion of elderly females who are single or divorced is also to be expected although it will be more limited than for males in the case of single females. On the other hand, changes in the proportion married and widowed among women are not unlikely but very difficult to anticipate because they will mostly depend on the change in the sex differentials in mortality.

Parallel to ageing, substantial changes in old-age benefit entitlement will occur as a result of past changes in working behaviour. Entitlement for men will decrease by two to 12 per cent as a result of decreasing activity at an older age, while sharp rises are to be expected for women: 15 per cent in Germany, 20 per cent in Austria, Finland, and France, 30 per cent in Czechoslovakia and Italy, 60 per cent in Hungary and Sweden, and 90 per cent in Norway if constant levels of activity and of mortality and fertility are assumed. As a consequence, the difference between male and female average benefits will be reduced to 20-30 per cent in most countries. Exceptions are Finland where it will represent about five per cent and, on the other extreme, and Italy with a 50 per cent discrepancy. Under the Western Low Rates Scenario, changes in the average marital history would again reduce the sex differential in average benefits by another 15 per cent in countries like France, Germany, and Italy. Similar reductions in the difference of entitlement between women of different marital statuses are also to be expected.

In the absence of migration, pensions will grow till around 2030 in most countries. Only in Czechoslovakia and Poland this upward trend would continue beyond this date. Highest increases would be observed under the Low Mortality Scenario in Western countries, under the Western Low Rates Scenario in Czechoslovakia and Poland, and under the national scenario in Hungary. Accordingly, pension expenditures would increase by about 60 per cent in Austria and the former FRG, and by between about 80 to 100 per cent in Czechoslovakia, Finland, and Italy. Pension expenditures would more than double in France, Hungary, the Netherlands, Norway, Poland, and Sweden and more than triple in Canada.

Expressed in terms of difference with average benefits received in 1985, the impact of sociodemographic changes on the state pension system is dramatic. In the short term, Sweden will definitely be the worst off among the 12 countries: by the year 2000, benefits would already have to be cut by 30 per cent assuming constant demographic conditions. By the year 2030, and still under constant demographic conditions, cuts would amount to 15 per cent in Hungary, 20 per cent in Czechoslovakia, Italy, and Poland and by between 37 per cent and 56 per cent in the other countries, the top ranking country being Canada. As already mentioned, there is no demographic answer to ageing at the horizon 2030. Fertility returning to replacement level in Western countries would only limit the cut in average benefits by three to eight percentage points. A further decrease in mortality, as assumed in the Low Mortality Scenario, would subtract another six to 15 points depending on the country. In Canada, Germany, the Netherlands, and Sweden, this would lead to a fall in average benefits of about 60 per cent. And the Western Low Rates Scenario would imply benefits cuts of 40 per cent and more in Czechoslovakia, Hungary, and Poland.

Obviously, figures for Canada, Germany, the Netherlands and, at the other end of the ageing spectrum, Czechoslovakia and Poland, widely support the existence of a positive relationship between ageing and the deterioration of the return from the state pension systems. In the Netherlands, where there is only a universal flat-rate state pension, the relationship is strict. This is also the case in Canada and Poland where benefits are poorly earnings-related. On the other hand, a very strong decline in the return from the state pension system is observed in Sweden together with a limited ageing. This suggests that the rules governing benefits entitlement under the Swedish pension system are not compatible with the current life expectancy and work behaviour of the Swedish population.

Five types of responses to the question of deteriorating pension funding have been tested: an increase in female participation in the labour force —to the level observed in the former GDR in 1985— a rise in age at retirement, an increase in contribution rate, a burden-sharing between actives and retirees, and the creation of a complementary capital-funded pension scheme. The increase in female activity, as assumed under the High Activity Scenario, would add 15 to 30 per cent to the size of the labour force. It will also raise the average benefit entitlement for women in several Western countries, sometimes dramatically like in Italy — plus about 70 per cent. Overall, under constant demographic conditions, this would roughly limit cuts in benefits by ten per cent with a maximum of 15 per cent in the Netherlands where benefits are not employment-related. Although it brings a clear improvement, this would not be sufficient to solve the pension problem. However, it should be noted that this would strongly reduce the gap in average old-age benefits between sexes to less than ten per cent. Additional gains are possible in Western countries if provisions for widow pensions are partially or totally released. Indeed, in a context of high female economic activity, general provisions for survivor pensions seem outdated. One open question remains: Is a strong increase in women's activity achievable without any further decline in fertility and, if it is not the case, could the fall in births offset the gains in contributions?

Within the framework of a labour/retirement policy, an alternative solution which was simulated is an increase in age at retirement to 65 years. In countries with relatively low ages at retirement this would substantially limit the absolute increase in the number of retirees. Benefit entitlement would increase but much less than with the High Female Activity Scenario. Impressively, this would solve the pension problem in Czechoslovakia and Poland under any demographic scenario, and strongly limit cuts in benefits in Austria, France, Hungary, Italy, and the Netherlands. This illustrates the fact that, under current mortality conditions, it is not possible to balance the public pension scheme if the age at retirement is below 65 years. The impact is evidently much more limited in countries with relatively high ages at retirement — Germany, the Scandinavian countries, and Canada. Increasing age at retirement probably requires a host of policy measures far more complex than a set of incentives. Indeed, work opportunities for older workers depend on the economic and labour market situation as well as their ability to adapt to changing technology.

Can the problem be solved by an increase in the contribution rate? If we consider the highest current contribution rate —24 per cent in Italy— the answer is definitively positive in Canada where the contribution rate needed to balance the pension scheme under the Low Mortality Scenario would represent a maximum of 28 per cent of gross earnings in 2030. The answer might still be positive for France, the Netherlands, and Norway but is certainly negative for countries with more generous pension benefits such as Germany, Austria, and Italy and for Czechoslovakia and Hungary in case of rapid ageing.

If contribution are to be increased, there is much to gain by linking benefits to net income and no longer to gross income. This would allow to distribute more equitably the future increase in the pension burden between the actives and the retirees. Under constant demographic conditions, it was estimated that this burden-sharing approach would lower contribution rates by between four to ten percentage points in 2030.

A more fundamental reform would be to partly move the pension system from pay-as-you-go to savings-based. Simulations have shown that for all Western countries with the exception of the Netherlands, the mixed-system (pay-as-you-go plus complementary capital-funded scheme) performs much better than the pure pay-as-you-go system. Assuming a two per cent interest rate, it allows to keep contribution rates below or close to the 30 per cent mark —even under the Low Mortality Scenario— in Finland, France, the former FRG, and Sweden. On the other hand, it would not really bring a solution to Austria and Italy where contribution rates would still represent more than 35 per cent of gross income. A mixed-system is less attractive for people with low work-record and could provide strong incentives to join or stay in the labour force. However, it requires immediate implementation and limited inflation. Calculations also suggest that, in the medium term, the capital-funded and the pay-as-you-go scheme would play an equal role in paying benefits because of the deterioration of the return from the pay-as-you-go system and of the logic of capital accumulation. There are also indications that the stock of capital accumulated will represent a large share of the national wealth, possibly of an order of magnitude of 2.5 to five times the national income by the year 2030.

Finally, there is little doubt that a relatively small increase in productivity can prevent a decline in real work income in many countries. However, this would not solve the problem of the deterioration of the performance of public pension schemes.

Public pension systems need to be reformed because their current provisions are being outdated by demographic developments. A simulation of different reform measures has shown that the dramatization arising from purely demographic considerations is in most cases exaggerated. However, it also indicates that there are strong reasons of technical, social, and economic order for the reforms to be implemented immediately.

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Appendix 3.1. Marital status projection model

Marital status projections were prepared using the DIALOG Personal Computer software prepared by Sergei Scherbov at the International Institute for Applied Systems Analysis (Scherbov and Grechucha, 1988).

As several detailed mathematical descriptions of the multidimensional projection model are available, only a brief and simplified presentation is given (Willekens and Drewe, 1984).

1. Population Dynamics

Assume that there are four marital states: never-married, married, divorced, and widowed. Then, for each sex, define a column vector K(x,t) with four elements, corresponding to the number of persons aged x at time t in each of these four states. Population dynamics is governed by the following equations:

$$K(x+h,t+h) = S(x,t)\,K(x,t) + Q(x,t)\,I(x,t)$$

$$K(0,t+h) = S(0,t)\,b(t) + Q(0,t)\,I(0,t)$$

$$K(z,t+h) = S(z\text{-}h,t)\,K(z\text{-}h,t) + S(z,t)\,K(z,t) + Q(z\text{-}h,t)\,I(z\text{-}h,t) + Q(z,t)\,I(z,t)$$

where S(x,t) represents the 4x4-transition matrix corresponding to age x and time interval (t,t+h), I(x,t) is a 4x4-matrix of immigrants, Q(x,t) represents the transitions these immigrants experience between time of arrival, and time t+h, b(t) is a 1x4-vector with the number of births by marital status of the child (hence only the first element is different from zero), and z is the last, open-ended, age category.

2. The Linear Model

Under the assumption of a linear development (as a function of time) of each element $k_i(x,t)$ of K(x,t) over the interval (t,t+h), the matrix S(x,t) can conveniently be expressed as a function of the matrix M(x,t) of occurrence/ exposure rates $M_{ij}(x,t)$:

$$S(x,t) = [I + h/2\, M(x,t)]^{-1}\, [I - h/2\, M(x,t)]$$

with I being the 4x4-identity matrix and with the matrix M(x,t) being defined as follows.

$$M(x,t) = \begin{bmatrix} M_{1d}(x,t)+\sum_{j\neq 1} M_{1j}(x,t) & -M_{21}(x,t) & -M_{31}(x,t) & -M_{41}(x,t) \\ -M_{12}(x,t) & M_{2d}(x,t)+\sum_{j\neq 2} M_{2j}(x,t) & -M_{32}(x,t) & -M_{42}(x,t) \\ -M_{13}(x,t) & -M_{23}(x,t) & M_{3d}(x,t)+\sum_{j\neq 3} M_{3j}(x,t) & M_{43}(x,t) \\ -M_{14}(x,t) & -M_{24}(x,t) & M_{34}(x,t) & M_{4d}(x,t)+\sum_{j\neq 4} M_{4j}(x,t) \end{bmatrix}$$

In the above expression, $M_{ij}(x,t)$ represents the rate for an event leading to a jump from marital status j to marital status i, and $M_{id}(x,t)$ is the death rate for marital status i. The following simple relation between Q and S holds:

$$Q(x,t) = 1/2\, [I + S(x,t)]$$

3. Specificities of the marital status projection model

With four marital statuses, the number of possible events is nine (see *Table A1*): three for marriages (first marriage, remarriage of divorced and of widow(er)s), two for marriage dissolution (divorce and widowhood) and four

Table A1. Events in the marital status model — no external migration

Before event		Marital status after event				Dead
		1	2	3	4	
1 Single	(s)	-	1	*	*	2
2 Married	(m)	*	-	3	4	5
3 Divorced	(d)	*	6	-	*	7
4 Widowed	(w)	*	8	*	-	9
Not yet born		10	*	*	*	-

- no event.

* impossible event.

for death. All new-born become single, but they result from the addition of natality of women in all four categories.

Then, for each sex, we have the following component-of-growth equations:

$$K_s(t+h) = K_s(t) + B(t,t+h) - M_s(t,t+h) - D_s(t,t+h)$$

$$K_m(t+h) = K_m(t) + M_s(t,t+h) + M_d(t,t+h) + M_w(t,t+h) - V(t,t+h) - D_m(t,t+h)$$

$$K_d(t+h) = K_d(t) + V(t,t+h) - M_d(t,t+h) - D_d(t,t+h)$$

$$K_w(t+h) = K_w(t) + W(t,t+h) - M_w(t,t+h) - D_w(t,t+h)$$

where B is birth, D is death, M is marriage, V is divorce, and W is widowhood. The index indicates marital status (single, married, divorced, or widowed).

As the number of newly married (divorced) women equals the number of newly married (divorced) men as well as the number of newly widows (widowers) equals the number of deaths among married males (females), we also have the following constraints:

$$M_s^m(t,t+h) + M_d^m(t,t+h) + M_w^m(t,t+h) = M_s^f(t,t+h) + M_d^f(t,t+h) + M_w^f(t,t+h)$$

$$V^m(t,t+h) = V^f(t,t+h)$$

$$D_m^m(t,t+h) = W^f(t,t+h)$$

$$D_m^f(t,t+h) = W^m(t,t+h)$$

where the upper index denotes sex and the lower index again denotes marital status.

Within a multi-state demographic framework, events occurring to males are modelled independently of events occurring to females, and conditions arising from the above constraint equations are not likely to be fulfilled. In order to obtain consistent flow figures for the two sexes, Keilman (1985) has proposed to average the observed differences in the number of events between sexes by using a harmonic mean. Under this approach, three steps are necessary for calculating consistent numbers of events. Firstly, the number of events is computed separately for males and females: for instance, the total numbers of marriage $M^f(t,t+h)$ and $M^m(t,t+h)$. Secondly, the adjusted total number of marriages $M^*(t,t+h)$ is set to the harmonic mean of these numbers:

$$M^*(t,t+h) = \frac{M^m(t,t+h)\ M^f(t,t+h)}{\frac{1}{2}\left(M^m(t,t+h) + M^f(t,t+h)\right)}$$

Thirdly, new numbers of marriages for each age category are recalculated using the adjustment factor $M^*(t,t+h)/M^m(t,t+h)$ for males and $M^*(t,t+h)/M^f(t,t+h)$ for females. New numbers of marriages by age and previous marital status are found by proportionally rating up or down the initial numbers.

4. DEMOGRAPHIC CHANGES AND ECONOMIC GROWTH IN PENSION SYSTEMS: the case of Sweden

Tommy BENGTSSON and Agneta KRUSE

4.1 | Introduction

Public pension schemes are by far the most important means in industrialized societies of distributing income and consumption throughout a lifetime, and of providing for old age when the ability to work is low or non-existent. Other chapters deal primarily with the question of how different pension systems will be affected by those demographic changes which are expected to occur up until the middle of the next century. The reason for focusing on demographic effects and excluding economic ones is that we expect the pension systems in operation today to be relatively insensitive to changes in economic growth. The majority of existing national pension systems are designed on a pay-as-you-go basis, a system in which one year's contributions are used for the pension expenditures of the same year. As such they should theoretically be relatively unaffected by changes in economic conditions. This is not always the case, however, as details of the design may make them sensitive to economic growth. The Swedish system is one example of how certain features can lead to economic sensitivity. Countries with similar features within their systems cannot merely consider the question of how to deal with a future population, but must also analyze future economic scenarios. Therefore, an analysis of the Swedish pensions system is of interest to other countries as well.

J.-P. Gonnot et al. (eds.), Social Security, Household, and Family Dynamics in Ageing Societies, 111-147.

Pension systems can be divided into two main types: funded systems and pay-as-you-go systems. They may be either compulsory or voluntary, and can be managed publicly or privately. Most countries have chosen public, compulsory pay-as-you-go systems (see also Chapter 3 by Gonnot). Compulsory systems can be designed to redistribute income between individuals and/or generations, an option hardly available in voluntary systems. Compulsory systems usually give an increased rate of coverage, reducing the temptation of free riding, and also a reduced adverse selection, something of a problem in a voluntary system. On the negative side there will be the efficiency losses due to distorted consumption patterns. Pay-as-you-go systems will be more vulnerable than funded systems to the ageing of the population but, as will be shown in Section 4.2 below, funded systems, too, are affected by demographic changes. Not only the choice of system but also its concrete features define how the system will be affected by and whether or not it will be robust to demographic and economic variations.

The dominant form of provision for the elderly in Sweden is the public pension system. This is a compulsory, non-actuarial pay-as-you-go system, yet with a certain degree of fund dependence. The system is sensitive to both demographic and economic variations and calculations of future contributions and benefits show that the system cannot survive in its present form. Knowledge of this problem is widespread, and discussions are currently centred around different reform options which will alleviate some of the present problems. The analysis of the system and forecasts of its performance are done, however, with only one demographic scenario, meaning that the demographic sensitivity of the system has not been discussed, nor has the question of how the system can be reshaped to sustain simultaneous economic and demographic changes, a shortcoming we are aiming at remedying in this chapter.

In the following we will give a general description of how demography and the economy affect funded and pay-as-you-go systems (Section 4.2). Next we will describe the Swedish system (Section 4.3), focusing on aspects which make it susceptible to demographic and economic changes. Finally, we discuss (in Section 4.4) the system's sensitivity to simultaneous changes in these areas.

4.2 | Funded versus pay-as-you-go systems: a theoretical note

Regardless of the type of pension system in effect, individuals set aside a certain portion of their income during their time on the labour market. In a funded system, the premium paid in is placed in a fund, while in a pay-as-you-go system the sum of contributions in one year is used to make pension payments that same year to existing retirees. The fund system 'guarantees' that the accumulated premiums plus a return based on market interest rates will be available when the worker retires. Pay-as-you-go systems 'guarantee' pensions through the 'promise' of future generations' pension premiums, a 'promise' which exists in what might be called the system's implicit social contract between today's generation and future generations. The returns in this system are dependent upon the economic growth of the economy, which is in turn determined by productivity growth and population developments. The quotation marks on 'guarantee' are meant to emphasize that no pension system ever can guarantee a certain standard of living in old age. The future is uncertain, and that goes for interest rates as well as growth rates.

Since interest and economic growth rates are equal in long-term equilibrium[1], the returns of the two systems are, ceteris paribus, equal and the advantage of a pay-as-you-go system is found in the initial generation's receipt of pension benefits without previous premium payments. The pay-as-you-go system thus allows one group in society to enjoy an increased standard of living without any other group reducing its consumption assuming that the pension system does not give rise to negative effects on production and growth, as shown in Samuelson's classical article of 1958.

This article sparked off an intense debate as to the advantages and disadvantages of a pay-as-you-go system compared with a funded one,

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1 Equality between interest rate and growth in equilibrium is a standard result in the theory of economic growth. See for example Solow's article from 1956 or a textbook presentation like the one in Mankiw (1992). In short the argument runs as follows. In a steady state equilibrium, output per worker is constant and can be expressed as a function of the capital/labour ratio. In the steady state which maximizes consumption, a so-called golden rule, the capital/labour ratio is at the level where net marginal product of capital, MPK, is zero, that is investment equals depreciation and capital per worker is constant. Now, if there is population growth, n, and/or technological progress, z, there has to be net investment to keep capital/labour constant. In a golden rule steady state there will be investment up to the point where net MPK equals n + z. MPK is the return to capital, that is the interest rate, and (n + z) is the growth rate.

particularly in terms of the effects on savings, capital formation, and growth — in other words, the extent to which a pension system's design affects total future production. The ceteris paribus assumption above states that the choice of systems will not affect the functioning of the economy in terms of savings, growth, or labour supply. Extensive theoretical and empirical research is being carried out on these questions, but we have yet to arrive at firm and unambiguous results.[2] The economy is rarely if ever in equilibrium, and returns on capital differ from growth rates. When the growth rate is higher than the interest rate, then a pay-as-you-go system is more advantageous. This was the case during the 1950s and 1960s when the majority of the industrialized nations introduced their pension plans. It is thus no coincidence that the majority of national pension plans are based on the pay-as-you-go principle. Recent years, however, have seen conditions reversed, and this is the most likely reason why the advantages of a funded system are stressed today.[3]

Payments into any sort of pension system represent a burden or a demand on future production. In funded systems the retirees hold a capital stock (funded premiums + interest) that will be sold to those of working age and thus give consumption entitlements to the holders of the capital stock, i.e., the pensioners. The pay-as-you-go system gives retirees an income based upon the implicit social contract inherent in the system. The design of the pension system decides what share of consumption is assigned to the retirees. In addition to distributing incomes over the entire life cycle, pension systems distribute a given year's production and consumption between workers and retirees.

Aside from possible effects on labour supply, savings, and growth, the main difference between the two systems is the manner in which returns are

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2 For an overview see Aaron (1982), Feldstein (1974), and Ståhlberg (1988).

3 Even if it is beyond the scope of this chapter to discuss why interest rates are sometimes higher and sometimes lower than the economic growth rate, it is interesting to note that there has been a 'world wide slowdown in economic growth during the last two decades' (Mankiw, 1992, p. 106). There is no single explanation of this phenomenon, but the decline in fertility rates and the accompanying changes in demographic structure might well be one element of an explanation. Furthermore, according to the life cycle hypothesis of consumption (see Ando and Modigliani, 1963; Modigliani, 1986), an ageing population also means a decline in savings (supply of capital), which will exert an upward pressure on interest rates. Both factors will thus work in favour of funded systems in the years to come.

determined and thus the effect which population changes have on the respective systems. Since the growth rate of the economy determines the returns of a pure pay-as-you-go system, and since the growth rate is itself determined by productivity and population changes, we can see that demography plays a large part in the pay-as-you-go system.

Pure pay-as-you-go systems utilize one year's premiums to pay out the same year's pension benefits. A pure pay-as-you-go system would thus experience the budget restriction given in equation 4.1, where equality must exist so that the system receives neither a surplus nor a deficit. The importance of changes in the population are evident in the equation:

$$q * w * L = b * R \tag{4.11}$$

where q is the contribution rate, w is the average wage, L is the size of the labour force, b is the average pension benefit, and R is the number of pensioners. The left-hand term of the equation gives the total revenue from contributions and the right-hand term the sum of pension benefits disbursed. q and b are the pension system's parameters, which must be changed when there are changes in any of the other variables in order to bring revenue and disbursements into balance. L and R are determined partly by purely demographic factors such as fertility, mortality, and migration, but also by labour force participation rates, age at entry into the labour market, the number of hours worked in a week and the number of weeks in a year, and retirement age. To a certain extent the latter aspects of L and R are influenced by political decisions and can thus be viewed as parameters of the pension system.

Population distribution and changes affect both sides of the equation. Let us assume that labour force, wages, and number of pensioners develop independently of the pension system's form. The contribution rate and/or the average benefit level are the factors which will vary in response to changes in L, w, and R. If the system features a fixed contribution rate, then benefits will rise with rising incomes and an expanding labour force, and the opposite will occur in the case of decreasing income. Rewriting the equation, we can more easily see the effects of population changes:

$$q = (b/w) * (R/L) \tag{4.1'}$$

b/w is the compensation ratio and R/L is the pensioner ratio. If the pension system has a fixed compensation ratio (a benefit-determined system), then the contribution rate must be increased in the event of an increased pensioner ratio so that premium receipts can cover pension benefits.

Let us see, as an illustration, what demography signifies in a pure pay-as-you-go system, using equation 4.1' and the forecasted demographic changes in Sweden. Let us start with a pensioner ratio of 0.33. This is the ratio we would have in an economy where everyone worked throughout their working life, assumed to be 45 years (20-64), and everyone lived 15 years as a retiree (65-79). We will further assume that the compensation ratio is fixed at 0.6. A contribution rate of 20 per cent would then be sufficient to cover all benefit payments. This is used as our reference alternative in illustrating the effects of an ageing population on the contribution rates and compensation rates shown in *Table 4.1.*

The trend of the pensioner ratio (R/L) shows an ageing population.[4] The ratio is fairly constant up to the turn of the century, increasing rapidly thereafter. As a consequence of the increase in R/L by eight percentage points between the year 2000 and 2015, the contribution rate has to be increased by 19 per cent or nearly five percentage points. Each percentage point increase in R/L requires an increase of the contribution rate by 0.6 percentage points.

With a fixed compensation ratio, the total burden of adjustment to the ageing population is laid on the working generation. The last column in Table 4.1 shows a pension system in which the contribution rate is fixed. With this design of pension system, the burden of changing demographics will be borne entirely by the retired generation. The compensation ratio will have to be

Table 4.1. Payment rates and premium rates at different pensioner ratios

Year	R/L	q (at p/w=0.6)	p/w (at q=0.2)
*	0.33	20.0	60.0
2000	0.34	20.4	58.8
2015	0.42	25.2	47.6
2030	0.46	27.6	43.5

* The reference alternative according to the assumptions above.

4 For the calculation of R/L the National 1 Scenario is used (see below) with the labour force participation rates from the 1989 projections by Statistics Sweden.

lowered by 11 percentage points in response to the eight percentage point increase in R/L between 2000 and 2015.

The illustration in Table 4.1 makes clear how sensitive a pay-as-you-go system is to demographic changes. It also makes clear that the design of the system determines who bears the burden of an ageing population; a fixed contribution rate puts the burden on the pensioners, while a fixed compensation ratio puts it on the working generation. An alternative would be to combine changes in q and b/w (see the 'burden sharing' computations by Gonnot in Chapter 3), but also to build up a buffer fund in response to those demographic changes which can be predicted long in advance.

The above formulation of a pay-as-you-go system is static and gives the conditions at a particular point in time. Economic growth, i.e., demographic and productivity changes, links the variables at successive points in time to each other: $R_t = L_{t-1}$ and $w_t \cdot L_t = (1+g) \cdot (w_{t-1} \cdot L_{t-1})$ with g representing the growth rate.[5] A reformulation of equation 4.1 which explicitly shows economic growth can be written as:

$$q[w * L(1+g)] = b * R \qquad (4.2)$$

with t omitted for the sake of simplicity. Through equation 4.2 we can obtain an intuitive understanding of the conclusion that pension benefits in a pay-as-you-go system follow the growth rate of the economy.[6] Since the growth rate, g, can be expressed as (1+n)(1+z)-1, where n is the population growth rate and z is productivity change, we can rewrite equation 4.2 as:

$$q = [b/\{w(1+2)\}] * [R/\{L(1+n)\}] \qquad (4.2')$$

An ageing population implies that the retired population increases relative to the population of working age. This relationship can be expressed in equation 4.2' through the use of a negative n value. A population decline will lead to a corresponding reduction in total growth. With a fixed contribution rate the return of the pension system declines and incomes of retirees and employees alike are reduced. An increased pensioner ratio can,

5 This is, of course, a highly simplified description, with among other things mortality being assumed zero at working ages. For the purpose of this section this simplification is satisfactory. A more realistic model will be introduced in subsequent sections.

6 For a thorough presentation, see Samuelson (1958).

however, be offset by a positive wage development, in other words there is a trade-off between z and n.

A funded system works in a different way. There will be an accumulation of wealth during the working period of life, and a dissaving through drawings on the pension fund during the years of retirement. A changing age structure in the population inevitably influences the society's aggregate pension fund.[7] The effects of a specific change in demographic structure will to some extent depend on how the change has arisen.

The ageing of a population might arise from a drop in fertility but another possibility is for example a decreased mortality in the age group 65 and over. In the first case the ageing appears after a number of years as a decrease in the proportion of middle-aged people, decreasing the relative importance of pension funds in the capital market which in turn creates a tendency to an increased rate of return. Later on, the ageing process results in an increase in the relative share of pensioners, with an increased dissaving out of pension funds as a consequence.

It is more difficult to handle decreased mortality at later ages (the second case) in a funded system than in a pay-as-you-go system. Suppose the change is caused by fairly sudden improvements in medical technology. Those already retired and those close to retirement age will not have the opportunity of adapting their contributions to the extended lifetime. In a funded system a collective risk like this cannot be handled otherwise than by dividing the fund by a greater number of years, that is by reducing benefits. In a pay-as-you-go system there is the possibility of sharing the 'burden' of longer life by a combination of an increased contribution rate and a decrease in benefits. For young people the higher contribution rate will be actuarial, since they can look forward to a longer life.

Demographic changes can also involve a variation in birth cohort size. These changing sizes do not have the same effects in funded as in pay-as-you-go systems. In a pay-as-you-go system, varying cohort sizes mean varying contribution rates and/or benefits; small cohorts supporting big pensioner

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7 Whether this effect on the pension fund will also have a major impact on the entire capital market or not is a subject of controversy within the economic discipline. The life cycle hypothesis (see footnote 3) which predicts such major effects has been challenged, see for example Kotlikoff (1988). See also Cigno (1992) and the references in footnote 3. The last word, however, has not yet been said.

cohorts will suffer under heavy burdens, or pensioners belonging to a big cohort will get only a small share out of a fixed sum of expenditures. Funded systems are affected by the fact that large cohorts amass large funds while smaller cohorts accumulate smaller funds. This response makes demographic variations much easier to handle than in a pay-as-you-go system, even if it does not eliminate all problems. A potential problem is that a large cohort with its large fund could expect reduced prices when the time comes to sell the fund. Small, open economies should find this a limited problem as long as all relevant countries are not more or less in the same demographic phase. Such a situation, however, does seem to be the case. The ageing of the population all over the industrialized world along with a fairly simultaneous cohort size variation thus would make funded systems vulnerable.

In the context of pension systems, not only pure demographic factors are important. The influence of fertility and mortality on demographic structure and changes are important, but so are changes in the labour supply. The dependency ratio is often calculated as the number of persons aged 65 and older in relation to the *number of persons of working age*, defined as 16-64. For economic questions, and especially when discussing social insurance and pensions financed by means of contributions levied on wages, it is primarily the *number of persons in the labour force* which is interesting.[8] In 2015 the Swedish dependency ratio using the two definitions will be 0.33 and 0.42, respectively,[9] with important differences in contributions and/or benefits as illustrated in Table 4.1.

Not only is the number of persons in the labour force important but also the amount of labour supplied (hours per week, weeks per year, and number of years). Changes in these factors have quite different effects on pay-as-you-go systems compared with funded systems. Suppose there is a positive economic growth. As leisure is a normal good (positive income elasticity) people will want to 'buy' more leisure as income increases, that is reduce their working hours. In a funded system there will be no immediate effects; the fund of those already retired will not be affected, those of working age will eventually have lower pensions as they have already consumed some of their income in the form of leisure.

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8 See Kruse (1989) for a more complete discussion. See also Cutler *et al.* (1990) for similar calculations of the effect of different definitions on the dependency ratio based on American data.

9 SCB (1989, 1991).

In a pay-as-you-go system reduced working hours will have quite another outcome. With fixed contribution rates, current pensioners will see their benefits lowered without regard to their working hours when young. In Samuelson's (1958) world, where productivity increases and population growth functions on an equal footing, population growth is assumed to come about through increases from below, increasing the labour force. Other modes of population change —more like the actual ones— may have a quite different effect on the pension system, as briefly discussed above. For that reason we shall now extend the scope of our discussion of the effects of population change on pension systems. In doing so, it is important to distinguish not only between changes in size, growth rate, and age distribution of the population but also between the demographic factors behind these changes. The reasoning behind this is that the effects on pension systems can be completely different depending upon whether the shifts in growth rate and age structure are driven by changes in fertility, mortality, or net migration.

The manner in which *population size* affects the pension system is fairly obvious. In a small population even short-term changes in births, deaths, and immigration can have large effects on the population. A temporary decrease in the birth rate can lead to such a large reduction in the contribution base some 20 years later that the entire pension system is threatened. Major changes in the labour market situation could create problems for small populations using a pay-as-you-go system. This problem disappears in larger populations, since short-term variations in contributions and benefits are relatively smaller. This could be referred to as the law of large numbers. The effects of population size are of little importance in this context since we are examining pension systems at the national level, but any discussion of pension plans for small groups must take size into account.

The effects of the *growth rate* on a pay-as-you-go pension system depend on whether it affects the age structure or not, as briefly discussed above. Let us first consider growth that affects a pay-as-you-go system without changing the age structure. The concept of *stable population* is useful here. A stable population is the result of a fairly long period of unchanged fertility, mortality, and net migration. It is stable in the sense that the age structure does not change over time despite the fact that the population size changes. In a closed population, that is a population with no migration, the proportion of elderly is determined by age-specific mortality rates and the birth rate. Given a certain life expectancy at birth (with a certain age-specific mortality scheme) the proportion of elderly is determined by the birth rate. A West European life expectancy, which is roughly 75 years at present, and a total fertility rate

(TFR) of 1.8 children per woman create after some time a stable population with about 20 per cent above 65 years of age. To maintain the proportion of elderly prevailing in today's Western Europe, i.e., 10-15 per cent, a TFR of 2.5-3.0 is needed. The slow-down in the population growth rate that most industrialized countries have experienced will undoubtedly lead to a further increase in the proportion of elderly in the next 50 years or so.

This has led to a fear that we shall have to reduce our future consumption to support a growing proportion of elderly. However, the result obtained from analyses of steady states are not alarming (Samuelson, 1958). As long as we have population increase, both pensioners and workers are able to increase their wealth. Why is population growth so beneficial to both workers and pensioners? The basic argument is that the average age of consumption is higher than the average age of production.[10] A positive growth rate therefore creates a higher production average. Thus high population growth occasioned by high fertility combined with high mortality is beneficial to a pay-as-you-go system. The catch is that the growth cannot go on forever. The losers are the generations retiring at the time population growth comes to an end. Another problem with this analysis is the strong assumption that the average age of consumption is higher than the average age of earning. In the example cited by Samuelson (1958), children are not included in the analysis, which, for example, could be interpreted as a population increase caused by immigration of 20 year olds. If children are included in Samuelson's example and they are assumed to have the same age-specific consumption as other age-groups, then the average age of consumption will be lower than the average age of earning. In this case population growth will reduce consumption for all age-groups. We would be better off with population decline. The third problem arises from the fact that the transition time from one stable population to another seems to be so long that one cannot ignore it when analyzing the performances of different pension systems. During these transitions the age structure of the population, and not merely its size, is changing.

The direct mechanism through which the *age structure* affects the pension system is fairly straightforward. The proportions of pensioners and workers determine the benefit level for pensioners and/or the contribution rate for workers as described in the previous section. Changes in age structure could be the results of changes in fertility, mortality, or migration. In the case of

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10 For an overview of Samuelson's model and criticism, see Lee (1980).

Sweden, and certainly for most other industrialized countries, the increase in the proportion of elderly is primarily a result of the great fertility decline starting in the late 19th century (Coale, 1956). Changes in mortality and migration have had fairly limited effects on the age structure up to now, but this does not mean that it will be the same in the future. It may well be that changes in mortality will play a more important role in the future, particularly if the level of fertility remains about the same.

Another factor which will certainly affect the proportion of elderly in the population is the *long waves* in the birth rate which have occurred since World War II. The long waves in the birth rate with peaks in the mid-'40s, early '60s, and late '80s will result in significant increases in the proportion of elderly in the future. These increases will not be permanent, however, since they will be followed by the smaller cohorts born between the peaks. The effects of variations in the birth rate on society have been compared with the waves which form after a stone is tossed into a still pond. The first waves are large, but they loose strength and become smaller and smaller as they move out from the point of impact. The reason for this smoothing process is that not everyone enters the labour market at the same time, nor do they marry or have children simultaneously. The analogy is not totally correct, however, since the cohort is regrouped as its members reach retirement age. Some members of the group will, of course, retire early, but the overwhelming majority retire at the ages 60-65. Thus when the waves hit the shore they are back to full strength. As the period of work is much longer than the period of retirement, and the number of workers therefore much higher than the number of pensioners, we also expect the effects of large birth cohorts to become more important when they become pensioners than when they became workers. Thus for two reasons, relative size and timing, we expect the effects of large birth cohorts to become greater when they retire than when they entered the labour force. Changes in age structure thus affect both contributions and benefits. The effects will no doubt depend on the direction and cause of the change. A continual decline in fertility, such as that experienced by Sweden from 1880 to 1930/40, gives a decrease in the size of the population of working age about 20 years later and onwards, but the number of retired people starts to go down about 65 years later and continues thereafter, given stable mortality. The result is a permanent reduction of labour in proportion to pensioners.

As regards effects of a temporary increase in fertility —a 'baby boom' followed by an equally sudden decrease of the same size and from then onwards stable fertility— this will create an increase in the labour force not only for the next 20-65 year period but for much longer periods. The reason is that the children of parents belonging to the first 'baby boom' generation enter the labour force before their parents retire. During the 20-65 year period, the contribution from the 'baby boom' generation makes it possible to increase benefits without reducing the consumption of the workers. But when the 'baby boom' generation reaches retirement age, the proportion of pensioners increases rapidly, causing problems for the pay-as-you-go system. The reason why the number of pensioners varies in long waves while the size of the labour force is stable is that the period during which a person receives pension benefit is much shorter than his or her working life. New large birth cohorts enter the labour force as the old ones retire. Variations in the size of the labour force will be much smaller than those in the number of pensioners.

A burst in fertility gives a period of 'overstability' for the pension system after an initial period of about 20 years but creates problems in the future, adding to the problems of long term fertility decline. The only fertility solution to the pension problem is high and stable fertility; and only if mortality remains unchanged. An increase in the average life span of the elderly (aged 65 and older) will result in a gradual increase in benefit payments. This change occurs without any time lag, and without having had earlier positive effects on the contribution base. The imbalance between contributions and benefits increases as long as mortality continues to decline.

These examples of demographic changes represent basic characteristics of the Swedish pattern of development. Some of the characteristics are shared by other countries, some are not. The long-term falls in fertility and mortality are common to most western countries, although they may differ with respect to speed and timing and came a little earlier in Sweden than in most other countries. The long swings in fertility differ somewhat in Sweden from those in many other western countries in that the increase is very early, very fast, and peters out very quickly. Overall, however, the pattern is much the same.

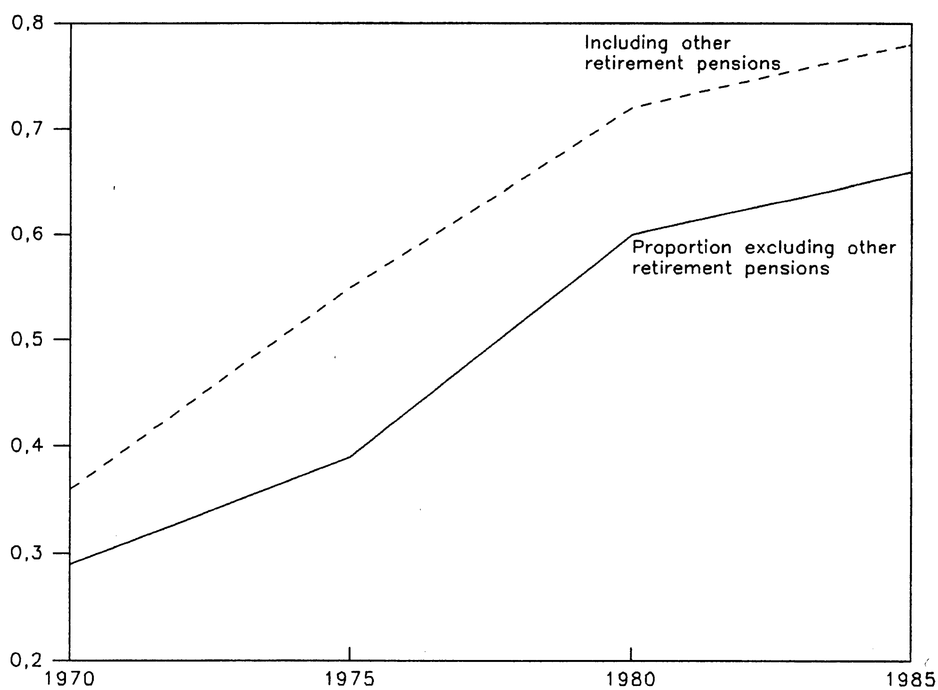
4.3 | The Swedish pension system

The Swedish public pension system consists of a basic pension, the *folkpension*, which is the same for everybody, and the general supplementary pension scheme, *allmänna tilläggspensionen* (referred to below by the customary abbreviation of ATP), based on previous income. Both systems are compulsory and organized on a pay-as-you-go basis. Both are benefit determined and financed by means of payroll taxes.

The basic pension was introduced in 1913 and provided for very low benefits.[11] In the beginning of the 1950s the remuneration level for a married couple amounted to 35 per cent of a blue-collar worker's wage. In 1960 the ATP was introduced, with benefits first being paid in 1963, and since then the standard of living of the pensioners relative to workers has continued to increase as is shown in *Figure 4.1*.

The sharp rise in average pensions relative to wages results partly from the fact that the ATP system is still in its building-up phase, which is

Figure 4.1. Average old age pension per person as a proportion of average wage per person aged 20-64 years



Source: Kruse (1988).

[11] See Bengtsson and Fridlizius (1993) for a description of the system's history.

characterized by generous transitional rules and more people becoming eligible for benefits as well as increasingly higher benefits, and partly from the fact that the pension benefits are related to inflation instead of the economic growth rate, i.e. the indexation method is a price indexation instead of a growth indexation as in a pure pay-as-you-go system. The system is now fully built out but is still in a maturing process that will not be ended until about the turn of the century or shortly thereafter.[12] In Section 4.4 we will show how the income distribution between workers and pensioners evolves under a number of demographic and economic scenarios.

Both systems feature early retirement pensions, including disability pensions, old age pensions and provision for survivors.[13] Before 1990 there were survivors' pensions (widows and children, not widowers) in both the basic pension and the ATP-system. This was replaced by an 'adaptation support' to both widows and widowers, lasting one year with the possibility of a means tested extension for another year.

Both the legally established and the actual retirement ages (65 and 63 years respectively) are the same for men and women. The mandatory retirement age was reduced from 67 to 65 in 1976, but a proposal is now before parliament to raise the age again.[14] The individual can begin drawing

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12 During the initial phase of ATP, contributions were fixed at a higher rate than necessary in order to cover benefit payments, and this gave rise to some accumulation of funds. These funds amount today to about 360,000 million Swedish crowns (SEK). This figure can be viewed in relation to the annual outgoings, which amounted to 53,000 million SEK in 1989. Between 10 and 15 per cent of disbursements on supplementary (ATP) pensions were financed by interest earned by the funds in certain years during the 1980s when revenue from contributions did not suffice to cover pension benefits.

13 In addition to these public pension systems there are negotiated pension schemes agreed between parties on the labour market as well as a wide variety of private insurances. These insurances are commented on briefly in Section 4.4. They form only a small proportion of total pensions as far as today's pensioners are concerned, but this proportion is expected to grow.

14 This is an example of what might be called a political rather than an economic sensitivity in pay-as-you-go systems, with pay-as-you-go systems being criticized for not being as stable as funded systems but exposed to political pressure. In the late 60s and in the 70s the female labour force participation rates increased considerably, increasing the contributions without giving rise to a parallel increase in pension benefits as these will be due only after many years. As there were no actuarial considerations, those who happened to be near their pensionable age at that time made large windfall

(continued...)

pension benefit between the ages of 60 and 70 by electing for advanced or deferred withdrawals of pension rights with a resultant actuarially-calculated reduction or augmentation of benefit. There are also provisions for partial pensions between the ages of 60 and 65, and for early retirement pensions. All age groups are eligible for disability pensions, but early retirement pensions have been granted with a milder form of disability test to persons between 60 and 65 years of age. Very limited advantage has been taken of the advanced withdrawal option, in contrast to both partial retirement and early retirement pensions. This is not very surprising since the latter two options contain a large element of subsidy (see Kruse and Söderström, 1989).

Table 4.2 summarizes some of the features of the Swedish pension schemes. The benefits of the basic pension are a fixed percentage of the 'base amount', a figure which follows the consumer price index and is adjusted once every year. Through this system the basic pension guarantees retirees a certain minimum purchasing power.

ATP benefits are not fixed by reference to the currently-employed population but in relation to the pensioner's previous income. Benefits are based on the 15 years in which the pensioner earned the highest income, and one must have worked 30 years with income above a minimum level (the 'floor') to qualify for full pension. For every missing year the pension is reduced by 1/30. Incomes above a certain maximum level (the 'ceiling') are not counted,

Table 4.2. Characteristics of the Swedish pension schemes

	Basic Pension	Supplementary Pension
Income bases for calculating benefits	—	Average of 15 best years
Number of years required to qualify for		
any pension	—	3 years
full pension	—	30 years
Floor (ceiling) for calculating		
benefits	—	yes (yes)
contributions	no (no)	no (no)
Indexing	prices	prices

[14](...continued)

gains, much as those near pensionable age today will make large losses. See also Browning (1975) for an analysis of the political sensitivity of pay-as-you-go systems.

but pension premiums are taken from all income, including that falling below the 'floor' and above the 'ceiling'.[15] The placing of floors and ceilings on the benefit side and not the contribution side, the 15-year rule for the calculation of pension benefits, and the fact that 30 years suffice for entitlement to full pension mean that from the individual's point of view the link between contributions and the benefits received is very weak. The link between contributions and benefits was weakened even more in 1969 when a so-called pension supplement was introduced. This is a supplement to the basic pension paid to those pensioners who have no ATP or only low benefits from the ATP. In these low income groups the marginal tax effect is 100 per cent as the supplement is reduced by the amount of the ATP-benefit.

The effect of these rules is that the pension system subsidizes leisure time or non-market oriented work and creates incentives for a diminution of the labour supply, something that is very costly in a pay-as-you-go system. These rules also mean that people with few years in the labour market, years of part-time work, and unevenly distributed life-cycle incomes are favoured. *Table 4.3* shows the redistribution within a generation, i.e., between men and women and between socioeconomic groups, that results from the present rules. In the table the contribution rate equalizing the expected sum of contributions with the expected sum of benefits for each group is shown, referred to as neutral contribution rate. Essentially, this is the contribution rate that does not result in redistribution.

As the actual contribution rate is the same for everybody, the groups with high figures in Table 4.3 are favoured by the rules. It is evident that the basic pension is progressive, while the ATP is regressive, the two cancelling each other as to redistribution between socioeconomic groups. The redistribution between men and women is still there, however. This is partly because of the 30/15-year rules and the ceiling being more advantageous to women as

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15 The formula for calculating the ATP-benefit is

$$ATP = 0.6 * p * t/N * B$$

where p is the average of the 15 years with highest pension points (the so called 15-year rule), a pension point being defined as (y-B)/B, for $B \leq y \leq 7.5B$, where y is income, B is the base amount the value of which follows the inflation. $B \leq y$ is the 'floor', and $y \leq 7.5B$ is the 'ceiling' and where $t/N \leq 1$ for $t \geq 30$, t is the number of years in the labour market with incomes above the floor, t/N is thus the labour market factor, the so called 30-years rule.

Table 4.3. The 'neutral' contribution rate for old age pensions, by gender and by socioeconomic group[a]

	Basic pension	ATP	Total old age pension
		per cent	
Men			
I	4.1	8.0	12.0
II	4.3	7.0	11.3
III	4.7	6.6	11.3
I+II+III	4.4	7.0	11.4
Women			
I	7.8	8.5	16.4
II	8.9	7.3	16.2
III	12.3	5.9	18.2
I+II+III	10.0	6.9	16.9

[a] Group I consists of high income earners and/or highly educated people, group II of middle-class, and group III of blue-collar workers.
Source: Ståhlberg (1990).

it is mostly women who exhibit the kind of labour market behaviour favoured by the rules, and partly because of the longer life expectancy of women.

The ATP system is also indexed with the 'base amount,' with benefits adjusted to account for inflation, but not for economic growth. This means that returns are not decided by economic growth as in a pure pay-as-you-go system (see Section 4.2). In a pure pay-as-you-go system, where for example the contribution rate is fixed and total contributions in one year are used for benefit payments that year, the *distribution* of income between workers and pensioners is constant. Their relative shares of the income are determined by the contribution rate and the two groups will share the fruits of good years and the burdens of lean years on an equal footing. This is quite contrary to the Swedish system. The indexation method in the Swedish system implies that, during a period of high economic growth, the standard of living of retirees declines relative to that of the work force. This aspect of the system leads to distribution between the two groups being determined by the growth rate (see Kruse, 1988). Obviously, the Swedish system deviates widely from a pure pay-as-you-go system. In fact Table 3.9 in Chapter 3 by Gonnot in which pay-as-you-go systems in 12 countries are compared, shows that Sweden is an outlier. No other country tries to combine a high remuneration level, few years of contribution for full pension, and price indexing.

The determining of pension benefits in this way means, firstly, that the system has a 'memory' of earlier economic events, and secondly, that all adaptation to changes in incomes and/or demographic structure is thrown on to the contributions side, i.e., on to the employed in the form of changed contribution rates. Through its 'memory' the Swedish pension system is sensitive to the economic growth rate. A high growth rate means that the contribution rate necessary to cover the pension expenditures —the balanced contribution rate— can be kept low, and vice versa for a low growth rate. Both our own calculations (see Section 4.4) and the calculations made by the Swedish National Board of Insurance[16] show that a yearly growth rate of zero and two per cent, respectively, will already give rise by the turn of the century to a difference of 5-6 percentage points in balanced contribution rates, which means an increase in the contribution rate by approximately 25 per cent!

The first point to be noticed is that the system's financial status is totally unpredictable. Benefits and premiums are extremely dependent upon the future growth rate as a result of the index method, and also because benefits are limited by a ceiling which becomes more effective as the growth rate increases. When the growth rate is high the contribution base grows while the benefits are calculated on the lower income of earlier years, and, at the same time, the ceiling on ATP limits the pension benefits to an increasing proportion of pensioners. At an annual growth rate of two per cent, by the year 2025, 75 per cent of all men and 50 per cent of all women will have incomes above the ceiling. There will be tensions in the system whether economic growth is high or low. At low growth rates we can certainly expect tensions as the contributions have to be raised by 50 per cent or more. At higher growth rates we can expect tensions as the link between previous income and pension benefits is weakened. Not only will the link to previous income be weakened, but the pensioners' standard of living will also be perceived as very low. Pressure to abolish the ceiling is probable, which in turn will require an increase in contributions.

A large portion of the problems facing the Swedish system today can be classified as 'design faults', with these faults resulting in a total inability to

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16 See, for example, Sou (1990, p. 30).

adapt to changing economic conditions. On top of this weakness, the strain of future demographic developments may prove unbearable.[17]

4.4 | Demographic and economic changes and their effects on the Swedish pension system

By virtue of their very design, pay-as-you-go systems are sensitive to demographic changes. In previous sections we have shown that the rules of the Swedish system make it extremely sensitive to economic growth as well. In this section we shall show the effects of demographic changes, of different economic growth rates, and of demographic and economic changes in combination.

In Bengtsson and Kruse (1992) a model is developed which enables predictions to be made of benefit payments and premium rates under various demographic scenarios and conditions specific to Swedish development. It consists of two parts, a model for population projection and a pension model.

The pension model

The basic pension model is described by Gonnot (Chapter 3). It is based on the general formula of a pay-as-you-go system:

benefits = yearly benefit rate * average number of years insured * average gross salary * population retired

contributions = payroll tax rate * average gross salary * labour force

In order to project the Swedish system, these general formulas were adapted as follows:

benefits = (0.6 * pension points * t/N * base amount + basic pension) * population retired

[17] As is evident from Gonnot (Chapter 3) other industrialized countries' pension systems can also expect difficulties. See also Hagemann and Nicoletti (1989).

where the product between parentheses gives the individual benefits from ATP.[18] Pension points are defined as the difference between income and base amount divided by the base amount and calculated as an average of the 15 years with highest income. Pension points are calculated as the averages of five-year age groups for both men and women. The same applies to the 'labour market factor', that is, the 30 year rule, t/N (see Table A6 in Bengtsson and Kruse (1992)).

contributions = payroll tax * average pension points by age
* labour force by age

where average pension points refer to the average over all income classes for each age group, and where average pension points = (average income - base amount) / base amount.

Data from 1985 were used in the projections, and we have chosen to keep this base year for everything except labour force participation rates, which are taken from 1989 data and projections from that year. In the present study this model is extended in two directions.

As the Swedish system is sensitive to economic growth, the latter has been included. Economic growth is incorporated in the model by recalculating the future pension points for each combination of age and sex. The formulas for benefits and contributions remain unchanged. The general idea is that income distribution will be constant, but the level will change with different growth rates. We have chosen three levels of economic growth: zero, one, and two per cent per year (economic growth is expressed here in real terms, that is, net of inflation). The choice of growth rates was determined by our wish to include expected economic scenarios and at the same time to depict the system's sensitivity to economic growth. A zero growth rate is by no means an implausible or unrealistic assumption, not the least because this scenario justifies itself because it shows the expected distribution of income between workers and pensioners irrespective of growth, as will be argued below. To use a two per cent yearly growth rate as the upper limit might perhaps be considered pessimistic. However, on a long-term basis the growth rate has been between one and two per cent, so we have judged two per cent growth

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18 Benefits are underestimated by the model as we have chosen to exclude orphans' pensions, early retirement pensions prior to age 55 and survivors' pensions prior to age 55. In the year 1985, this gives an underestimation of about seven per cent.

a year to be appropriate as an upper limit. Furthermore, the implications of higher growth rates may easily be considered by extrapolation of projection results.

The second extension is a variation in the rules. We check the sustainability of the system with three different sets of rules concerning the ceiling: the current rules with a ceiling on the income for calculating benefits but not on the contributions, one scenario with no ceiling on either side,[19] and one scenario with a ceiling both on benefits and on contributions. One reason for these choices is that it enhances the understanding of the economic costs of the negative incentives created in the labour market by the lack of linkage between premium payments and benefits.

The population scenarios

The various scenarios are described briefly in Chapter 3 and in full detail in Bengtsson and Kruse (1992) and will, therefore, only be briefly commented on here. Of the six scenarios used in Bengtsson and Kruse only three were considered in the following.

The *National 1 Scenario* is based on the same assumptions as the main alternative in the official 1989 population forecast.[20] It is, therefore, based on analysis of cohort fertility and assumptions about this in the future. These cohort assumptions have then been converted to period assumptions. The result is that the period TFR is estimated to decline over the next few years and then climb slowly until the year 2010, when it will be 1.9 for all females regardless of whether they are married or not. It is assumed that it will be constant from then. The assumptions about mortality are based on analysis of period mortality, not cohort mortality. Mortality is assumed to be independent of civil status and to decrease until the year 2010, remaining constant after that. The decrease corresponds to an increase of 1.4 years in mean life expectancy of males and of 2.0 years in that of females compared with 1989. Sweden's immigration surplus is assumed to fall from 29,000 in 1988 to 10,000 in 2010, which is the main alternative in the official 1989 prognosis. The result of the National 1 Scenario turns out to coincide almost completely with the official prognosis despite some differences of methodology.

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[19] In the scenario with no ceiling, the information on pension points in table A6 in Bengtsson and Kruse (1992) is insufficient. Information on the distribution of pension points above the ceiling is also needed. This distribution is estimated on the basis of unpublished figures received from the Swedish National Insurance Board.

[20] See SCB (1989).

In the *Replacement Fertility Scenario* fertility is assumed to return to 'replacement level' in the year 2005, remaining constant thereafter. For Sweden, this increase actually took place between 1985 and 1990. Mortality is assumed to remain constant as of 1985, and net external migration is assumed to be zero. Despite the fact that Sweden today has already reached the level of fertility assumed in this scenario, this projection justifies its appellation since fertility is not expected to become any higher.

In the *Low Mortality Scenario* death rates are assumed to fall by 30 per cent for females and 45 per cent for males up to the year 2005, remaining constant thereafter. The diminution implies a rise in average life expectancy at birth by eight years for males and five years for females, i.e. 83 years for men and 85 years for women. Fertility is assumed to remain constant as of 1985, and net external migration is again assumed to be zero. The fall in death risks in the Low Mortality Scenario is significant. It seems unreasonable to assume lower mortality than this.

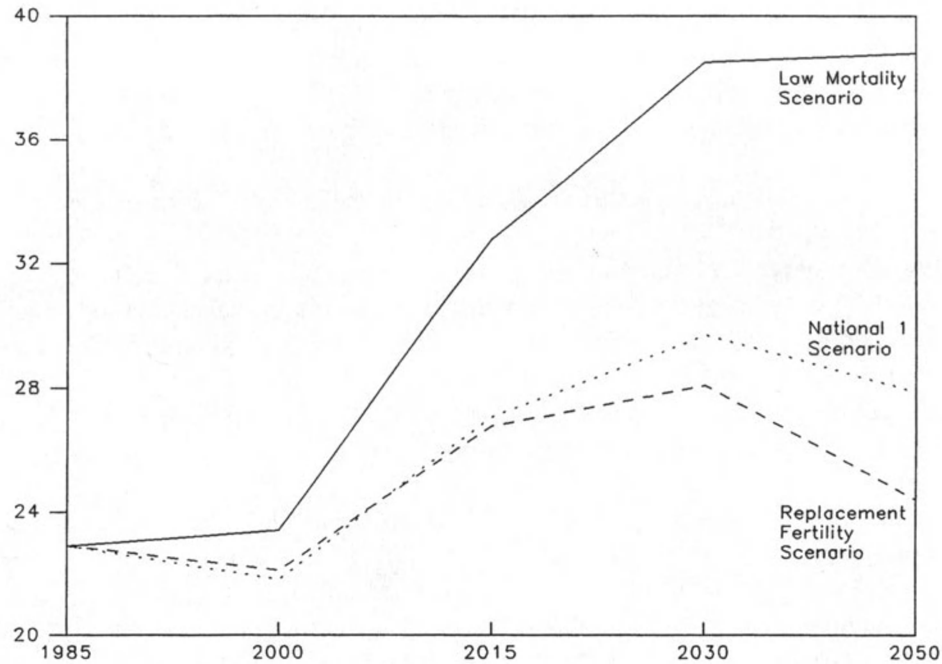
How extreme are these scenarios? Neither of them is especially extreme. Today, many countries show the same fertility as that in our scenarios. The Low Mortality Scenario is perhaps a little unrealistic, not in terms of the size of change in the death risks but in the sense that it will all take place in the period up to the year 2005. But more important than their degree of plausibility, these three scenarios probably cover the major part of a *possible* demographic futures of Sweden.

The ageing of the population and the dependency ratio

Figure 4.2 shows old-age dependency ratio (OADR), that is the number of persons aged 65 and over in relation to the potential labour force, i.e. persons aged 20-64 years. All scenarios show a pronounced rise in the OADR after the turn of the century, whether the population increases or decreases. Only on the assumption that fertility is high does the OADR diminish substantially, and even then not until after the year 2030. Moreover, in all scenarios the ratio is much higher in the year 2050 than it is today.

The increase in the OADR between the years 2000 and 2015 is partly a result of a decline in the absolute number of persons of working age, and partly a result of an increase in the number of persons aged 65 years and over. In the Replacement Fertility and the Low Mortality Scenarios, the decline in the population of working age is of the order of ten per cent. Due to the assumption of continued net immigration the decline in National 1 is about

Figure 4.2. Population aged 65 years and over as a percentage of the population aged 15-64



half that in the other scenarios. The increase in the numbers of elderly is 15-20 per cent in all scenarios except the low mortality one, where the increase is twice as high. Thus the increase in the OADR is mainly a result of the momentum of population growth, i.e. the pensioning of the 'baby boom' generation of the 1940s. The results are as we would expect from our discussion in the previous section. The increase between the years 2015 and 2030 is also a combined result of decrease in the number of persons of working age and an increase of pensioners, with a certain variation between the different scenarios.

The number of pensioners in relation to the gainfully employed population is of greater interest than the mere proportion of pensioners bearing in mind the way in which their pensions, medical care, etcetera are financed today. Since the end of the 1960s, the labour force has increased considerably more than the number of persons of working age. Thus, for example, the number of persons aged 20-64 years rose by 75,000 between 1970 and 1985, while the labour force rose by 592,000 during the same period. This is attributable exclusively to increased female participation in the labour market — the percentage of females at work rose from 59.3 to 79.2 per cent during the period while that of males fell by one percentage point. Despite this increase in the number of persons composing the labour force, the number of hours worked fell by an average of 0.2 per cent per year, partly because of longer holidays and increased parental leave (i.e. paid leave or absence from work, taken by either parent, following childbirth).

Measured in terms of labour force participation rates, the differences today between male and female participation in the labour market are small. However, females work part-time to a considerably greater extent than males even though there is some equalization arising from the fact that during the period 1963-88 females increased their average working week by 5.9 hours at the same time as males reduced theirs by 7.7 hours.[21]

Figure 4.3 shows pensioners in relation to the labour force. The difference compared with Figure 4.2 is that the projected number of pensioners is not related to that of the potential labour force, i.e. number of persons of active age, but rather to the projected actual labour force. Thus, changes in this ratio are the combined result of changes in the number of pensioners, the number of persons at working age, and the labour force participation rates. With respect to changes over time, the result is very much the same as in Figure 4.2. In all scenarios the ratio will decrease during the last decade of this century. From *Table 4.4* it is evident that this relief to the pension system emanates from a relative increase in the labour force. During the first 15 years of the next century the pressure comes from both sides, with very high increases in the number of pensioners and high decreases in the labour force. In the National 1 scenario the labour force decline is less than in the other scenarios because of the assumption of net immigration.

Furthermore, there is little hope that increases in the labour force participation rates can compensate for the decline in the number of persons of working age as these are already very high by international standards, also among women.

Demographic scenarios, current rules, and zero economic growth

The changing dependency ratios in conjunction with the rules of the pension system determine the development of the pension system. *Figure 4.4* shows

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21 See tables 3.3 and 3.4 in Jonung and Persson (1990).

Figure 4.3. Population aged 65 years and over as a percentage of the labour force

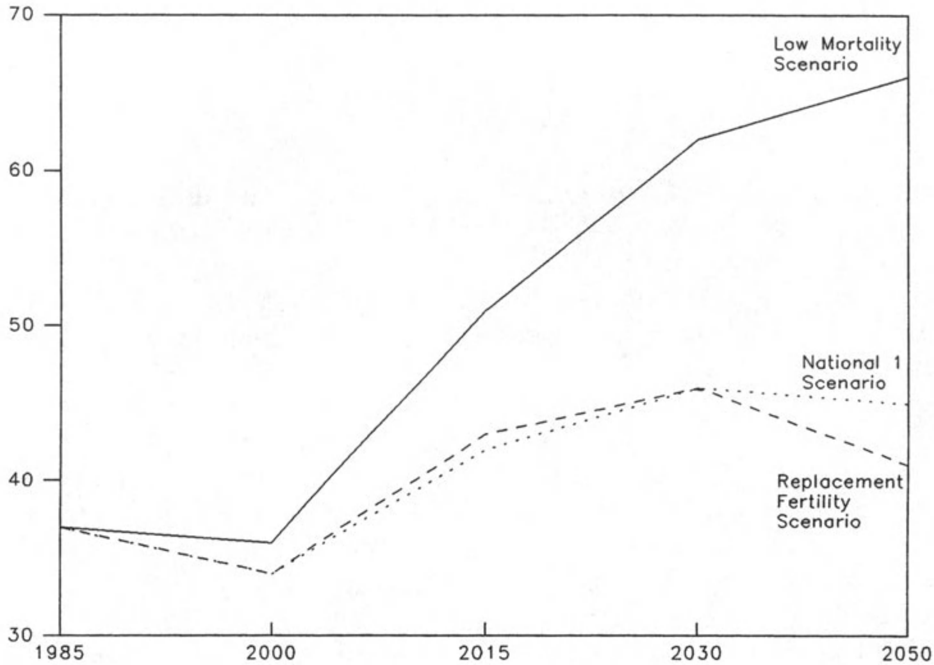
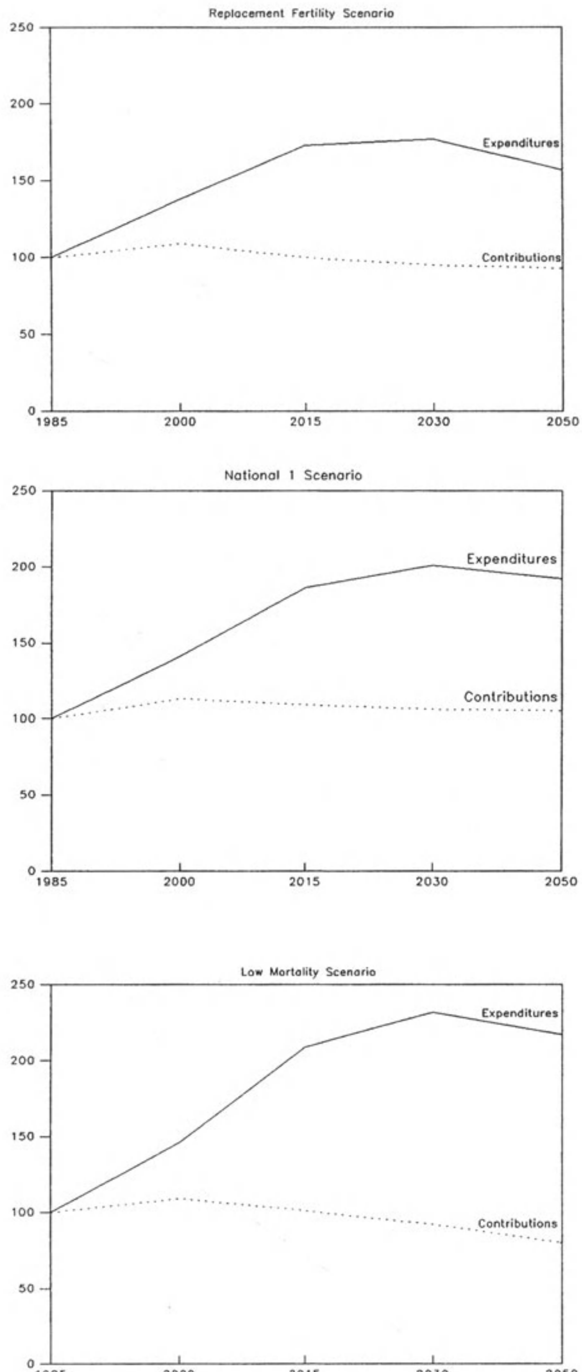


Table 4.4. Percentage change in the number of pensioners and the labour force

	1985/2000	2000/15	2015/30	2030/50	1985/2050
Pensioners					
Repl. Fertility	-0.4	14.4	2.5	-11.5	3.4
National 1	2.3	21.9	8.1	4.7	-26.3
Low Mortality	5.4	30.0	10.2	-6.7	40.9
Labour force					
Repl. Fertility	8.5	-7.5	-4.8	-1.3	-5.8
National 1	13.1	-3.1	-2.7	-1.2	5.4
Low Mortality	8.9	-7.3	-9.3	-12.7	-20.1

Figure 4.4. Expenditures and contributions according to three scenarios



expenditures and contributions for the three demographic scenarios. Despite the fact that the pensioner ratio falls somewhat in all three scenarios during the last decade of this century, expenditures on pension benefits rise continually. One of the reasons for this is that those who were pensioners in 1985 had lower average pension points and a lower number of pension-reckonable years, i.e., a lower t/N, than those who will become pensioners later. This effect will probably have vanished almost completely by about 2005, when the maturation period of the system will have ended. Another reason is the memory effect, i.e., the rapid accumulation of pension points to which the rapid increase in wages during earlier periods of high economic growth had led.

The increases to be seen after the year 2005 result largely from demographic changes. Another factor underlying the rises in benefit expenditure is that more and more women will have qualified for ever-higher pension benefits. The increasing female participation in the labour market during the 1960s and 1970s increased the contributions during that period and will make these women eligible for pension benefits just after the turn of the century and thereafter.

Increases in expenditure as are shown in Figure 4.4 cannot be covered by present contribution rates at constant incomes. If neither contribution rate nor pension benefits are changed a heavy deficit will make its appearance in the pension system. Revenue from contributions will defray only a limited portion of pension benefits, which means that the rest, amounting in certain cases to half the expenditure, must be met from other taxes or by borrowing.[22] The latter alternative, of course, means an increase in national debt left to future generations to pay for the consumption of today's generations.

It is worth reiterating that none of the scenarios is implausible or inconceivable. The range covered by the various scenarios also means that all conceivable population trends are accounted for. By the turn of the century there will already be deficits in the system, as shown in *Table 4.5*. The deficits will increase very fast until 2015, when the rate of increase slows down and even changes sign at the end of the period (except under the Low Mortality Scenario).

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22 See Bengtsson and Kruse (1992). Table 8 and Table A.9 of the Appendix in that paper show this proportion for all scenarios.

Table 4.5. Ratio contributions/benefits and balanced contribution rates (the contribution rate 1985 = 19.5 per cent)

	1985	2000	2015	2030	2050
Ratio					
Replacement fertility	1.06	0.83	0.64	0.60	0.68
National 1	1.06	0.85	0.65	0.60	0.62
Low Mortality	1.06	0.79	0.54	0.45	0.42
Balanced contribution rates (%)					
Replacement fertility	18.4	23.5	30.5	32.5	28.7
National 1	18.4	22.9	30.0	32.5	31.5
Low Mortality	18.4	24.7	36.1	43.3	46.4

The premium increases which would be necessary to cover benefit payments, assuming benefits are fixed, are shown in the lower section of Table 4.5. A comparison between the Replacement Fertility Scenario and the other two shows that it is not until after 2015 that replacement fertility has a reducing effect on the necessary contribution level compared with the Low Mortality Scenario. The reason, of course, is that there is a delay of about 20 years before the rise in the number of children has any effect on the size of the labour force, thus helping to increase the contribution base. The National 1 Scenario gives almost the same result as the Replacement Fertility Scenario mainly because of the yearly net immigration. It is plain that replacement fertility alone offers no solution to the pension problem even in the long term.

Under the assumption of zero economic growth and the current rules of the Swedish pension system it is obvious that even if the most favourable demographic scenario occurs, it will be difficult to convince those who are of working age in 2015 and thereafter that the pension contributions they are paying are reasonable. Premium increases such as these would imply serious limitations on the consumer purchasing power of those of working age, and would be bound to create conflicts between generations.

Will economic growth save the system?

The indexation of the pension system, making benefits 'inflation proof' by linkage to the base amount, B, and the ceiling on the benefit side (see footnote 15) makes the system sensitive to economic growth. *Table 4.6* shows the ratio between contributions and benefits at different growth rates.

Table 4.6. Ratio contributions/benefits at different economic growth rates

	1985	2000	2015	2030	2050
Yearly economic growth rate (per cent)					
National 1					
0	1.06	0.85	0.65	0.60	0.62
1	1.06	0.95	0.80	0.77	0.87
2	1.06	1.07	1.00	1.03	1.37
Replacement fertility					
0	1.06	0.83	0.64	0.60	0.68
2	1.06	1.05	0.98	1.04	1.48
Low Mortality					
0	1.06	0.79	0.54	0.45	0.42
2	1.06	1.01	0.83	0.78	0.94

The growth sensitivity is outstanding; in 2015 in the National 1 Scenario for example, the deficit would be 15 percentage points lower with a one per cent yearly growth rate than with zero growth and 35 percentage points lower with two per cent than with zero per cent yearly growth. It is evident, however, that a yearly growth of one per cent is not sufficient to save the system. The deficit is less than at zero growth but still substantial. It takes a yearly growth of two per cent to make the system sustainable over the whole period. The same proposition holds in the Replacement Fertility Scenario.

Our argument, however, is that even with great hopes of future economic growth, confidence should not be placed in the stability of the system. In the lower part of Table 4.6 the results with the Low Mortality Demographic Scenario are shown. Even at two per cent growth per year the system will run into a deficit shortly after the turn of the century. Let us remind ourselves that the Low Mortality Scenario is by no means impossible. The decline in mortality which is assumed under that scenario is actually weaker than the one Sweden has experienced during the last decades.

Another reason why the system should not be trusted to be stable at two per cent growth is the ceiling. The better performance at two per cent growth is caused by the ceiling limiting the benefits for an increasing number of pensioners while the contribution base, not being limited by the ceiling, is expanding. This weakens the already weak link between contributions and benefits and increases the tax wedge in the system. The figures do not take into account the fact that persons in the labour market have the option of adapting their behaviour in response to changes in the contribution rate. The increase in the tax wedge may well lead to a decrease in labour supply in response to increases in the contribution rate.[23] Such a reaction diminishes the contribution base leading to a need for even higher contribution rates. We did not consider it worthwhile to include a scenario with these labour market reactions, since the pension system is unsustainable anyhow and we expect it to be reformed even without an elastic labour supply.

The combination of ceiling and economic growth also undermines the principle that benefits should be based on the individual's previous income — the ATP system turns into an extra basic pension. This will most probably lead to demands for a reform of the ceiling, which brings us back to the deficits of the zero per cent growth scenario as will be shown below.

Finally, negotiated pensions have to be brought into the picture. These are pensions agreed upon by the parties in the labour market. They are obligatory and financed through levies on the payroll. There are four important negotiated pension systems: one for blue-collar workers, one for employees in the private sector, one for local government employees, and one for federal government employees. They are all based on the loss-of-income principle, linking benefits to previous income. The remuneration level for incomes below the ceiling is very low, but in all systems except the one for blue-collar workers, good compensation is given for incomes above the ceiling, increasing the importance of these systems as the ceiling in the public system becomes effective when economic growth is positive. In this case the contributions to the negotiated systems will, of course, have to be raised. Overall, the public system and the negotiated systems taken together will develop more or less as shown in the zero growth rate scenarios.

System variations
One way to lessen the excess burden resulting from the distortions in the labour supply caused by lack of linkage between contributions and benefits would be either to put a ceiling on both sides (scenario c-both) or to relax it from the benefit side (scenario c-no). The results are shown in *Table 4.7.*

23 See, for example, Hansson and Stuart (1985) for estimations of tax effects on labour supply.

Table 4.7. Ratio contributions/benefits with different assumptions about the ceiling and different economic growth rates. National 1 Scenario

	1985	2000	2015	2030	2050
Yearly economic growth rate (per cent)					
Current rules					
0	1.06	0.85	0.65	0.60	0.62
1	1.06	0.95	0.80	0.77	0.87
2	1.06	1.07	1.00	1.03	1.37
Ceiling on both sides					
0	1.02	0.82	0.63	0.58	0.60
1	1.02	0.90	0.74	0.68	0.71
2	1.02	0.98	0.83	0.72	0.71
No ceiling					
0	1.06	0.82	0.62	0.57	0.60
1	1.06	0.92	0.76	0.71	0.76
2	1.06	1.03	0.93	0.89	1.00

Both these ways of reforming the system increase the deficit, the increase being negligible in the zero growth rate scenario, and considerably more significant at positive growth rates. In the case with no ceiling on either side and given two per cent growth we see that the deficit does not reveal itself until 2015 and is more moderate than in the case with a ceiling on both sides. This is explained by the time lag resulting from the method of calculating benefits: as the benefits are being based on the 15 best income years this refers on average to incomes 7.5 years ago and more, whereas contributions are based on today's income.

In the case of a ceiling on both contributions and benefits there will be a deficit even at a two per cent yearly growth rate, which is also true in the case of no ceiling although to a lesser extent. In *Table 4.8* we give the results for different demographic scenarios as well.

As remarked earlier, one strong reason for changing the current rules, either by introducing a ceiling on both sides or by relaxing it on both sides, would be to lessen the pressure of taxation. These measures would increase the linkage between contributions and benefits, making the system more actuarial, and thereby reducing the excess burden of taxation. It is evident that such changes of the system are not sufficient to make it sustainable.

Table 4.8. Ratio contributions/benefits. Current rules and no ceiling, different economic growth rates and different demographic scenarios

	1985	2000	2015	2030	2050
Current rules: g = 0 per cent					
National 1	1.06	0.85	0.65	0.60	0.62
Replacement Fertility	1.06	0.85	0.64	0.60	0.68
Low Mortality	1.06	0.79	0.54	0.45	0.42
g = 2 per cent					
National 1	1.06	1.07	1.00	1.03	1.37
Replacement Fertility	1.06	1.05	0.98	1.04	1.48
Low Mortality	1.06	1.01	0.83	0.78	0.94
No ceiling: g = 0 per cent					
National 1	1.06	0.82	0.62	0.57	0.60
Replacement Fertility	1.06	0.80	0.61	0.58	0.65
Low Mortality	1.06	0.76	0.51	0.43	0.40
g = 2 per cent					
National 1	1.06	1.03	0.93	0.89	1.00
Replacement Fertility	1.06	1.02	0.92	0.90	1.08
Low Mortality	1.06	0.97	0.77	0.68	0.69

Reforming the pension system

In most scenarios there will be large deficits. It might be possible to pick a scenario where the future does not look too gloomy. There is, however, no higher probability for such a scenario than for any of the others. As long as there are deficits, not reforming the system means that consumption takes place on a loan basis, thus increasing the national debt. Future generations are required to pay for today's consumption. If this is considered unreasonable and/or economically unsound the system has to be changed. It will not be sufficient merely to raise the contribution rate or to lower the benefits, since both these options eventually give rise to a distribution between workers and pensioners that will be perceived as unreasonable and unfair.

The pension system establishes a distribution of consumption over the life cycle via levels of contributions and pension benefits. In a pay-as-you-go system, the assets which individuals build up are not funded but take the form of charges on the result of future production whereby the working generations of the future, through their contributions, relinquish part of their incomes. In this way the pension system, via the regulations governing it and the levels of contributions and benefits, establishes the distribution between persons belonging to the labour force and pensioners. For the pension system to work this distribution must be perceived as reasonable. Figure 4.1 measured how this distribution evolved between 1970 and the mid-1980s. The growth of an average pension in proportion to an average wage from 30 to 35 per cent in the early 70s to 65-75 per cent in the middle of the 80s might well be considered reasonable. By examining the results presented in the tables in this section, it is easy to get an idea of the income distribution between workers and pensioners that will result under the various scenarios; and this income distribution cannot be considered reasonable in most instances.

If the contribution rate is not raised, the ratio between contributions and benefits shows how much benefits will have to be reduced in order not to leave a deficit. In this case the workers' position is preserved and the burden is totally borne by the pensioners. If on the other hand the contribution rate is raised in order to cover the pension benefits established according to the regulations, the workers' consumption entitlements will suffer a proportionate reduction. The distribution between workers and pensioners will shift in accordance with economic and demographic changes, not as a result of a conscious decision as to what distribution is desirable. This is an unstable situation and calls for a reform of the pension system.

The most important reform would be to change the indexation method from an inflation indexation to an economic growth indexation. The distribution between the groups will then be fixed and the consumption entitlements of both groups will follow the economic trend. Furthermore, a strengthened linkage between contributions and benefits with a view to minimizing the excess burden would increase the efficiency of the system.

4.5 | Conclusions

In this chapter we have looked at the consequences of economic growth for the performance of the system of public pensions in Sweden until 2050. The Swedish system is rather strongly influenced by economic growth rates. Therefore, economic growth was explicitly introduced into the Swedish model which was used in this chapter, whereas in Chapter 3 economic growth was largely ignored (in other words, it was implicitly assumed there that per capita wages would grow at the same rate as per capita pension benefits).

Growth sensitivity of the Swedish pension system was clearly demonstrated in Section 4.3. For instance, Table 4.6 shows that under the High Fertility Scenario, the ratio between total contributions and total benefits in the year 2050 would amount to 0.68 with zero growth, and to no less than 1.48 with an annual real growth rate of two per cent. Under the Low Mortality Scenario the 2050 ratio would be 0.42 (no growth) and 0.94 (two per cent growth). Given the fact that the pension system currently is quite well balanced (a ratio of 1.06 as of 1985), these figures show a dramatic impact of economic growth on the system's performance in the long run. This comes on top of the system's sensitivity for demographic developments, which was extensively investigated by Gonnot in Chapter 3. Stated differently: public pension expenditures that are based on demographic considerations alone sketch a much worse picture of the future system's performance (a contribution/benefit ratio of between 0.42 and 0.68 in 2050) than projections which take economic growth into account as well (a ratio of between 0.94 and 1.48).

An important reason for the system's sensitivity for economic growth is the role played by pension points and the ceiling on the income from which benefits are calculated. See Section 4.3. Firstly, pension points depend on current income and on a fixed (i.e. indexed for inflation only, not for economic growth) base amount. With relatively high economic growth, pension points grow fast, but not as fast as the contribution base; in other words: average wages grow significantly faster than average pension benefits. Secondly, the ceiling sets an upper limit to individual benefits (other things remaining equal), and when economic growth increases, the share of employees with wages above the ceiling increases, too. This implies that the contribution base would rise steeper than average benefits; the retiree's standard of living would decline further relative to that of workers. For these two reasons economic growth would be beneficial to the performance of the system. However, growth would be harmful to those who retire. The earnings related part of the Swedish pension, the ATP pension, would simply turn into an extra basic pension. And as a consequence, the negotiated pension —currently implemented in order to compensate some of the earnings beyond the ceiling— would take on the function of today's ATP system.

Until only recently the 'official' truth in Sweden has been that the pension system is sustainable when economic growth is two per cent per year. This is true only if demographic variables behave in a favourable way — an important condition here is that mortality rates at old ages do not decrease any further (which would be a change in the trend of more or less continually falling rates). But even if the population of Sweden would witness such a favourable demographic development, the pension system would not be stable, because the incomes of employees would follow economic growth, and those of retirees only inflation. On the long run, assuming positive real economic growth, the result is a slowly widening gap between the incomes of employees and retirees, and this would increase the pressure upon authorities to reform the system. This pressure is not only due to financing problems but also to increasing inequality.

In addition to the investigation of economic growth impacts, we looked at two possible pension reforms that are being discussed in Sweden at present: (i) to introduce a ceiling on the income from which contributions are calculated (in addition to the ceiling on the benefit side), and (ii) to remove the current ceiling on the benefit side. In both cases the main aim would be to establish a more direct link between contributions and benefits. As could be expected, both reforms would lead to a deterioration of the system's performance (see Tables 4.7 and 4.8), and the differences with results for the current system are much larger with two per cent economic growth than with zero growth.

Reforms of the kind discussed in this chapter are unavoidable both in order to re-establish the link between individual contributions and benefits and to avoid inequalities between actives and retirees. However, they would not solve the ageing problem. With those reforms the Swedish pension system's peculiarities would be removed, making it more similar to the 'average' European system. Sweden faces the same problems as all other European countries. The reforms suggested and tested in Chapter 3 of this book are still relevant and important.

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5. CHANGING FAMILY STRUCTURE AND AN EMANCIPATORY PENSION POLICY: the case of Austria

Christopher PRINZ

5.1 | Introduction

Fertility and social security issues are frequently dealt with simultaneously, as several links between low fertility and the existence of social security and particularly pension provisions exist. In societies which lack collective systems to provide for retirement, people are dependent on their offspring for old age security. In such societies, old age security is recognized as one of the motives for having children (Joshi, 1991). As a consequence, pension provision has been suggested as a policy to reduce birth rates in poor, high fertility countries.

Pension provision has also been pointed at as an explanation of low fertility in rich countries. As Paul Demeny (1987) said:

> "*The emergence of national social security schemes that made old age support a collective social responsibility completed this process [of weakening the motives for having children] by severing the link between persons' economic status in old age and their fertility behaviour in the earlier stages of adulthood.*"

J.-P. Gonnot et al. (eds.), Social Security, Household, and Family Dynamics in Ageing Societies, 149-179.

Falling fertility rates cause a problem for the financing of old age security, since large generations of the retired expect transfers from a smaller generation of workers. This is particularly true for pay-as-you-go social security systems which characterize Austria and most industrial countries. Each generation of workers contributes collectively to the pensions of their predecessors, hence current and expected changes in the age structure will put a strain on this inter-generational contract. One way to resolve the difficulty would be to maintain fertility at replacement level. It was suggested that the new direction for pronatalist policies

> "*should be a search for institutional innovation that would re-establish the positive material link between fertility behaviour and old age security*" (Demeny, 1987).

Rather than transferring part of individual social security contributions directly to living parents as suggested by Demeny, the pension reform proposed in this study increases entitlement for retired women according to their parity. Additional benefits do not depend on the professional activity and income of a women's own children but only on the number of children she has raised. The pension policy should have several effects: Firstly, the policy aims at re-establishing the positive link between childbearing and pension entitlement. Women with children should no longer be discriminated with respect to their income during the period of retirement (emancipatory goal). Secondly, the policy aims at increasing fertility to avoid excessive population decline. Women should be encouraged to give birth to additional children by offering them certain pension benefits in dependence on the number of children born (pronatalist goal). Thirdly, the new pension system should not significantly worsen the performance of the social security system in general, even if there is no response to the implementation of the system in the form of an increase in birth rates (performance neutrality).

The feasibility of the proposed pension reform has to be tested on both the system level and the individual level. A cost-benefit analysis on the social security system level demonstrates under which circumstances the policy is affordable. A cost-benefit analysis on the individual level shows whether the policy is reasonable.

5.2 | Demographic model and data

A projection of the female population by family type is needed from the demographic side to calculate costs and benefits of the pension policy proposed. In the projection model, family type is characterized by the dimensions age, marital status, and number of children ever born.

The projection model fulfils the minimum requirement for a family model, that is connecting adults and children, and it is of the dynamic multistate type. The model allows simultaneous analysis of family formation processes for two dimensions, marital status and number of children ever born. It is based on the concept of the 'family related life cycle of individuals' which is an extension of the 'family cycle concept'. The latter assumes a standard sequence of events given a nuclear family (i.e. first marriage, birth of the first child, ..., birth of the last child, ..., death of the spouse), neither allowing for different sequences, e.g. first marriage only after the birth of the first child, nor for different events, like divorce or remarriage. The family related life cycle concept, which is still based on legal marital status, however, is flexible both with respect to possible events and to their sequence.

The increase of new living arrangements, like non-marital consensual unions, has introduced new limitations to the concept of the life cycle. Considering marital status only, it is for example not possible to distinguish between an unmarried two-parent family and a family consisting of a single mother and her child(ren). The extent of the bias connected with the choice of using marital status depends on the particular country under consideration and on the extent to which marital status is a good predictor of the relevant behaviour of the individuals considered. For the following analysis it seems appropriate to rely on legal marital status statistics. In Austria, marital status still is a reasonable proxy for living arrangements of individuals aged 25 years and over. The Austrian pension system now as before uses information on marital status and not on actual living arrangements.

The model is a one-sex model, which is typical for most of the family models in operation. It is hierarchical with respect to the parity dimension and to the increment-decrement type in the marital status dimension. It distinguishes 12 life cycle stages of a woman, namely:

- never married, no child;
- never married, one or more children;
- married, no child;
- married, one child;
- married, two children;
- married, three or more children;
- widowed, no child;
- widowed, one child;
- widowed, two or more children;
- divorced, no child;
- divorced, one child;
- divorced, two or more children.

It is assumed that births of parity 4+ among married women, parity 3+ among widowed and divorced women, and parity 2+ among never married women do not cause a change in the life cycle. Changes in the life cycle result from birth of a child (depending on parity), first marriage, divorce, remarriage, and widowhood caused by the death of the husband. Removal or death of a child does not affect the mother's life cycle, since both the model and the pension policy investigated are based on the number of children ever born. Demographic events that affect the life cycle are assumed to occur independently. Possible events included in the model are given in *Table 5.1*.

Entry into and exit from the state space, namely birth of a girl and death of a woman, both depend on a woman's age and marital status, but are —due to a lack of available data— independent of the number of children already born. Marriage, divorce, and remarriage depend on age and the number of children born, widowhood depends only on a woman's age.

The model belongs to the family of multidimensional population projection models which are based on the Markovian assumption. That is, the model supposes that future behaviour only depends on current status, and not on the path via which this status was reached. For some of the variables considered, this assumption may be too crude an approximation of reality, since for example divorce rates increase with marriage order. However, to incorporate such dependencies would greatly complicate the model. A detailed mathematical description of multistate projection models is, for example, given in Willekens and Drewe (1984).

Table 5.1. Possible events considered in the family model

Life cycle status before event:	Life cycle status after event: s0	s1	m0	m1	m2	m3	w0	w1	w2	d0	d1	d2
nev.mar., 0	-	B	M	*	*	*	*	*	*	*	*	*
nev.mar., 1+	*	-	*	M	M	M	*	*	*	*	*	*
married, 0	*	*	-	B	*	*	W	*	*	D	*	*
married, 1	*	*	*	-	B	*	*	W	*	*	D	*
married, 2	*	*	*	*	-	B	*	*	W	*	*	D
married, 3+	*	*	*	*	*	-	*	*	W	*	*	D
widowed, 0	*	*	M	*	*	*	-	B	*	*	*	*
widowed, 1	*	*	*	M	*	*	*	-	B	*	*	*
widowed, 2+	*	*	*	*	M	M	*	*	-	*	*	*
divorced, 0	*	*	M	*	*	*	*	*	*	-	B	*
divorced, 1	*	*	*	M	*	*	*	*	*	*	-	B
divorced, 2+	*	*	*	*	M	M	*	*	*	*	*	-

events: B ... childbearing
M ... marriage or remarriage
D ... divorce
W ... widowhood
* ... impossible event
\- ... no event.

Status-specific fertility and mortality rates were taken from the data base of the Austrian Statistical Office. Occurrence/exposure rates between life cycle stages have for the most part been made available from a recent study undertaken by the Demographic Institute of the Austrian Academy of Sciences (Aufhauser and Lutz, 1987). In this study, a similar model was used to analyze the family related life cycle of Austrian women from a purely demographic point of view. Occurrence/exposure rates were estimated on the basis of the Austrian 1986 Microcensus, where women aged 16-59 were asked about their complete marriage and birth biography. The respective population at risk and the number of events, i.e. changes between statuses, were estimated on a monthly basis for the years 1981-86 to calculate monthly rates. To eliminate random fluctuations, average monthly rates for the period 1981-86 have been converted into annual occurrence/exposure rates.

With these 12 life cycle statuses, the number of possible transitions is 28: 12 for marriages (first marriage or remarriage), four for divorce, four for widowhood and eight through birth of a child. Another 12 transitions result from the exit from the state space (death). All newborns enter the population via the status never married/parity zero.

Projections of the number of women by age, marital status, and number of children born were prepared using the DIALOG personal computer software, a multidimensional population projection model, developed by Sergei Scherbov (Scherbov and Grechucha, 1988). This projection model is a mixture of the linear and the exponential type, while occurrence/exposure rates are estimates of the parameters of an exponential model. The resulting bias, however, is not of significance for the purpose of testing policy reforms. Starting with the 1985 female population of Austria by age, marital status, and number of children born, the future population distribution is obtained by applying the estimated transition intensities, taking into account observed status-specific fertility and mortality rates.

5.3 | A policy simulation tool

Combining the demographic family model with a pension model and cost profiles of social security expenditures, a policy simulation tool is obtained which allows testing different social security policies. The simulation tool can be used not only to look at the performance of the social security system but also at policy consequences for individuals, i.e. women.

5.3.1. The pension model

The pension projection model is the one used in the comparative study of which results are presented in Chapter 3 of this book. Benefits received by an individual are calculated as the product of the yearly benefit rate, the number of years insured, and past gross salary. Since no information on salary by life cycle status was available and the yearly benefit rate is constant, only the number of years insured differs by life cycle status. Like for the model in Chapter 3, number of years insured are assumed to equal the number of years worked and are thus estimated from observed labour force participation rates along cohort lines. Labour force participation rates of Austrian females are available both by marital status and by number of children born, but cross-classifications by marital status and number of children, i.e. by life cycle status, had to be estimated. Labour force participation rates are kept constant at their 1985 level. Observed recent increases in female labour force participation rates result in an increase in the number of years worked of around 3-5 years by 2015. The estimation procedure resulted in life cycle status-specific average number of years worked at mean age at retirement as shown in *Table 5.2.*

The average number of years worked is highest among divorced and lowest among married women, and strongly declines with the number of children born. For example, married women retiring in 1985 with parity zero have on average worked 29.6 years, and women of parities one, two, and three plus worked around five, ten and twelve years less, respectively. Similar differences in work histories have also been discovered in other countries. In a recent Norwegian study, it was estimated that a woman born in 1950 who has had two children, the first at age 21-22 and the second a couple of years afterwards, worked 6.8 years less up to age of 37 than a childless woman (Kravdal, 1991). In a British analysis it was estimated that the time diverted from market work by a two-child mother was 9.1 years up to age 60 (Joshi, 1990).

Other variables needed to calculate total pension benefits are kept constant at their 1985 level: the proportion of the population retired at each age (90

Table 5.2. Average number of years worked by life cycle status, 1985 and 2015

Life cycle status	1985	2015
never married, parity 0	30.6	34.7
never married, parity 1+	24.9	28.3
married, parity 0	29.6	34.3
married, parity 1	24.1	27.9
married, parity 2	19.0	22.0
married, parity 3+	17.6	20.3
widowed, parity 0	30.5	35.3
widowed, parity 1	24.8	28.7
widowed, parity 2	19.5	22.6
widowed, parity 3+	18.0	20.9
divorced, parity 0	36.0	40.9
divorced, parity 1	29.3	33.3
divorced, parity 2	23.0	26.2
divorced, parity 3+	21.3	24.2

per cent of all women aged 55 and over), the mean age at retirement (58.9 years), and average gross salary of women (141,192 Austrian Schillings per year).

5.3.2. An emancipatory and pronatalist pension scheme

Continued fertility below replacement level significantly reduces the size of the population and of the labour force and most likely a country's economic competitiveness. Pay-as-you-go pension systems are, however, only sustainable on the basis of an increasing or at least constant cohort size. Today's level of fertility in Austria is around 1.4-1.5 children per woman thus reproducing only around 70 per cent of a generation. With no change in fertility, Austria's population would decline from around 7.5 million in 1985 to around five million in 2050. Introducing a pronatalist policy may be one possibility to increase fertility, although hardly any signs indicating a shift from increased individualism and desire for independence back to familism or rather towards a new and modern form of familism can be observed. As an example, Karl Schwarz (1992) has shown that in Germany the introduction of parental allowances, parental leave, and the crediting for parental periods with old age pensions in 1986 has not affected fertility rates. One reason for the low number of births is the bad financial situation of families and more so of one-parent families, which still to 90 per cent consist of women and their child or children. Parents are materially disadvantaged against individuals or couples without children. Childbearing costs have increased to an extent that in no way reflects the essential contribution the existence of a child makes to the future society. Not only are women and especially unmarried women with children discriminated during the time of childbearing, but also during retirement. Consequently, the notion of a pronatalist policy has to be expanded to that of an emancipatory policy as well.

The proposed pension policy includes a provision of five years counting as years of insurance per child born —up to three children— i.e. five years for one child, ten years for two children, and maximally 15 years for three or more children, to compensate for the interruption of work during active life. It is not possible to compensate a woman's loss of career opportunities. Compensation of direct childbearing costs by increasing child allowances is not considered in this paper since the aim was to test a pension policy and not policy options in general.

The suggested emancipatory and pronatalist policy is easy to implement both in the pension model in hand and in reality. A problem might arise in the case of women who do not take care of their children, e.g. after a divorce. It is assumed that those women do not loose their pension rights. In the model, years worked are set equal to years of insurance, thus the respective status-specific number of years worked (see Table 5.2) is increased by five, ten, or 15 years for women with children. Whether providing five years per child is sufficient to make up for the pension disadvantage of mothers during their retirement is tested in the model. Only women are considered, since still most fathers' economic activity is not affected by the birth of a child. What is not considered in the model is a possible reaction to the new policy in the form of a reduction in female labour force participation rates. Although such a reaction is possible, in practice it is rather unlikely since women's economic activity has clearly increased during recent decades and is generally expected to increase even further. In the model, constant activity levels are assumed which reflects the author's belief that activity rates, even with the new policy introduced, will increase rather than decline.

The pension policy to be implemented has a second characteristic, namely a gradual cancellation of the provision of survivor benefits. Survivor benefits or widowhood pensions at least in Austria mainly ensure a minimum income for elderly woman; they make up around 35 per cent of total pension expenditures paid to women in 1985. Survivor benefits provided by the current system equal 60 per cent of the husband's former pension, independent of the woman's own old age pension. Within the framework of an emancipatory and pronatalist pension policy it seems reasonable to partly or even completely cancel survivor pensions, depending on how many additional years per child counting for the pension are provided. In this model, a complete cancellation of survivor benefits is assumed in the long run. Whether savings to the state due to the cancellation of survivor benefits are sufficient to compensate additional old age benefits provided by the new pension scheme is one of the major questions to be tested in the model.

For the introduction of the pension policy a period of smooth transition is assumed. The new system is implemented for birth cohorts 1946 and thereafter only, i.e. for women below age 40 in 1985. During the coming two decades the old pension system is still in operation. From 2005 on, new retirees receive their benefits according to the new rules. From this time on, two parallel systems are in operation until the new system reaches maturity (around 2030). This smooth transition period was taken for both old age and survivor pension benefits, thus increasingly cancelling provisions of survivor benefits until the year 2030.

Two scenarios concerning future fertility were tested: (i) a Constant Rates Scenario assuming that marital status-specific fertility levels remain constant at their 1985 level (TFR of 1.47), and (ii) a High Fertility Scenario assuming an increase in fertility of half a child per woman, resulting in a TFR of almost two children per woman. Both scenarios assume that mortality, (re)marriage, divorce and widowhood rates remain constant at their 1985 level. Occurrence/exposure rates between life cycle statuses that are related to fertility, e.g. the jump from married/parity one to married/parity two, are changed proportionally to the change in fertility. The increase in fertility which is assumed in the High Fertility Scenario is based on the possibly unlikely assumption of an immediate response to the pronatalist pension policy introduced. While it is not possible to foresee whether women actually respond to an emancipatory and pronatalist pension policy by giving birth to additional children, it is possible to calculate costs and benefits of different pension policies on the basis of certain assumed population developments and reactions.

For the social security system the cost neutrality of the new pension system is the main concern. Other macroeconomic consequences of both the policy itself and a possible fertility increase, like additional education expenditures or shifts in consumption and savings, are not considered.

5.3.3. Cost profiles of social security expenditures

In a first step, total and per capita pension benefits were calculated, both with the current system and with the new regulations. Such we can derive how much benefits an individual would gain per additional child in the pronatalist regulation and how much this would possibly cost the system.

In case of an immediate and full response to the pension policy —that is assuming that women decide to give birth to additional children— several additional calculations are required to estimate the performance of the social security system (see *Table 5.3*). An increase in the number of children and hence in total population size would directly affect expenses of other social security programs, such as health expenditures (mainly benefits in kind), work injury and unemployment benefits (only cash benefits), and family benefits including both family allowances and maternity benefits (also cash benefits only). Additional social expenditures, like for example education expenditures, are not considered in this analysis.

Additional social security costs may —at least in the long run— be covered by additional contributions paid by an increased labour force. For the

Table 5.3. Social security revenues and expenditures included in the model

Revenues and expenditures with the current social security system	
plus additional old age pension benefits minus survivor pension benefits	due to the new system
plus contribution losses due to lower economic activity of women minus contributions of the additional labour force plus additional health expenditures plus additional family allowances and maternity benefits plus additional work injury and unemployment benefits	due to a response to the new system, i.e. an increase in fertility

calculation of contributions to the social security system, the contribution rate was kept constant at the 1985 level which was 43.7 per cent of gross salary liable to contributions, 15.6 per cent and 28.1 per cent for employees and employers, respectively. On the other hand, additional children would also lessen the average number of years a woman works and thus reduce social security contributions somewhat.

In contrast to pension expenditures, additional social security expenditures are estimated on the basis of per capita age-cost-profiles. Observed age-cost-profiles for Austria in 1986 were taken from Findl, Holzmann, and Münz (1987) and kept constant throughout the projection period. According to their estimates, Austria's total social security expenditure in 1986 was around 335 billion Austrian Schillings (ATS) or 29.5 per cent of GNP, of which 60 per cent was paid for pensions. A further 22 per cent was used on health expenditure, 11 per cent on family benefits and seven per cent on work injury and unemployment benefits. Social security expenditures depend not only on age but also on marital status. Hence, in this model age-marital status-cost-profiles would be preferred. But as information on the marital status structure of social security costs is lacking, only age-profiles were used. As a consequence, future health expenditures are probably underestimated. This bias results from the increase in the elderly population living alone —the group with highest per capita health costs— an increase that is not accounted for in the calculation of health expenditures. Observed age-cost-profiles of social security expenditures for the three social security programs are given in *Figure 5.1*. Health expenditures increase with age, while family benefits mainly apply to the youngest age-groups. Unemployment is more frequent at ages 20-30 and ages 50-60, work injury mainly concerns people aged 50 and over.

Figure 5.1. Age-profiles of social security costs in Austria, 1986

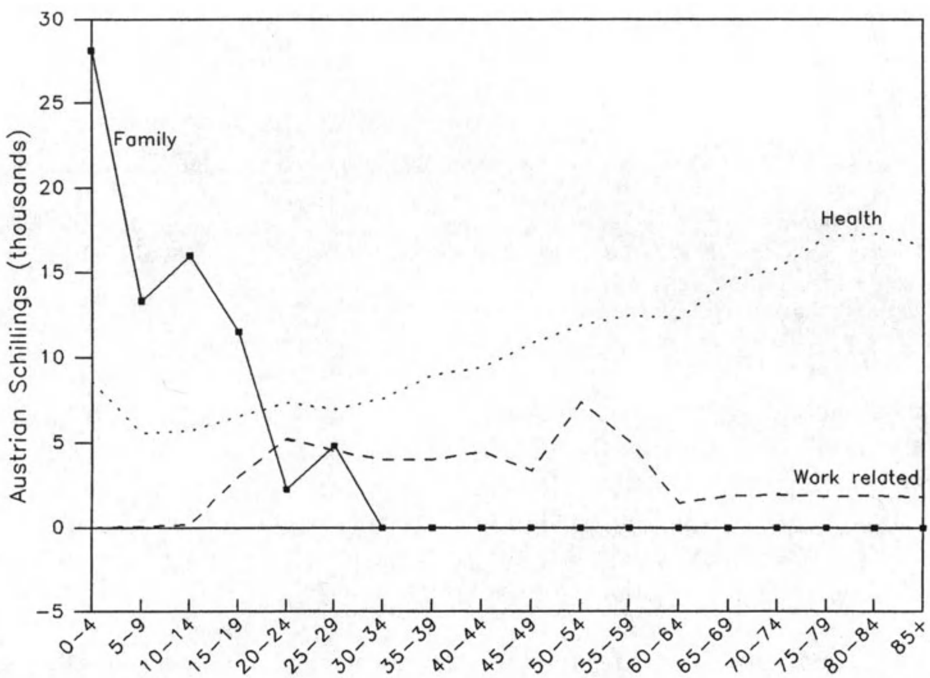


Table 5.4. Child-rearing costs by number of children present in the family (in ATS)

Child-rearing costs	1 Child	2 Children	3 Children
Per month	5,230	5,970	6,950
During life	1,254,000	1,566,000	1,923,000
Per child	1,254,000	783,000	641,000

Source: Own calculations based on Münz (1984).

5.3.4. Childbearing costs and a funded pension scheme

On the individual side, the aim of the pension policy is to remove disadvantages during retirement, while disadvantages during active life are not affected. However, the model does consider savings losses that are caused by direct childbearing costs. It is assumed that a women uses a certain percentage of her income, in the general model set equal to ten per cent of gross salary, to realize a private funded or savings-type pension scheme. Childbearing costs lower the income of which ten per cent is accumulated. The funded pension scheme can thus be seen as an alternative to the emancipatory and pronatalist pension rule to be implemented. A woman with children can benefit from the new public pension scheme but less money will be accumulated for her privately funded pension.

Based on data on childbearing costs by household expenditure and number of children published in Münz (1984), childbearing costs by number of children present in the family were estimated for 1985 as shown in *Table 5.4*. Those data give childbearing costs including proportional housing costs after subtraction of family allowances.

Given monthly costs by number of children present in the family, i.e. data in the first row, lifetime costs were estimated on the basis of a specific family formation schedule. Assumptions concerning this schedule include: age 25 at first birth, a two and a half year birth interval, a 20 year childbearing period per child, and a maximum of three children per woman. Consequently, a mother of one child spends 20 years with her child, a mother of two children spends five years with one child and 17.5 years with two children, and a mother of three children spends five years with one child, five years with two children and 15 years with three children thus spending 25 years with children altogether.

Data in Table 5.4 show that additional costs resulting from a second and/or third child are to a large extent covered by family allowances, although it looks as if a third child more often leads to a change in housing, because the difference between two and three children is larger than the difference between one child and two children. During a woman's life, costs for one child amount to 1,254 million Austrian Schillings or nine times the average yearly gross salary. Costs for two and three children are, respectively, 25 and 53 per cent higher than costs for only one child.

Lifetime childbearing costs by number of children (Table 5.4) can also be compared with a woman's average lifetime salary. Costs for one child correspond to 36 per cent of the estimated lifetime salary of a woman of parity one, costs for two and three children amount to 56 and 76 per cent of the estimated lifetime salary of a woman of parity two and three, respectively. Comparing costs per child in one, two, and three children families, each child in a three children family is half as costly as a child without siblings.

Now, to the lower pensions: savings losses due to childbearing are calculated out of lifetime childbearing costs. Since women bear their children in their twenties (between age 25 and 30 in our model), for those women who do not have children there is a long period to accumulate saved money until retirement. For that purpose an actuarial calculation was added, assuming real rates of interest equal to zero, one and a half, and three per cent.

A second factor reducing a mother's pension —apart from savings losses due to direct childbearing costs— is the lower economic activity resulting from the interruption of work during upbringing of children. Lower economic activity again lowers income, of which ten per cent is accumulated in the saving-type pension scheme, a fact that is also taken into consideration in the actuarial calculation. Consequently, from an individual point of view, the relevant calculations oppose pension benefit gains that are due to the new pension scheme, and savings losses that are due to childbearing and could alternatively be invested in a private savings-type pension scheme.

The life expectancy at mean age at retirement, which was 23 years in 1985, was set constant. This variable is needed to distribute total savings losses due to both childbearing costs and lower economic activity over the period of retirement. While pension benefit gains are calculated on a yearly basis, savings losses are calculated on a lifetime basis and hence have to be distributed over years of retirement to make gains and losses comparable. On average, this distribution procedure is correct; on an individual level, however, women who survive more than 23 years after retirement gain more than the average.

5.4 | Female population structure

The marital status structure of the adult female population by parity is shown in *Table 5.5*. Half of the population aged 15 and over is married with at least one child, and one-fifth is never married without children (mainly young women). Every sixth woman is widowed (mainly old women), most of them have two or more children, and only five per cent are divorced.

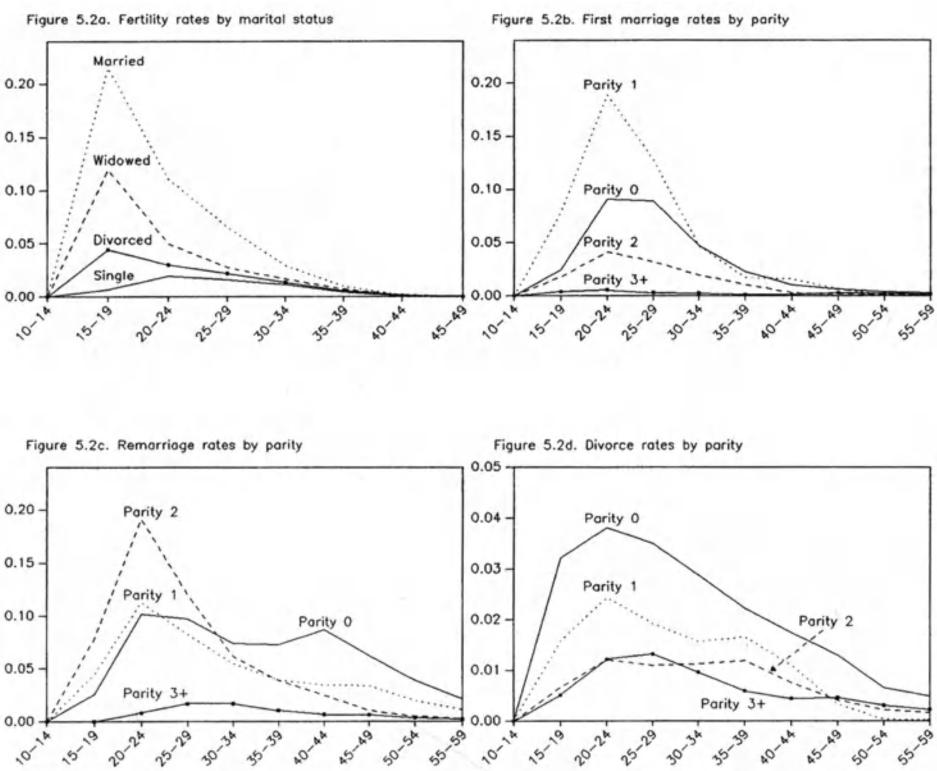
Age-specific transition rates are shown in *Figures 5.2a-5.2d*. Fertility rates are by far highest among married women. In many cases marriage still is

Table 5.5. Women aged 15 years and over by life cycle status, 1985 (percentages)

Status	Never married	Married	Widowed	Divorced
Parity 0	19.7	5.2	1.7	0.7
Parity 1	3.5	13.2	3.0	1.9
Parity 2	-	18.9	5.1	1.8
Parity 3+	-	17.6	7.0	0.7

Source: Own calculations based on Microcensus 1986.

Figure 5.2. Age-specific rates for fertility, marriage, and divorce of females, Austria, 1985



a prerequisite for a birth. Note that widowed women have higher birth rates than divorced and never married women (see Figure 5.2a). For example, the average number of children born by a married woman during her main childbearing ages (ages 20 to 35) is 1.03. The corresponding figures are 0.47, 0.33 and 0.23, for widowed, divorced and never married women, respectively.

Marriage rates are highest among never married women of parity one, a first birth often being the reason for a first marriage (see figure 5.2b). For women with two or more children, first marriage rates are significantly lower than for women without children. Remarriage rates of divorcees among women with parity 3+ are by far lower than among parities 0-2 (see figure 5.2c). Both first and remarriage rates peak at age 20-24 and decline rapidly with age, the exception being remarriage rates among childless women which indicate a second peak at age 40-44. Divorce rates clearly decrease with parity, independently of a woman's age (see figure 5.2d). Divorce rates also indicate a first peak at age 20-24 and, except for childless women, a second peak at around age 40.

Similar to fertility, mortality rates are lowest for married women, but they differ insignificantly for the other marital statuses. The results of the demographic family model are already interesting by themselves. Both the structure by marital status and by number of children ever born will change significantly. Changes in the marital composition have been documented in Chapter 3 of this volume. *Table 5.6* gives results concerning the number of children born per woman only. Since the aim of this policy simulation is also of a pronatalist nature, resulting changes in the population structure are especially interesting with respect to changes in fertility.

In 1985, an almost equivalent share of women fell in the categories parity zero, one, two, and three plus (see Table 5.6). Assuming both constant fertility and constant family formation and dissolution rates (Constant Rates Scenario), the share of women giving birth to one child at most will increase by around ten percentage points at the expense of the share of women with three or more children.

With an increase in fertility by 0.5 children per woman (High Fertility Scenario) the 1985 population distribution will only change to a smaller extent: the share of women of parity two will grow at the expense of the share of women of parity three plus. Hence, the share of women of parity

Table 5.6. Women aged 15 years and over by parity, 1985-2050 (percentage)

Scenario	Parity	1985	2000	2015	2030	2050
Constant Rates Scenario	no child	27	27	28	29	31
	one child	22	23	24	26	27
	two children	26	28	29	29	28
	three children	25	22	18	15	14
High Fertility Scenario	no child		25	27	27	28
	one child		23	23	24	24
	two children		29	30	31	30
	three children		24	21	19	18

three plus will decline even when an immediate response to the pension policy in terms of an increase in fertility is assumed.

5.5 | Cost-benefit analysis

From around 338 billion Austrian Schillings in 1985, total social security expenditure would steadily increase until 2030 up to around 372 billion Austrian Schillings assuming constant fertility and mortality rates (Constant Rates Scenario, see *Table 5.7*). In this period, total population size already declines significantly, thus social security contributions would decline from around 303 billion Austrian Schillings in 1985 and 2000 to around 231 billion Austrian Schillings in 2030. The decline in total population size is also reflected in a decline in family benefits (minus 42 per cent) and to a smaller extent a decline in health expenditures (minus nine per cent) and unemployment benefits (minus 18 per cent). Although total population size decreases, the number of pensioners increases and pension expenditure would increase by around 30 per cent. The share of pension expenditures among total social security expenditure would thus increase from around 60 per cent in 1985 to more than 70 per cent in 2030. The resulting balance between social security contributions and benefits, the ratio contributions/ expenditures, would decline from 0.89 in 1985 to 0.62 in 2030 assuming constant contribution rates.

Table 5.7. Social security expenditures and contributions, 1985-2050 (in billion Austrian Schillings)

	Old age and survivor pensions		Other social security expenditures		Social security contributions		Ratio contributions/ expenditures	
Year	Const. Rates	High Fertility	Const. Rates	High Fertility	Const. Rates	High Fertility	Const. Rates	High Fertility
1985	204	204	134	134	303	303	0.89	0.89
2000	219	219	130	138	303	302	0.87	0.85
2015	239	239	122	139	283	297	0.78	0.79
2030	265	265	108	137	231	274	0.62	0.68
2050	218	225	87	132	181	276	0.60	0.77

Table 5.8. Old age and total pension benefits of women in million Austrian Schillings; current versus emancipatory/pronatalist pension system

System	Scenario	1985	2000	2015	2030	2050
Old age pension benefits						
Current system:	Const.rates	61796	66444	73723	84875	72468
New system:	Const.rates	61796	66444	86214	108017	89836
	High fert.	61796	66444	86223	108022	95281
Total (= old age plus survivor) pension benefits						
Current system:	Const.rates	94274	96024	103176	115381	97917
New system:	Const.rates	94274	96024	105849	108017	89836
	High fert.	94274	96024	105858	108022	95281

It is not before 2015 that the assumed increase in fertility by 0.5 children per woman would have its impact on the performance of the Austrian social security system (High Fertility Scenario, see Table 5.7). In the short run additional children would increase family benefits and thus total social security benefits, deteriorating the ratio contributions/expenditure. In the long run, however, the assumed increase in fertility would result in a stable size of the labour force, while according to constant rates assumptions the labour force would decline rapidly. As a consequence, the ratio contributions/expenditure would swing back up to 0.77 in 2050.

Figures in Table 5.7 are based on the current Austrian pension (and social security) system. Below, costs and benefits of the emancipatory and pro-natalist pension policy suggested are tested from the point of view of the social security system on the one hand and of individual retiring women on the other hand.

5.5.1. Social security system perspective

It is assumed that the new pension system will be matured in 2030 (see Section 5.3.2). In the year 2000 the old system still applies for each retiring woman, while in 2015 roughly half of the retired female population will receive benefits according to the new rules. As a consequence, in the year 2000 pension benefits do not differ from those calculated for Table 5.7.

Old age pension benefits provided for women will increase even with the current Austrian pension system and constant 1985 demographic settings, by 37 per cent until the year 2030 (see *Table 5.8*, item a) — due to an increase in the retired population and due to an increase in average old age benefits per beneficiary by around 20 per cent. The latter increase is a consequence of the observed increase in female activity levels during the last two decades. Under the new system which provides five additional years of insurance per child, old age benefits would rise by another 27 per cent. Assumptions on fertility levels have no impact on pension expenditures before around 2045.

The effect is quite different when we look at total pension expenditures for women — that is, the sum of old-age and survivor pensions (see Table 5.8, item b). In the long run, the pension policy introduced could even reduce the expected increase in total pension expenditures somewhat, in 2030 by six per cent. The increase in old age benefits is more than made up for by the decrease in survivor benefits. Calculations for the new system are based on a gradual cancellation of survivor pensions. In 2030, when the system has reached maturity, total pension benefits equal old age pension benefits.

Whether the existence of a survivor's pension, which until today has been a social necessity, can be challenged in the future is difficult to judge. This issue is connected with the question of the role and status of women in the future society. Calculations for this study are based on the assumption that the following decades will bring the desirable development that there will be an end to the discrimination of women in all respects, including their economic, political, and personal situation. In view of this assumption, a cancellation of survivor regulations together with an implementation of an emancipatory policy is both sensible and desirable. The total amount of benefits hardly changes, but the distribution of benefits among the female population changes significantly. With the current system, childless married (and at a later date often widowed) women benefit at the expense of never married or divorced women with children. The more children a woman has the more she is discriminated by the pension system.

While an increase in fertility as a consequence of the introduction of a pronatalist pension system has virtually no impact on total pension expenditures —at least not before the end of our projection period— it immediately affects other social security expenditures. *Table 5.9* gives social security costs by major program (excluding pension expenditures) both for Constant Rates and High Fertility Scenario assumptions. Since the calculation for social security costs is based on 'social security age-profiles', changes in time and differences between scenarios are entirely due to changes in the age structure of the population. While current low fertility (Constant Rates Scenario) reduces family benefits by 42 per cent until 2030, fertility around replacement level (High Fertility Scenario) keeps family and maternity benefits almost at the 1985 level (see Table 5.9). The assumed increase in fertility gives a 40 per cent increase in family benefits until 2015, a 70 per cent increase until 2030 and a 120 per cent increase until 2050, compared with constant fertility.

Since health expenditures significantly increase with age, and work-related benefits mainly apply to people at working ages, these types of expenditures are less sensitive to both the expected change in the population's age structure and assumptions concerning fertility — at least until the end of our projection period. With constant fertility, the decline until 2030 is only nine

Table 5.9. Social security costs by major program, 1985-2050 (in million Austrian Schillings)

Scenario	Expenditures	1985	2000	2015	2030	2050
Const. rates	Health expenditures	72862	73590	71978	66638	53914
	Family benefits	37829	32519	26567	21939	16949
	Work-related benefits	23813	23827	23229	19467	15623
High Fertility	Health expenditures	72862	75636	76932	76374	72821
	Family benefits	37829	38497	37136	37545	36995
	Work-related benefits	23813	23841	24475	22461	22667

per cent for health expenditures and 18 per cent for work-related benefits, which consist of unemployment benefits and work injury costs. On the other hand, an increase in fertility results in an increase in health expenditures by five per cent and almost constant work-related benefits until the year 2030. Compared with constant fertility this corresponds to a 15 per cent increase in both types of social security expenditures in the year 2030.

Apart from higher social security costs the assumed increase in fertility results in an increase in the labour force and thus in social security contributions. The female labour force will slightly decline in the short run, since the increase in fertility gives a different distribution of women across parity and thus reduces overall labour force participation rates (see *Table 5.10*). In the long run, however, additional young adults will move into the labour force, which will then increase by five, 19, and 52 per cent until 2015, 2030, and 2050, respectively, compared with the Constant Rates Scenario.

Having calculated both costs of and contributions to the social security system, it is possible to elaborate on the performance of this system in dependence on the political and demographic assumptions. From around 36 billion Austrian Schillings in 1985, the Austrian social security deficit will increase almost exponentially to 142 billion Austrian Schillings in 2030 if the current system and current fertility are assumed to continue (see *Table 5.11*). In percentage of contributions the deficit amounts to 62 in 2030 and to 68 in 2050. The deterioration is most dramatic in the period 2015-30, when the ageing process reaches its maximum. If the new pension system

Table 5.10. Additional labour force due to the assumed increase in fertility, in 1000 people and in percentage of total labour force

Sex	2000	2015	2030	2050
		x 1,000		
Women	-33	64	191	413
Men	0	95	286	638
Both sexes	-33	159	477	1051
		in percentage		
Women	-2	+5	+18	+50
Men	0	+5	+19	+53
Both sexes	-1	+5	+19	+52

Table 5.11. Estimated social security deficit, 1985-2050

	Dificit in billions ATS		Dificit in per cent of contributions		Ratio contributions/ expenditures		Proportion of pension among ss-costs	
Year	Current system, Constant Rates	New system, High Fertility	Current system, Constant Rates	New system, High Fertility	Current system, Constant Rates	New system, High Fertility	Current system, Constant Rates	New system High Fertility
1985	-36	-36	12	12	0.89	0.89	60	60
2000	-45	-55	15	18	0.87	0.85	63	61
2015	-78	-83	27	28	0.78	0.78	66	64
2030	-142	-120	62	44	0.62	0.70	71	65
2050	-123	-73	68	26	0.60	0.79	71	62

is adopted, the deficit would be slightly lower than with the current system even under constant fertility assumptions — although the difference is barely significant. A possible response to the new system in the form of an increase in fertility, however, could substantially improve the performance of the system. The growth of the deficit accelerates in the following decades, but it is more limited during the periods of strongest ageing. In percentage of contributions, the deficit amounts to 44 in 2030 and to 26 in 2050. The ratio contributions/expenditures will again improve after 2030, thus in 2050 being back to the level of 2015.

At this point it seems interesting to show how an emancipatory and pro-natalist pension scheme that still provides full survivor benefits would perform. Assuming fertility increases by 0.5 children per woman, the deficit with such a system would be significantly higher than with the current pension system given no increase in fertility. After around 2035, however, the increase in fertility starts to be of importance, keeping the deficit increasingly lower than with the current system and current fertility. This calculation demonstrates that in the long run any scenario would be better than continued low fertility.

It is also interesting to look at the distribution of social security costs by major programs. While under constant fertility assumptions and with the present system the share of pension expenditures would increase at the expense of other programs, especially family benefits, shares of the major programs would almost remain unchanged if fertility reaches a level of around two children per woman and if the new system was adopted.

Still, some other measures like, for example, increasing the mean age at retirement would be necessary to prevent the social security system from a partial breakdown. The main conclusion from the point of view of the social security system is that the implementation of an emancipatory and pronatalist pension policy of the kind suggested in this paper will

- by no means deteriorate the performance of the social security system;
- possibly improve the performance of the system if a certain response in the form of an increase in fertility would occur;
- put an end to some of the discussions currently going on in Austria. Among those is the conflict concerning the lower legal age at retirement for women, which is 60 years in contrast to 65 years for men, that blocks any change in the system since the Austrian Constitutional Court declared this law unconstitutional. A first decision made by the government (January 1992) was to suspend this Court's decision by one year. This year it was decided that the legal age at retirement for women will be adjusted to that for men by the year 2018. The ongoing discussion concerning the role of the survivor's pension, its relevance, and its justification in the light of the strong changes in living arrangements, the question whether it should be extended to divorced spouses as well, could all be swept aside. Replacing survivor benefits by additional old age benefits, of course, requires a certain attitude towards women's rights and an adequate policy to achieve equality. It would almost be of no consequence if certain survivor benefit regulations, possibly in a different form, would be kept for those few women who are not entitled to their own old age pension.

5.5.2. Individual perspective

From the point of view of a retiring woman quite different questions arise. What pension benefits will a mother of three children on average receive compared with a childless mother? How much money could this mother already have saved during her life if she had decided not to have children? What should a pension policy look like to, at least, compensate a mother's lower income during the period of retirement?

With the current system, average old age pension benefits differ strongly by a woman's life cycle status. This is not surprising since benefits are directly proportional to the number of years worked, or rather years of insurance, which depend on life cycle status as shown in Table 5.2. The main aim of the emancipatory and pronatalist pension scheme would be to achieve a kind of equity for childbearing efforts, at least during the period of retirement.

Table 5.12 opposes status-specific old age pension benefits women would receive on the basis of the current pension system and the new pension system. The table gives average benefits by life cycle status as a percentage of the overall average for the year 2030, the year when the new system would have reached maturity. With the current pension system, never married and divorced women are better off since they, on average, have less children than married and widowed women. Old age pensions significantly decline with parity, the average for a childless mother being 60 per cent higher than the average for a mother of three or more children. With the new system implemented, differences by parity are no longer significant and so are differences by marital status.

In the case of the current pension system, the uneven distribution of pension benefits across life cycle status is even more pronounced when survivor pensions are included and hence total pension benefits are compared. Differences by marital status are changed to the opposite. Widowed women receive by far the highest amount of total benefits, while divorced and never married women are discriminated. Married women usually still live with their spouse and can expect to become widowed some time in the future. Pension differentials by parity are not influenced to a significant degree when survivor benefits are added, but there is a small reduction in the expected differences.

How much money would a retired mother receive because of her children under the new pension system? Yearly gains in old age benefits by parity are given in *Table 5.13*. Figures again relate to the year 2030 when the new

Table 5.12. Index of old age pension benefits in 2030 by marital status and by parity (average over all groups = 100)

	Marital status				Parity			
System	sin	mar	wid	div	0	1	2	3+
Current system	121	95	95	113	130	111	88	81
New system	99	98	100	108	102	99	97	104

Table 5.13. Yearly benefit gains and saving losses by parity due to the emancipatory and pronatalist pension policy in the year 2030 (in Austrian Schillings)

Real interest rate	Parity	Gain in benefits	Loss of savings	Absolute difference gain-loss	Difference in per cent of average pension
0 per cent	1 child	11103	9702	1401	1.6
	2 children	25028	13810	11219	12.4
	3 children	36573	15693	20880	23.1
1.5 per cent	1 child	11103	16439	-5336	-5.9
	2 children	25028	22994	2035	2.3
	3 children	36573	25673	10900	12.1
3 per cent	1 child	11103	27577	-16474	-18.2
	2 children	25028	37988	-12960	-14.3
	3 children	36573	41768	-5195	-5.8

pension system would have reached maturity. Since five, ten, and 15 additional years of insurance are granted to women with one, two, and three children, respectively, the increase in additional old age benefits with parity is approximately linear. Yearly benefit gains amount to around 11,100, 25,000, and 36,600 Austrian Schillings or, expressed in percentage of the average old age pension in 2030: 12.3, 27.7, and 40.5 for parities one, two, and three, respectively.

Table 5.13 also shows average losses of savings by parity and depending on the real interest rate. As discussed in Section 3.2, savings losses consist of losses due to direct childbearing costs and losses due to lower economic activity caused by the existence of children. For both parts, losses are calculated assuming a ten per cent savings rate and alternative real interest rates of zero, one and a half, and three per cent. The two components of savings losses —childbearing costs and loss of income due to lower economic activity— are responsible for around 50 per cent of total savings losses each. Savings losses have been calculated on a lifetime basis and have then been distributed over years of retirement to make gains and losses comparable.

Given a zero per cent real interest rate, savings losses —distributed over 23 years of retirement— amount to around 9,700, 13,800, and 15,700 Austrian

Schillings (see Table 5.13) for parities one, two and three, respectively. Savings losses do not increase linearly with the real interest rate, since compound interests result in an exponential increase. Hence, savings losses for a mother of two children equal 23,000 Austrian Schillings with a one and a half per cent, and even 38,000 Austrian Schillings with a three per cent interest rate. Losses do not increase linearly by parity either, as a consequence of the shape of parity-specific childbearing costs and economic activity levels. The ratio of savings losses by parity is —assuming a zero per cent interest rate— 1.0 (for parity one) : 1.42 (for parity two) : 1.62 (for parity three), which roughly averages the ratio of parity-specific childbearing costs (1.0 : 1.25 : 1.53, respectively, see Table 5.4) and the ratio of losses in economic activity (1.0 : 1.65 : 1.73, respectively, see Table 5.2).

Comparing pension benefit gains and savings losses, it turns out that, from the point of view of the individual woman, no consistent conclusion can be drawn. Whether the new pension policy implemented could actually force women to have additional children is difficult to say, since the conclusions heavily depend on the economic assumptions adopted. What actually was looked at in those calculations is the following: are additional pension benefits provided by the new system sufficient to make having children more rational than using a certain amount of the additional income, in our calculations ten per cent, to realize a private savings-type pension in addition to the state pension scheme. In this case 'additional income' refers to the difference in salary between parity zero and parities one to three. The lower the assumed real interest rate, the lower the capital cumulated by a savings-type pension scheme. When viewed by a mother of two children (see Table 5.13), the policy is effective in case of a zero per cent and a one and a half per cent interest rate (yearly gains of 11,200 and 2,000 Austrian Schillings, respectively), but a three per cent interest rate clearly gives preference to the savings-type option (yearly losses of 13,000 Austrian Schillings). The real interest rate necessary to balance losses and gains is —in the case of a mother of two children— at around 1.8 per cent. Any real interest rate below 1.8 per cent makes the pension policy reasonable. However, viewed by a mother of only one child or of even three children the balance real interest rates are 0.5 and 2.6 per cent, respectively. For a mother of three children the policy is rational up to a real interest rate of 2.6 per cent. In case of a zero per cent interest rate benefit gains (savings losses deducted) would almost reach one-fourth of the average old age pension. For a mother of one child, however, only a low level of economic performance makes the pension policy reasonable. A three per cent interest rate induces savings losses (already including benefit gains) of almost one-fifth of the average old age pension.

Even if no general conclusion independent of assumptions on economic variables can be drawn, the above results indicate the following:

- The rationality of the pension policy increases with parity. One-child families are supported the least, three-children families the most. The emancipatory goal of the new pension policy is fulfilled.
- From the point of view of a childless mother the incentive to give birth to a child is only modest since one child is not sufficient to exhaust the policy's possibilities. To decide in advance on having more than one child is a difficult if not impossible precondition.
- From the point of view of a mother of one child the incentive to give birth to a second child is strong. A woman with one child is already discriminated against childless women (in terms of lifetime income including pensions); a second child would significantly increase the income available during the period of retirement.
- From the point of view of a mother of two children the incentive to give birth to a third child is even stronger. Again, a third child would significantly increase the income available during the period of retirement, while —on average— economic activity and thus income during active life changes only limited when moving from parity two to parity three.
- It may be possible to achieve the pronatalist goal of the new pension policy. Since one main reason for the low fertility level in Austria is the large number of children without siblings, and since women of parity 1 are encouraged to have additional children, the policy could be effective. Assuming a 'rational' fertility behaviour, a decrease in the proportion of one-child families and an increase in the proportion of families with two or more children should be expected. The proportion of childless women should probably increase further.

It is important to look at the sensitivity concerning assumptions on some of the economic variables. The savings rate was assumed to equal ten per cent of gross salary. A balance of pension benefit gains and savings losses is easily achieved by changing assumptions on the respective savings rate. The lower the assumed savings rate, the better the proposed pension policy performs in comparison with a private savings-type pension scheme. In the case of a one and a half per cent real interest rate the savings rates necessary to adjust savings losses to parity-specific gains in benefits are seven, 11, and 14 per cent for parities one, two, and three, respectively (see *Table 5.14*).

Table 5.14. Sensitivity analysis of the new pension policy, according to an assumed real rate of interest

Number of children	Balance private savings rate (as a percentage of the gross salary) for real interest rates of:			Balance number of years provided by the policy for real interest rates (percentage) of:		
	0	1.5	3	0	1.5	3
Parity 1	11	7	4	4	8	13
Parity 2	18	11	7	5	9	17
Parity 3+	23	14	9	6	10	18

The higher the interest rate, the lower the required savings rate. Given a three per cent real interest rate, from the point of view of a mother with only one child only a savings rate below four per cent makes the pension policy rational. On the other hand, for a mother of three children and given a zero per cent real interest rate, even a high savings rate of 22 per cent would give pension benefits that are lower than those provided by the new pension system.

A good indication of a proper emancipatory and pronatalist pension policy can be obtained by calculating the additional number of years of insurance such a policy should offer to balance benefit gains and savings losses, based on assumptions concerning both the savings rate and the real interest rate. The savings rate is again assumed to be ten per cent, and —to be consistent with other conclusions— real interest rates of ten per cent, one and a half per cent and three per cent are compared. On the basis of a one and a half per cent real interest rate, the policy should at least provide seven and a half, nine and ten additional years of insurance for women of parities one, two, and three plus, respectively, to legitimately be called 'pronatalist' from the point of view of any mother (see Table 5.14). A pension scheme can still be called pronatalist, of course, if only women of parities two and over benefit, as would be the case with the provisions of the pension policy tested (given a one and a half per cent real interest rate). Again, the higher the interest rate the more difficult it is to implement a policy that makes having children rational. A real interest rate of three per cent would give the private savings-type pension scheme preference over having children and taking advantage of the pronatalist changes in the pension system, independent of a woman's parity.

Table 5.14 confirms the conclusion that the adopted pension policy supports women of parity three the most and of parity one the least, which can again be interpreted as an achievement of the emancipatory goal of the policy. If one would decide to set up a pronatalist, but not emancipatory policy that supports mothers equally, irrespective of the number of children born, different changes would have to be implemented. The increase in the number of years provided should not be linear, as is the case in the adopted policy which provides five, ten, and 15 years, for parities one, two, and three, respectively, but rather logarithmic.

5.6 | Summary and discussion

By incorporating results of a family projection model in a policy simulation tool that combines a pension model with social security age-profiles, it was possible to arrive at several conclusions concerning the future of the Austrian pension system. The new emancipatory and pronatalist pension policy suggested in this study consists of a provision of five additional years of insurance per child born (up to three children) for a woman claiming old age pension benefits. At the same time those increased old age benefits should replace survivor benefits. Assuming a smooth transition period for the implementation of the new pension system, the system would reach maturity in 2030. The first conclusion is that, independent of demographic developments, the new system would not increase total pension benefits. Secondly, it would significantly change the income distribution of retired women to the extent that married and widowed childless women would no longer benefit at the expense of never married and divorced women with children. Thus, the emancipatory goal of the policy is fulfilled. Thirdly, provided a certain response to the new system in the form of an increase in fertility, the performance of the social security system would improve. Discussions that currently prevent the Austrian pension system from being changed at all should seriously consider the options tested.

In the long run, fertility at around replacement level significantly facilitates the maintenance of a social security system of the pay-as-you-go type. To a certain extent the policy implemented could be called pronatalist since mothers could benefit from the new system, depending on the economic variables (savings rates, real rates of interest). On the other hand, for a childless mother the incentive to give birth to a child is only modest. Assuming a strong potential for response to the policy, more two- and three-children families should be expected, while the proportion of one-child families should decline. The proportion of childless women, however, should probably increase further. Given the large number of one-child families in Austria, overall fertility should be expected to increase.

Some general questions arise in the context of a pronatalist policy. In light of the recent decline in fertility to a level far below replacement level, which for the time being marks the end of a steady long-term fertility decline over the last centuries, a pronatalist approach does not seem useful at all. Fertility changes and parallel changes in living arrangements were mainly caused by the changing status of women in modern society. In earlier times, for most women, purpose and accomplishment have been defined largely in terms of motherhood. Education has motivated women to pursue activities outside the family, and at the same time equipped them with the skills to do so. Higher education brought about higher economic activity and thus economic independence of women. Work has encouraged women to limit their family size by providing them with sources of satisfaction and security outside the family. Women are no more naturally inclined to limit themselves to motherhood than men are inclined to limit themselves to fatherhood. Strong changes in women's rights and possibilities have occurred although women still are discriminated.

Returning to earlier motivations of childbearing is certainly impossible. Any pronatalist policy must provide conditions that encourage women and men, not women alone, to have larger families. Issues like providing individual child-care facilities to an adequate degree, or especially encouraging men to share childbearing efforts with their partner have to be addressed. Thus, using a one-sex model is a simplification not only from a modelling point of view, but also with respect to the contents: both women and men have to be covered in a pronatalist policy in a modern European society. A pronatalist policy should aim at a new form of familism that enables both parents to make their individual freedom and independence and their family ambitions compatible. But even then it is not certain whether policies actually can influence individual behaviour.

As a consequence, the main purpose of the pension policy suggested in this paper is emancipatory: it contributes to a society that guarantees a fair treatment of everybody. Neither shall women be discriminated against men, nor shall mothers be discriminated against childless women. The latter aim is easy to address in an emancipatory pension policy; the former needs additional changes in both the policy and the society.

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6. MODELLING THE IMPACT OF CHANGING HOUSEHOLD STRUCTURE ON SOCIAL SECURITY IN THE NETHERLANDS

Evert VAN IMHOFF[1]

6.1 | Introduction

This chapter reports the findings of the research project 'The impact of changing household structures on future social security expenditures in the Netherlands', which was carried out at the Netherlands Interdisciplinary Demographic Institute (NIDI) with financial support from the Netherlands Ministry of Social Affairs and Employment.

In this study, population dynamics is interpreted as changes in living arrangements (household formation and dissolution) and age structure of the population. Regarding social security, the emphasis is on those social security arrangements that are particularly sensitive to the living arrangement and/or age of the recipient. The consequences of population dynamics for social security are traced by linking the results of macrosimulations, produced by the household projection model LIPRO, to fixed user profiles for social security arrangements.

[1] The research reported in this paper was financed by the Netherlands Ministry of Social Affairs and Employment. Most of the data used for the calculations presented here were collected by the Netherlands Central Bureau of Statistics.

J.-P. Gonnot et al. (eds.), Social Security, Household, and Family Dynamics in Ageing Societies, 181-208.

An outline of the methodology adopted in the research project is given in Section 6.2. Contrary to Chapter 3 in the present volume, which presents calculations for the less ambitious operationalization of the concept of living arrangement, namely marital status, the present chapter presents results for a fully specified household model. Individuals are classified according to their household position. The model distinguishes 11 household positions, corresponding to seven different household types. The specification of the model is briefly discussed in Section 6.2.

The most difficult task in building a household model consists of estimating the parameters of the underlying household dynamics. Statistics on household structure (static) are relatively scarce, and data on household formation and dissolution (dynamic) are almost nonexistent. In the Netherlands we are in the fortunate position of having a huge data set available that contains some, although incomplete, information on changes in household position. These data became available when the Netherlands Central Bureau of Statistics (NCBS) published the results of the Housing Demand Survey held in 1985/1986. Section 6.3 of this chapter describes the methods and assumptions used to transform these data into a full set of demographic parameters.

Social security user profiles were constructed from the same data set. Their construction is discussed in Section 6.4.
Sections 6.5 and 6.6 present the empirical results for six different scenarios. Their presentation is split into two parts. Section 6.5 discusses the demographic aspects of the simulations. First we investigate what the implications would be for the household structure of the population assuming that current household dynamics as observed in the mid 1980s would apply to the future population of the Netherlands. Subsequently, the outcomes of this so-called Constant Scenario are compared with those for five alternative scenarios. In Section 6.6 we concentrate on the consequences of these demographic changes for social security expenditure.
The final section summarizes the main results.

6.2 | Model specification

The NIDI household projection model LIPRO (Van Imhoff and Keilman, 1991) belongs to the class of *multidimensional projection models*. Multidimensional demographic models have applications in a wide range of areas. Examples include internal migration, labour market dynamics, and household projections. Willekens and Drewe (1984), and Keilman (1985) provide a technical discussion of this class of models.

In LIPRO, the population is broken down by type of household (or marital status), age, and sex. This breakdown defines a state vector, the elements of which consist of numbers of *individuals* at one point in time, occupying a particular position in a particular household type, of a certain age, male or female.

It should be pointed out that the term 'model' is used here in two different senses. On the one hand we have the LIPRO model as a calculation device. The computer program LIPRO can be used for any kind of multidimensional demographic projection. The program does not care whether the state space defines household types, regions, or marital states.

The model only becomes a household projection model (and this is the second sense in which the term 'model' is used here) if the state space defines household types. For the computer program, the definition of the state space is part of its input. Thus, the LIPRO household projection model is just a particular *specification* of the more general LIPRO multidimensional projection model.

6.2.1. Definition of the state space

A meaningful classification of individuals should be such that the resulting categories are relatively homogeneous, with respect to both demographic behaviour and use of social security arrangements. Throughout this chapter we will limit ourselves to *private* households.

The considerations that gave rise to the specification of the LIPRO household model are discussed extensively in Van Imhoff and Keilman (1991, Section 7.1) and will not be repeated here. After weighting all the arguments, it was decided to use the following classification of household positions:

1. CMAR child in family with married parents
2. CUNM child in family with cohabiting parents
3. C1PA child in one-parent family
4. SING single (one-person household)
5. MAR0 married, living with spouse, but without children
6. MAR+ married, living with spouse and with one or more children
7. UNM0 cohabiting, no children present
8. UNM+ cohabiting with one or more children

9. H1PA head of one-parent family
10. NFRA non family-related adult (i.e. an adult living with family types 5 to 9)
11. OTHR other (multi-family households; multiple single adults living together)

These 11 household positions together define seven household types:

1. SING a one-person household
2. MAR0 a married couple without children, but possibly with other adults
3. MAR+ a married couple with one or more children, and possibly with other adults
4. UNM0 a couple living in a consensual union without children, but possibly with other adults
5. UNM+ a couple living in a consensual union with one or more children, and possibly with other adults
6. 1PAF a one-parent family, possibly with other adults (but no partner to the single parent!)
7. OTHR multi-family households, or multiple single adults living together without unions.

We feel that this classification offers a reasonable compromise between the conflicting objectives of completeness and feasibility.
Numbers of households of various types may be inferred easily from numbers of persons in the 11 household positions. Thus a household projection which reads in terms of individuals may be translated into one which reads in terms of households:

1. the number of households of type SING equals the number of persons in household position SING;
2. the number of households of type MAR0 equals half the number of persons in household position MAR0;
3. the number of households of type MAR+ equals half the number of persons in household position MAR+;
4. the number of households of type UNM0 equals half the number of persons in household position UNM0;
5. the number of households of type UNM+ equals half the number of persons in household position UNM+;
6. the number of households of type 1PAF equals the number of persons in household position H1PA;

7. the number of households of type OTHR equals the number of persons in household position OTHR divided by the average number of persons in OTHR households. This average household size was 2.82 persons in 1985. It is assumed that the average size of OTHR household remains unchanged throughout the projection period.

The events matrix corresponding to this model specification is depicted in *Table 6.1*. For the event 'birth' the household position of the newly born child is uniquely determined by the household position of the mother prior to giving birth. Two important assumptions underlying the events matrix are:

Table 6.1. Events matrix of the household model

from:	to:	1	2	3	4	5	6	7	8	9	10	11	dead	rest
1.	CMAR	-	-	x	x	x	x	x	x	-	x	x	x	x
2.	CUNM	x	-	x	x	x	x	x	x	-	x	x	x	x
3.	C1PA	x	x	-	x	x	x	x	x	-	x	x	x	x
4.	SING	x	x	x	-	x	x	x	x	x	x	x	x	x
5.	MAR0	-	-	-	x	-	x	-	-	-	-	x	x	x
6.	MAR+	-	-	-	x	x	-	-	-	x	-	x	x	x
7.	UNM0	-	-	-	x	x	-	-	x	-	-	x	x	x
8.	UNM+	-	-	-	x	-	x	x	-	x	-	x	x	x
9.	H1PA	-	-	-	x	-	x	-	x	-	-	x	x	x
10.	NFRA	-	-	-	x	-	-	-	-	-	-	x	x	x
11.	OTHR	x	x	x	x	x	x	x	x	x	x	-	x	x
a.	birth from													
	CMAR	-	-	-	-	-	-	-	-	-	-	x	-	-
	CUNM	-	-	-	-	-	-	-	-	-	-	x	-	-
	C1PA	-	-	-	-	-	-	-	-	-	-	x	-	-
	SING	-	-	x	-	-	-	-	-	-	-	-	-	-
	MAR0	x	-	-	-	-	-	-	-	-	-	-	-	-
	MAR+	x	-	-	-	-	-	-	-	-	-	-	-	-
	UNM0	-	x	-	-	-	-	-	-	-	-	-	-	-
	UNM+	-	x	-	-	-	-	-	-	-	-	-	-	-
	H1PA	-	-	x	-	-	-	-	-	-	-	-	-	-
	NFRA	-	-	-	-	-	-	-	-	-	-	x	-	-
	OTHR	-	-	-	-	-	-	-	-	-	-	x	-	-
b. rest		x	x	x	x	x	x	x	x	x	x	x	-	-

- = impossible event.
x = possible event.

- a return to the status of child is possible only from the household position 'single';
- adults can change household only via the status 'single'.

6.2.2. Consistency relations

An important part of the model consists of the module that handles the *consistency problem.* Within the context of household models, the consistency problem can be considered a generalization of the well-known two-sex problem in marital-status models. Unless the modeller includes a two-sex algorithm in such a marital-status model, male marriages will *not* be equal to female marriages (nor will male divorces correspond to female divorces, or deaths of married persons to transitions to widowhood of the other sex). In household projection models, numbers of male entries into cohabitation have to correspond to numbers of female entries into cohabitation in a certain period, and the number of last children who leave a one-parent household must be equal to the number of heads of such a household who become single. These requirements are but a few of the many consistency relations that may appear in the framework of a household projection model.

The current version of the LIPRO computer program contains a very flexible consistency module that automatically produces consistent numbers of events once the user has specified which sets of events are linked in linear combinations. The algorithm was developed by Van Imhoff (1992) who proved that the solution used in the earlier version of LIPRO is a special case of his more general algorithm developed with weighted linear least-squares optimization. In the present chapter we shall use the harmonic-mean solution to the consistency problem which involves a proportional adjustment of age-specific numbers of inconsistent events to find age-specific numbers of consistent events.

Most of the consistency constraints (e.g. the two-sex requirements) stem from the nature of the household classification chosen; this type of consistency is referred to as *internal* consistency. Other constraints may occur because of interrelationships between different models. For instance, numbers of events computed from models of a low aggregation level may be required to add up to the corresponding numbers in the national population forecasts, which is of a higher aggregation level. The latter type of constraints is referred to as *external* consistency (Keilman, 1985). LIPRO's consistency algorithm ensures that the projected numbers of events satisfy certain linear constraints, thus allowing for both internal and external consistency requirements. External consistency has played a role during the phase of model estimation, to be discussed in Section 6.3.

The events matrix for the LIPRO household model, depicted in Table 6.1, contains 69 internal events, 22 exits, and 22 entries. For two sexes, this amounts to a total of 226. Formulation of consistency relations between these 226 events was a painstaking activity, finally leading to 38 restrictions in terms of 129 variables. The main assumptions are:

- divorced partners do not continue to live together;
- adoption can be disregarded for the entry of a first child into the household;
- the formation and dissolution of homosexual consensual unions can be disregarded as far as the two-sex requirement for cohabitation is concerned;
- only complete households can migrate.

6.3 | From data to input parameters

6.3.1. The Housing Demand Survey of 1985/1986 (WBO 1985/1986)
A projection of future household positions requires two types of input data:

1. an initial population at the start of the projection interval;
2. data on jump intensities, or, alternatively, data on jumps and exposed population from which jump intensities can be estimated.

Our main source of demographic data is the so-called 'Woningbehoeftenonderzoek 1985/1986' [Housing Demand Survey 1985/1986] or simply WBO 1985/1986. This massive set of data, containing 46,730 households, was collected by the NCBS during the last few months of 1985 and the first few months of 1986. It contains detailed information on, among other things, the household situation of the respondents at the time the survey was taken, and their household situation one year earlier. A slight drawback of the WBO 1985/1986 is that the questionnaire focuses on private households: for persons in collective households only a few basic questions are included.

The WBO 1985/1986 gives us the household position of all individuals in the sampled private households at a single point in time. This information was used, together with data on the distribution by age, sex, and marital status of the WBO-respondents living in collective households, to construct the initial population for the simulation (see sub-section 6.3.2). The WBO-data were corrected so as to correspond to the observed population structure by age, sex, and marital status as per December 31, 1985.

Information on jumps between the 11 household positions can be obtained from variables indicating the household position of each person one year earlier, to be reconstructed from a small number of 'retrospective' questions included in the questionnaire. Unfortunately, this 'retrospective' information is incomplete, requiring the use of simplifying assumptions and approximation methods, to be described in sub-section 6.3.2.

6.3.2. The initial population

The starting point of our projections is the situation as per December 31, 1985. From the WBO 1985/1986 we can calculate (using the weighting factors provided by the NCBS) the number of persons in each of the 11 household positions, by age and sex. Since these WBO 1985/1986 figures are subject to sampling error, we have adjusted them to bring them into line with the official NCBS population statistics for December 31, 1985. These population statistics are broken down by age, sex, and marital status.

First, the population statistics were adjusted to eliminate the population living in collective households, using estimated age-, sex-, and marital status-specific numbers living in institutions as given by Faessen and Nollen-Dijcks (1989). Next, the age- and sex-specific numbers from the WBO 1985/1986 were adjusted proportionally over the 11 household positions, equalizing the sum of the numbers in positions MAR0 and MAR+ to the numbers in marital state 'married', and equalizing the sum of the numbers in the other nine household positions to the sum of the numbers in marital states 'never married', 'widowed', and 'divorced'.

6.3.3. Transition probabilities

If we knew, for each individual in the sample, his/her household position at some previous point in time, we would be able to calculate transition probabilities from the simple age- and sex-specific cross-tables of past versus present household positions. Unfortunately, the variables in the WBO 1985/1986 do not allow an exact reconstruction of past household positions, at least not in terms of our 11-cell classification. Therefore, an approximation method has to be devised.

For each individual, the WBO 1985/1986 gives the following relevant variables on the household situation one year before the survey date:

- did the individual live in the same household ?
- relation to head of household (RELTOHEAD) in which the individual lived at the time (whether or not this was the same household as the present one), coded as follows:
  1. head of one-person household
  2. head of multi-person household
  3. married spouse of head
  4. unmarried partner of head
  5. (step)child of head and/or partner
  6. other adult
  7. other child
  8. not yet born (i.e. born during last year)
  9. living abroad (i.e. immigrated during last year)
- marital status
- how many individuals left the household during the past year ?

The households in the sample fall into one of three categories:

1. households without entries and without exits. For these households, reconstruction of the state of its members one year ago is trivial. The only point to bear in mind is the possibility of a transition from an unmarried to a married couple.
2. households with entries. For the non-entrants (i.e. the members of the household who were already present one year earlier) the household position can be found by 'subtracting' the entrants from the present household composition. For the entrants, the previous household position has been approximated by considering their previous value on the variable RELTOHEAD and assuming that the age- and sex-specific cross-tabulation of RELTOHEAD versus our 11-cell classification did not change between 1984 and 1985. Immigrants were not taken into account. Newly born individuals were treated separately.
3. households with exits. Here too, an approximation method had to be used since the household position of the person(s) who left, and consequently the household position of the remaining household members before the departure, is unknown. For the stayers, their previous values on the variables RELTOHEAD, marital status, and household size were considered assuming an unchanging age- and sex-specific distribution across the 11 household positions within each combination of RELTOHEAD, marital status, and household size. The departed persons do not need separate treatment. If they moved into another household, they can be assumed to be included in the entrants discussed in the

previous paragraph. If they left the population (through death or emigration), the corresponding jump intensity is estimated from different sources (to be described in the next sub-section).

For those individuals born during the year before the survey date, we tried to reconstruct the household position of the mother at the moment of childbirth. If necessary, we made use of simplifying assumptions. Once the household position of the mother has been determined, the household position into which the child is born follows automatically. If this household position at birth is crossed with the household position at the survey date, the transition matrix for age group zero is easily calculated.

6.3.4. From transition probabilities to intensities

The computations thus far have yielded single-year transition matrices for internal events, for each age/sex group. What we need are *intensities*, being the fundamental parameters of the exponential multidimensional projection model (Van Imhoff, 1990). The mathematical relationship between a transition matrix $\boldsymbol{T}$ and an intensity matrix $\boldsymbol{M}$ is given by:

$$\boldsymbol{T} = \exp[\boldsymbol{M}h] \tag{1}$$

where h is the length of the observation interval (here 1 year, except for age group 0 where h is approximately equal to ½). Then

$$\boldsymbol{M} = \log(\boldsymbol{T}) \,/\, h \tag{2}$$

where the log of a matrix is defined in terms of its Taylor power series. It may happen that the latter power series does not converge. In that case the empirical transition matrix $\boldsymbol{T}$ is said to be not-embeddable, i.e. inconsistent with the assumptions of the exponential model (Singer and Spilerman, 1976). In our application, only four out of 176 transition matrices turned out to be not-embeddable.

However, even for embeddable transition matrices, application of (2) leads to very unreliable estimates of the intensities. This is caused by the fact that the logarithm of a matrix is very sensitive to small changes in one of its elements. Since the empirical transition matrices $\boldsymbol{T}$ are subject to a high degree of sampling error, the resulting intensities exhibit a very irregular and unrealistic pattern when plotted as a function of age.

Therefore it was decided to follow a different approach instead. This approach rests on the assumption that an observed transition can be identified with an *event*. That is, it is assumed that each individual experiences at most one event during the observation period. Since the observation period is rather short (one year), this assumption appears to be quite reasonable. The only exceptions were made for transitions that are impossible events according to the events matrix of Table 6.1. E.g. if a woman was observed to be in position UNM0 one year before being observed to be in state MAR+, it has been assumed that she experienced two events, namely first the event from UNM0 to MAR0 and then the event from MAR0 to MAR+. A full list of these assumptions on multiple events in the case of 'impossible transitions' is given in *Table 6.2*.

From the events matrices constructed in this way, intensity matrices can be estimated using the moment estimator developed by Gill (1986). The computer program for estimating intensities from events matrices of any rank is described in Van Imhoff and Keilman (1991, Appendix 4).

The intensity matrices obtained in this way refer to internal events only. In order to estimate household position-specific mortality and emigration intensities, we used marital status as a proxy. From the NCBS population statistics 1981-85, marital status-specific exit intensities were estimated using the method of Gill and Keilman (1990). These intensities were subsequently transformed into intensities by household position, using the age- and sex-specific marital status distribution for each household position as weights. A similar approximation method was used to produce estimates of the immigrant population by household position from immigration statistics 1981-85 by marital status.

Since the number of estimated intensities is very large compared with the number of observations, the resulting estimates are subject to large random variations. In order to reduce this variation, the one-year/single age group intensities were transformed into five-year/five-year age group intensities. A secondary advantage of this transformation is that it reduces the number of computations for a given projection by a factor of 25. The transformation involves a weighted average of the single-year intensities, using the average (over the year) population in each household position as weights, and taking into account the fact that a five-year age group over a period of five years involves nine different one-year age groups. This procedure was applied to internal intensities, to the exit and fertility intensities, and to the numbers of immigrants, and resulted in 38 sets of intensity matrices (viz. two sexes and 19 age groups, 18 ranging from 0-4 to 85+, and one for the age group born during the five-year period).

Table 6.2. Assumptions on multiple events

Observed transition			Assumed events				
cmar	→	cunm	cmar	→	c1pa	→	cunm
mar0	→	cmar	mar0	→	sing	→	cmar
mar0	→	cunm	mar0	→	sing	→	cunm
mar0	→	c1pa	mar0	→	sing	→	c1pa
mar0	→	unm0	mar0	→	sing	→	unm0
mar0	→	unm+	mar0	→	sing	→	unm+
mar0	→	h1pa	mar0	→	mar+	→	h1pa
mar0	→	nfra	mar0	→	sing	→	nfra
mar+	→	cmar	mar+	→	sing	→	cmar
mar+	→	cunm	mar+	→	sing	→	cunm
mar+	→	c1pa	mar+	→	sing	→	c1pa
mar+	→	unm0	mar+	→	sing	→	unm0
mar+	→	unm+	mar+	→	h1pa	→	unm+
mar+	→	nfra	mar+	→	sing	→	nfra
unm0	→	cmar	unm0	→	sing	→	cmar
unm0	→	cunm	unm0	→	sing	→	cunm
unm0	→	c1pa	unm0	→	sing	→	c1pa
unm0	→	mar+	unm0	→	mar0	→	mar+
unm0	→	h1pa	unm0	→	unm+	→	h1pa
unm0	→	nfra	unm0	→	sing	→	nfra
unm+	→	cmar	unm+	→	sing	→	cmar
unm+	→	cunm	unm+	→	sing	→	cunm
unm+	→	c1pa	unm+	→	sing	→	c1pa
unm+	→	mar0	unm+	→	sing	→	mar0
unm+	→	nfra	unm+	→	sing	→	nfra
h1pa	→	cmar	h1pa	→	sing	→	cmar
h1pa	→	cunm	h1pa	→	sing	→	cunm
h1pa	→	c1pa	h1pa	→	sing	→	c1pa
h1pa	→	mar0	h1pa	→	sing	→	mar0
h1pa	→	unm0	h1pa	→	sing	→	unm0
h1pa	→	nfra	h1pa	→	sing	→	nfra
nfra	→	cmar	nfra	→	sing	→	cmar
nfra	→	cunm	nfra	→	sing	→	cunm
nfra	→	c1pa	nfra	→	sing	→	c1pa
nfra	→	mar0	nfra	→	sing	→	mar0
nfra	→	mar+	nfra	→	sing	→	mar+
nfra	→	unm0	nfra	→	sing	→	unm0
nfra	→	unm+	nfra	→	sing	→	unm+
nfra	→	h1pa	nfra	→	sing	→	h1pa

6.3.5. Adjusting the intensities to achieve internal and external consistency
The five-year intensities were used to make a household projection over a single projection interval, i.e. the five-year period 1986-90. The projected numbers of events, not surprisingly, failed to satisfy the conditions for internal consistency. In addition, the results on vital events in several respects diverged from the official numbers of the NCBS, i.e. the sum of observed numbers for the years 1986-87 and the corresponding numbers in the national population forecast for the years 1988-90. Using the consistency algorithm, the numbers of events projected by LIPRO were adjusted to yield internal consistency, as well as external consistency with the official numbers on seven vital events:

- number of births;
- number of deaths;
- number of marriages;
- number of marriage dissolutions;
- number of male entries into widowhood;
- number of female entries into widowhood;
- net international migration.

From these both internally and externally consistent numbers of events, the intensities were reconstructed. It is this adjusted set of jump intensities that constitutes the basis of the projections to be discussed in Section 6.5.

6.4 | User profiles for social security

If one is prepared to make certain assumptions about the way in which social security expenditures are distributed across the population, then demographic projections can be used to yield projections of social security expenditures. Such assumptions would concern participation rates and average benefit levels for each cell in the demographic cross-classification table. For both variables we use the term *user profile*.

An example may clarify this approach. Let us assume that the number of female heads of a one-parent family in the age bracket 40-44 will increase from 30,000 now to 50,000 in 1995. A user profile indicates that 80 per cent of these women are on welfare at an average level of 15,000 Dutch guilders (Dfl.) per year. The increase in welfare allowances induced by the change in household composition would then be from 0.80 * 30,000 = 24,000 now to 0.80 * 50,000 = 40,000 in 1995. The corresponding increase in welfare expenditure would be from Dfl. 36 million now to Dfl. 60 million in 1995, which amounts to additional expenditure on welfare of Dfl. 24 million.

A complete user profile comprises *all* categories distinguished in the demographic projection model, defined by the relevant combinations of sex, age, and household type. If desired, user profiles can be constructed for different types of social security allowances, e.g. state pensions, disability allowances, welfare, etcetera

Although for the purpose of the present chapter we will assume that user profiles are invariant over time, there is no compelling reason for doing so. On the basis of expected or presumed changes in economic conditions, social security policy, and/or behavioural patterns, future trends in user profiles can be postulated and their effects on social security expenditures calculated. Just as the demographic model allows one to specify scenarios for demographic behaviour, so the social security module allows one to specify scenarios for social security behaviour.

In the Netherlands the system of social security arrangements is highly elaborate and complex. Total expenditures in 1985 amounted to Dfl. 125 billion, which is one third of Net National Income. Most of these expenditures are financed from social security premiums, the remainder being financed by general tax revenues. Here we will concentrate on those social security arrangements which provide the recipient with a source of *income*, thus excluding compulsory health insurance and similar arrangements.
All social security arrangements can be classified into three main categories:

1. General social insurances. The arrangements in this category apply to all citizens and have been implemented in the form of a compulsory insurance. Premiums are levied on all personal income. The general social insurances include:

   - AOW Old age state pensions (compulsory retirement at age 65)
   - AWW Widow's and orphan's allowances
   - AKW Child allowances
   - AAW Disability benefits

2. Employees' social insurances. These are insurances compulsory for employees only. Premiums are levied on wage income. The most important arrangements in this category are:

- ZW Sickness benefits
- WAO Disability benefits
- WW Unemployment benefits

3. Social provisions. No insurance principle is involved. Expenditures are wholly financed by general tax revenues. The most important social provisions are:

- ABW Welfare
- RWW Unemployment benefits

The level of benefits in the second category (employees' insurances) is generally a fixed percentage of wage foregone. If the benefit would otherwise come below the so-called 'social minimum' level, a supplementary allowance is provided, financed by general tax revenues. The social minimum plays an important role in social security legislation. Its level is related to the legal minimum wage and dependent on the household situation of the recipient. Most of the allowances in the third category (social provisions) are at the social minimum level.

Official data on numbers and average levels of social security allowances are very scarce. A complete breakdown by age, sex, and household position is not generally available for most arrangements. We therefore decided to rely on the WBO 1985/1986 to yield the necessary social security user profiles, although it is widely acknowledged that self-reported income data suffer from high selective non-response and are otherwise notoriously unreliable. However, the results of the exercise turned out to be reasonably consistent with aggregate data from other sources.

The WBO 1985/1986 contains data on non-labour net income from 14 different sources for the persons who answered the questionnaire for the household in question, and for his/her partner, if present. Of these 14 sources, we investigated three for the purpose of the present chapter:

1. old age state pensions (AOW)
2. widow's and orphan's benefits (AWW)
3. social welfare (ABW)

The levels of these benefits are net levels, after deduction of income tax and social security premiums. Since most of these benefits are at or close to the social minimum level, the difference between net and gross benefits is relatively small because of the progressive Dutch tax schedule. Respondents who reported to be on social security without providing information about the level of the benefit were assumed to receive the average benefit of those respondents in the same category who did give the benefit level.

This procedure, for each of the three social security arrangements, 11 household positions and two sexes, yielded two age user profiles: one for the fraction of the population on social security, and one for the average net benefit per individual.

In order to check the reliability of these user-profiles, the data were compared with statistics from the NCBS Personal Income Distribution 1985. Some aggregation across household positions was necessary to make such a comparison possible. The results of the calculations are summarized in *Table 6.3*. As can be seen from Table 6.3, the various data sources are reasonably consistent, with a possible exception for the social provisions. There, the difference can for a large part be attributed to the fact that RWW benefits to children living with their parents are not observed in the WBO 1985/1986.

In the calculations to be presented in Section 6.6, we will limit ourselves to *relative* changes in social security expenditure. This further reduces the number of objections that one could raise against using self-reported income statistics.

6.5 | Demographic scenarios for the Netherlands, 1986-2050

In this section we will present the results of several illustrative projections with LIPRO, carried out to show the changes in the household composition and the household dynamics in private households in the Netherlands in the decades to come. First we investigate what the implications would be for the household structure of the population assuming that current household dynamics as observed in the mid 1980s would apply to the future population of the Netherlands. In this so-called Benchmark projection we use intensities for fertility, mortality, migration, and household events as they were constructed in Section 6.3. These intensities are applied to the entire projection interval 1985-2050. The unit projection interval is five years; it is equal to the width of the age brackets in the initial population.
Subsequently, the outcomes of this so-called Benchmark Scenario are compared with those for five alternative scenarios:

Table 6.3. Comparing social security data from different sources

	Total = 100%	Share of household types (per cent) [e]				
		SING	MAR0	MAR+	1PAF	OTHER
Old age state pensions (AOW)						
Number of recipients [a]:						
PID 1985 [b]	1,554.7	31	49	7	3	10
WBO 1985/1986 [c]	1,414.7	34	50	6	2	7
Aggregate expenditure [d]:						
PID 1985	19,085.0	35	44	7	4	10
WBO 1985/1986	17,168.0	36	48	7	2	7
Widow's and orphan's benefits (AWW)						
Number of recipients:						
PID 1985	143.8	46	0	0	36	17
WBO 1985/1986	141.0	47	1	1	42	9
Aggregate expenditure:						
PID 1985	2,041.3	44	0	0	39	17
WBO 1985/1986	1,877.0	45	1	1	45	9
Social provisions (ABW+RWW) [f]						
Number of recipients:						
PID 1985	688.8	27	5	31	20	17
WBO 1985/1986	367.5	35	5	15	31	14
Aggregate expenditure:						
PID 1985	8,074.6	26	6	26	27	15
WBO 1985/1986	4,825.0	31	6	18	34	11

[a] In thousands.
[b] NCBS Personal Income Distribution 1985.
[c] Own calculations, based on NCBS Housing Demand Survey 1985/1986.
[d] Net expenditure, in Dfl. million.
[e] SING one-person households.
MAR0 married couples without children.
MAR+ married couples with children.
1PAF one-parent families.
[f] RWW unemployment benefits.

1. 'TFR + 0.5': all fertility rates are proportionally adjusted upwards in order to increase the total fertility rate by 0.5 child per woman;
2. 'MAR - 50 per cent': all intensities relating to the formation of unions, whether consensual or legal, are reduced by 50 per cent;
3. 'DIV + 25 per cent': all intensities relating to the dissolution of unions, whether consensual or legal, are increased by 25 per cent;

4. 'MORT - 20 per cent': all mortality rates are reduced by 20 per cent;
5. 'Realistic': in this scenario we try to adhere, as closely as possible, to the assumptions underlying the official national population projections prepared by the Netherlands Central Bureau of Statistics. Extreme trends are not present in this scenario. The following 'reasonable' assumptions are made: a) a slight further increase in life expectancy at birth being somewhat larger for males than for females; b) fertility increases slightly, but remains significantly below replacement level; c) an increase in the proportion of extramarital births; d) a drop in marriage rates, fully compensated by a simultaneous increase in the propensity to form consensual unions; e) an increase in divorce rates, for both marriages and consensual unions; f) a modest decline in international migration.

In Scenarios 2-5, the relevant changes in jump intensities are assumed to take place immediately, while in the Realistic Scenario the changes occur gradually over time.
In setting these scenarios, one has to take into account the fact that many of the intensities are linked together by the consistency relations. If one fails to adjust these related intensities, then the net effect of setting the scenario is smaller than intended. For example, if in Scenario 5 male mortality is reduced by 20 per cent without reducing the rate at which married women are widowed, then the consistency algorithm will partially offset the 20 per cent reduction of male mortality. Adjusting related intensities is rather complex and the exact way in which it has been done will not be discussed here in detail.

The development of the total population by household position is illustrated in *Figure 6.1* for the Realistic Scenario. Total population size reaches its maximum in 2025 (16.4 million), after which a gradual decline sets in. Developments of the population by household position are characterized by:

- a decrease in the number of children;
- a strong decline in the number of couples with children;
- an increase in the number of lone parents which is modest in the absolute sense, but much stronger in the relative sense;
- a diminishing average household size;
- an enormous growth in the number of individuals living in a one-person household.

The tremendous increase in the number of persons living alone is the most striking result of the application of the LIPRO-model to household projections in the Netherlands, irrespective of the scenario chosen. This trend is even stronger when the number of households is considered, instead of the number of persons by household position. *Figure 6.2* shows the development in the number of households of various types for the Realistic Scenario. The increase in the proportion of one-person households is dramatic: from 27 per cent in 1985 to no less than 51 per cent in 2050.

The rise in the number of persons living alone goes hand in hand, to a large extent, with the general aging of the population. In 1985, 34 per cent of the persons living alone was of age 65 or more; in 2035 and in 2050 the share is 49 per cent. Also note, in Figure 6.2, the diminishing share of the traditional family, i.e. the married couple with one or more children. Changes in the age structure explain this trend to a small extent only: elderly couples are more frequently in the 'empty nest' phase than younger couples. However, changes in household formation patterns are more important: more couples remain childless, less persons marry, and more marriages are dissolved at a relatively early stage.

Figures 6.3 and *6.4* show the effects of the various demographic scenarios on the household composition of the population in the year 2035.
The largest effects are found for Scenarios 2 and 3. Increasing fertility (Scenario 2) has the obvious effects of increasing the proportion of the population living in the state 'child' and increasing the proportion of traditional families. Reducing the tendency to form unions (Scenario 3) leads to more one-person households and less children. It is interesting to note that in Scenario 3 the number of consensual unions (unm0, unm+) is larger than in the Benchmark Scenario while the number of married couples (mar0, mar+) is much lower, even although both types of formation rates have been reduced by the same amount. The reason for this result is as follows: a lower tendency for children living with their parents to start a union leads to a relative increase in the number of single persons. Consequently, entries into the state 'couple' tend to originate more frequently out of the state 'single' than out of the state 'child'. And given that one enters into the state 'couple', a person from the state 'single' more frequently chooses a consensual union instead of a formal marriage than a person from the state 'child'.

The Mortality Scenario (5) hardly affects the household composition of the population. With lower mortality, elderly people tend to live longer in the state 'couple' and shorter in the state 'single'. The main effect of the

Figure 6.1. The population in private households by household position, 1985-2050 (Realistic Scenario)

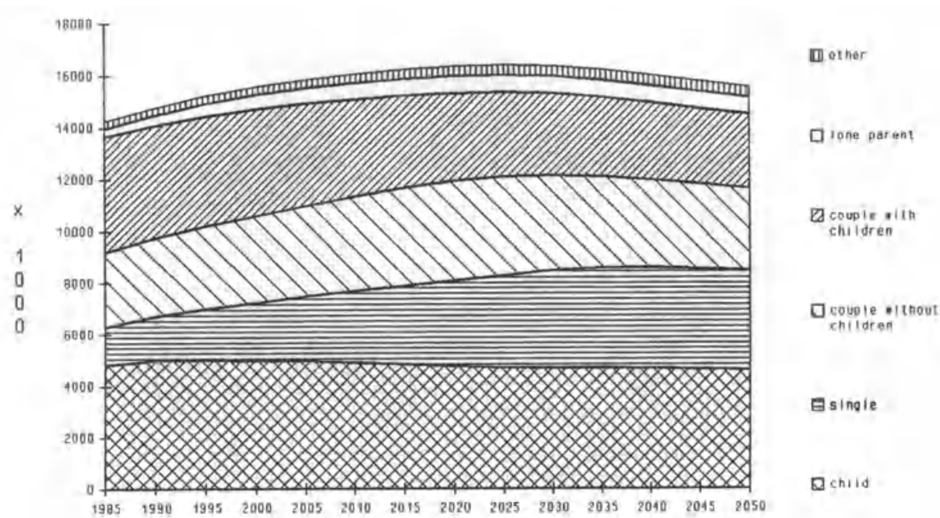


Figure 6.2. Private households by type, 1985-2050 (Realistic Scenario)

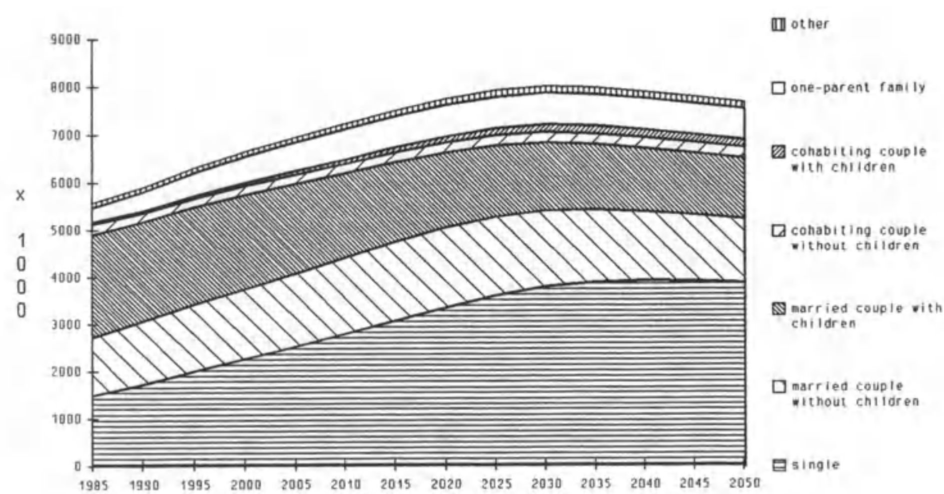


Figure 6.3. Population by household position, 2035, various scenarios

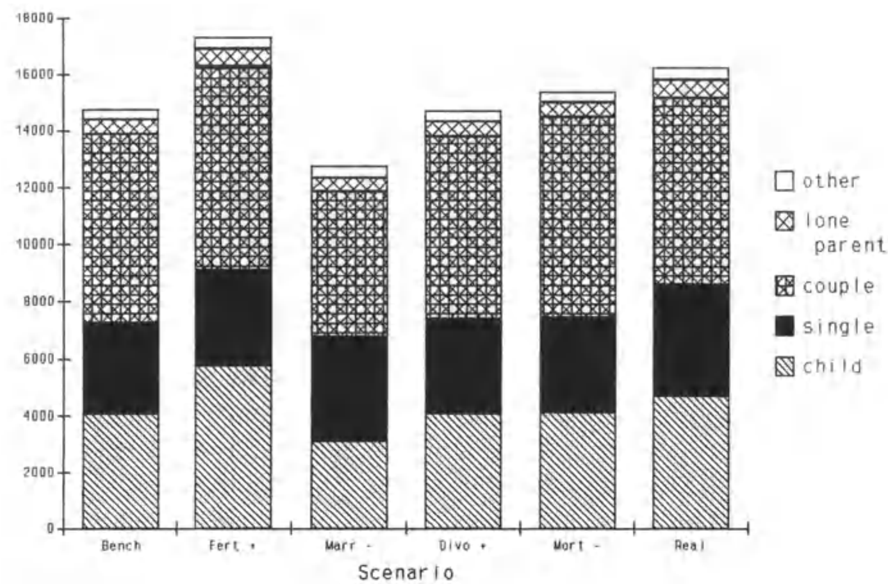
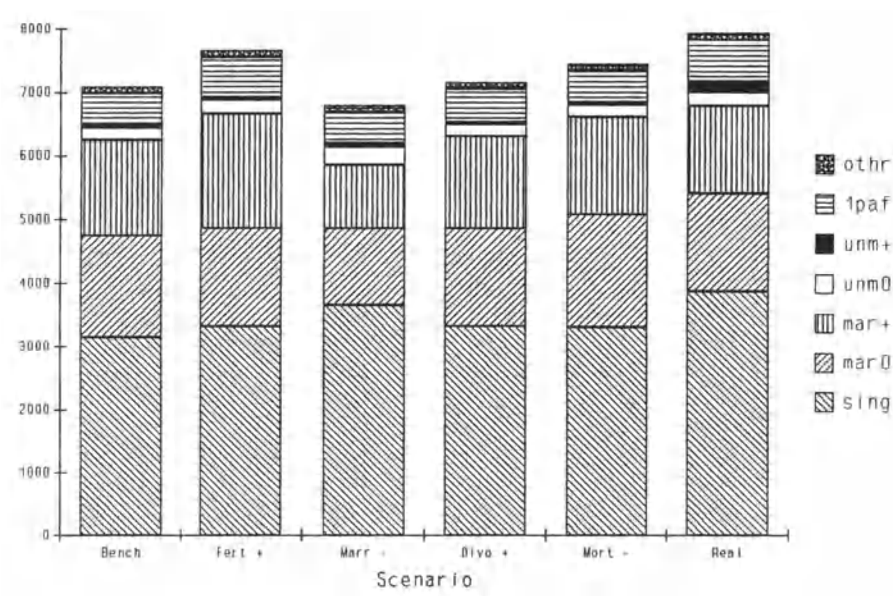


Figure 6.4. Households by type, 2035, various scenarios



Mortality Scenario is, of course, to increase the degree of aging in the population, as can be verified from *Figure 6.5*.

6.6 | The effects on social security expenditure

The effects of demographic changes on social security expenditure can be traced by linking the population projections presented in the previous section to the user profiles calculated in Section 6.4. In presenting these results, we have aggregated widow's and orphan's benefits (AWW) on the one hand and social welfare (ABW) on the other hand. The reason for this aggregation is that both social security arrangements are to an important extent used by one-parent families: AWW by the widowed and ABW by the divorced. Since the LIPRO household model does not distinguish single parents according to the event by which they entered the state 'single parent', it seems to be more appropriate to aggregate AWW and ABW in presenting the results of the simulations.

Figure 6.5. Population by age, 2035, various scenarios

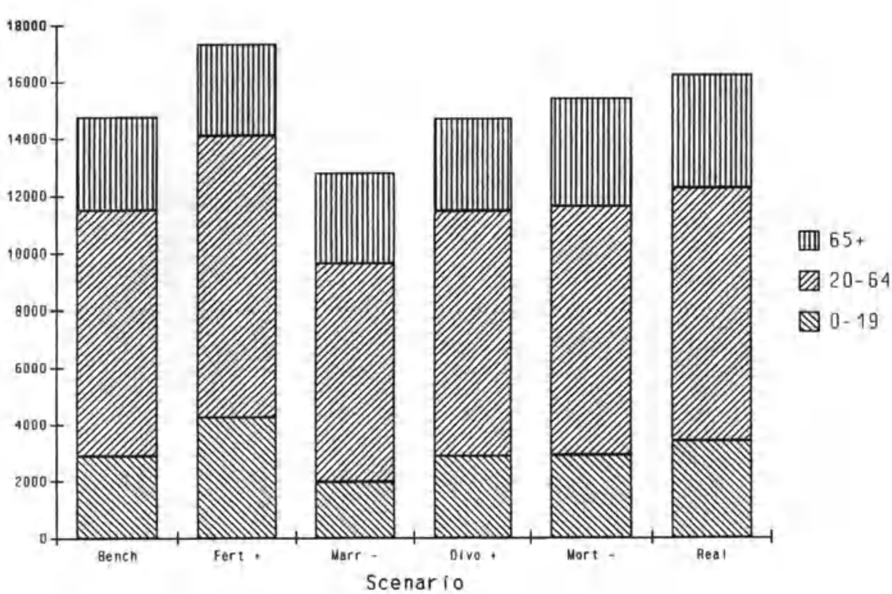


Figure 6.6 illustrates the development over time of expenditure on old age state pensions in the Realistic Scenario. From 1985 to 2035 total expenditures rise steadily to 2.7 times the expenditure in 1985.
The same figure also shows how this expenditure decomposes into three different sources:

- size of the population;
- age structure of the population;
- household structure of the population.

The latter results were obtained by combining, for each of the years shown in Figure 6.6, aggregated population projection results with the following aggregated user profiles, respectively:

- a 'profile' which consists of the average per capita expenditure;
- a profile with a breakdown by age only;
- a profile with a breakdown by household position only.

The aggregated profiles were calculated on the basis of the same social security data (taken from WBO 1985/1986, see Section 6.4) as the full profile.

The conclusion from this decomposition is that old age state pensions are not very sensitive to changes in household composition. A model that does not distinguish household position but only considers age (see first column for each year) performs almost as well as the LIPRO household model (see fourth column) as far as pensions are concerned: the age effect is by far the dominating factor.

The opposite holds true for survivor pensions and social welfare (*Figure 6.7*). Here the use of user profiles classified by age only leads to estimates of total expenditures that are far off the mark. The inclusion of household position as an additional dimension in the state space leads to much more accurate social security projections. Even when age is not taken into account (second bar) the projections are close to those on the basis of age *and* household position (fourth bar). The expenditures themselves show a sharp rise by about 100 per cent in the initial 30 years and stabilize thereafter.

Finally, note how the results for the pension expenditures indirectly illustrate the strong relation between age and living arrangement. Adding household position to a profile with a breakdown according to age only, does not yield

Figure 6.6. Expenditures on old age state pensions (AOW), Realistic Scenario (1985=100)

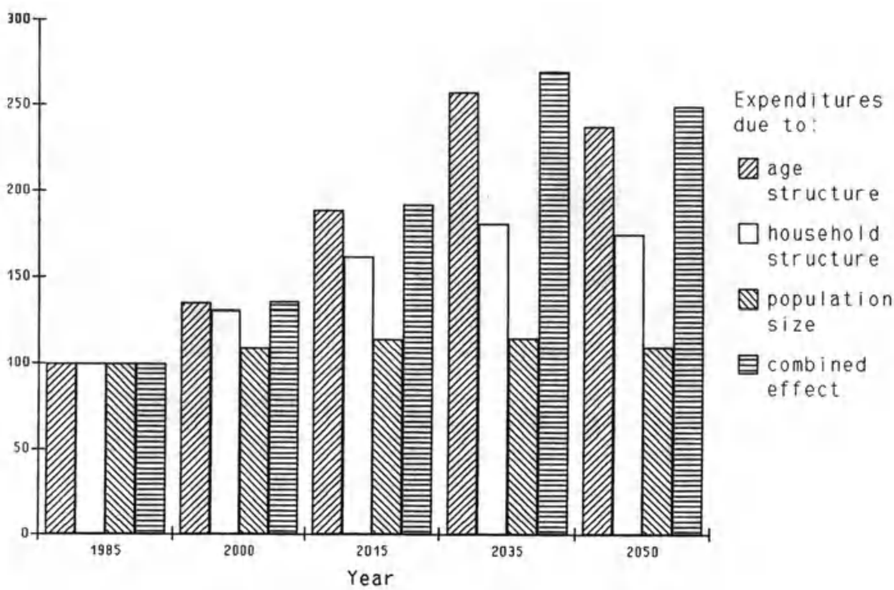


Figure 6.7. Combined expenditures on widow's and orphan's benefits (AWW) and social welfare (ABW), Realistic Scenario (1985=100)

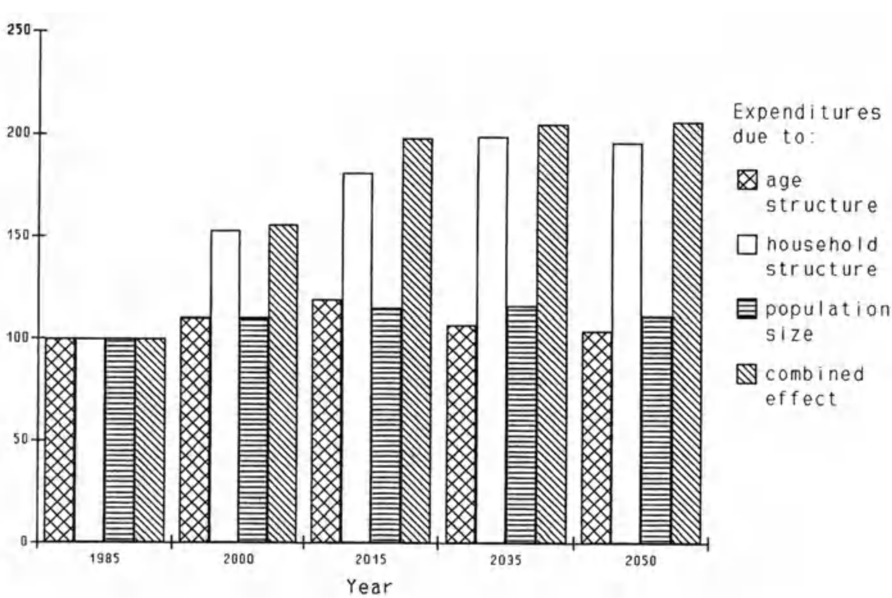


Figure 6.8. Expenditures on old age state pensions (AOW), various scenarios (1985=100)

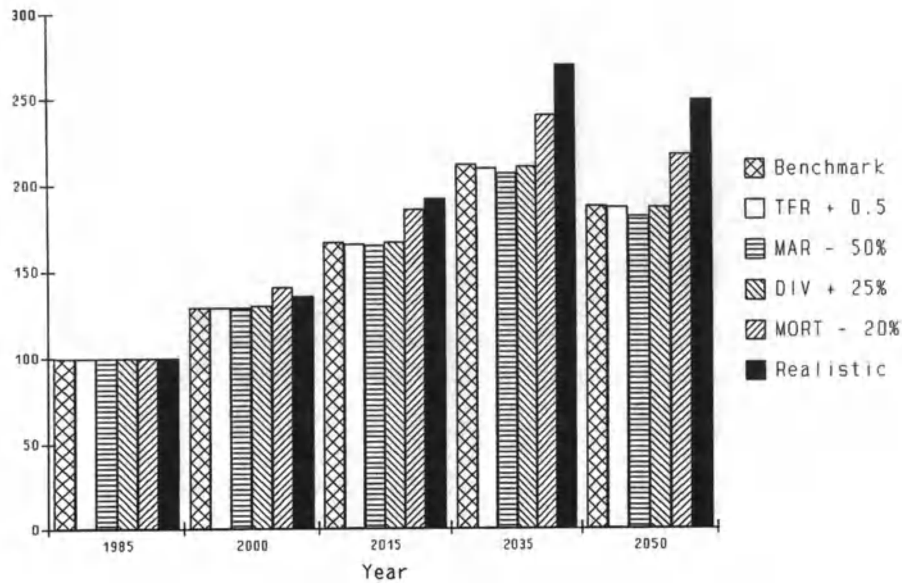
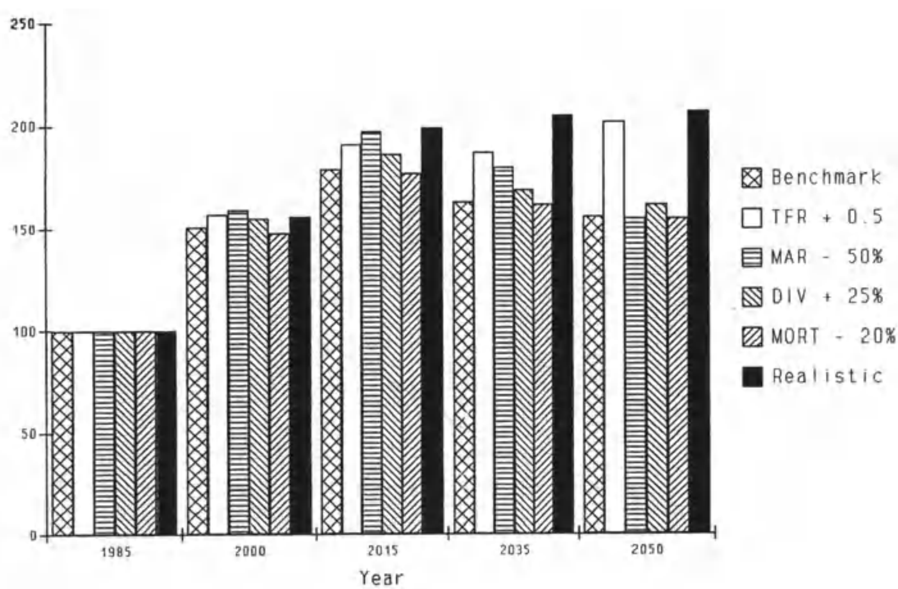


Figure 6.9. Combined expenditures on widow's and orphan's benefits (AWW) and social welfare (ABW), various scenarios (1985=100)



any substantial improvement, compare the first and the fourth bar for each year in Figure 6.6. However, a profile in which age is *replaced* by household position (cf. the second and the fourth bar) projects roughly half the total rise in expenditure. This may be explained by the fact that many of the single persons are aged 65 and over (50 per cent in 2035 and 48 per cent in 2050).

Next, we turn to a comparison of the six demographic scenarios. The corresponding time paths of social security expenditure are plotted in *Figures 6.8* and *6.9*. Figure 6.8 illustrates once more that mortality is the main determinant of expenditure on old age state pensions. While Scenarios 1-4 all lead to more or less similar developments in expenditure, Scenarios 5 and 6 lead to expenditures that are much higher than in the Benchmark. In 2035, the index numbers are 210 for the Benchmark Scenario, 240 for Scenario 5 and 270 for Scenario 6.

Figure 6.9 gives the results for the combined expenditures on AWW and ABW. Household structure has a clear effect on total expenditure. In Scenario 3, the increase in expenditure is primarily caused by an increase in social welfare to singles, while in Scenario 4 the main determinant is the increase in the number of one-parent families. The results for the High Fertility Scenario (Scenario 2) are interesting. In the short run, higher fertility leads to a relative increase in the number of couples that have children at the moment that the marriage or consensual union is dissolved. In the long run, higher fertility leads to larger cohorts that are subject to the risk of becoming single parents, or one-person households in need of social welfare. This long-run effect is particularly large.

6.7 | Summary and conclusions

In this chapter we have demonstrated how a multistate projection model can be used to trace current and future dynamics in living arrangements. We have used a household classification of 11 distinct positions that an individual person may occupy at a certain point in time. Our model is able to describe household events for the individuals concerned as they jump from one household position to another one. The model was applied to data from the Netherlands for the years 1985/1986.

Illustrative projections, corresponding to six different demographic scenarios, were carried out starting in 1985. The Benchmark Scenario was used to investigate what the implications would be for the household structure of the population assuming that current household dynamics as observed in the mid 1980s would apply to the future population of the Netherlands. Subsequently, the outcomes of this Benchmark Scenario were compared with those for five alternative scenarios. The most important outcome of the projections is a major shift towards one-person households.

The effects of these demographic changes on social security expenditure were assessed by linking the population projections to age-, sex-, and household-specific user profiles for various social security arrangements. The differences between the scenarios are enormous. Old age state pensions are primarily affected by mortality, while widow's and orphan's benefits and social welfare are mainly affected by changes in household structure.

One of the main conclusions of the calculations presented in this chapter must be that a multistate household projection model is a very useful device for making social security projections. Adding the household dimension to more traditional projection models has proven to be a very worthwhile investment as far as social security projections are concerned.

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7. CONCLUSIONS AND EVALUATION

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7.1 | General

The changing demographic structure of populations in industrialized countries has a number of socioeconomic consequences, among which that for social expenditures has attracted most attention in recent years. An important factor here is the marked age-dependency of social expenditures. Although an ageing population may have implications for aspects such as economic growth, aggregate demand, the labour force, and income distribution, the problem of resources necessary in the future for maintaining current levels of living among the elderly in developed countries, in particular in the long term, has probably most often been an issue of concern to policy makers and scientists (Myers, 1993). In 1985, almost nine per cent of GDP in OECD-countries was spent on public pensions (OECD, 1988a), and the substantial rise in both the number and proportion of the elderly in most industrialized countries is likely to have a major upward effect on this share. Indeed, whereas OECD-projections indicate a twenty per cent rise in social expenditure spending during the period 1980-2040, the growth in public pension expenditures alone may be as large as almost 80 per cent (OECD, 1988b).

In this book we have investigated what the impact of dynamics in living arrangements and age structures might be on future public pensions expenditures in industrialized countries.

As was stated in Chapter 1, the project has a number of merits over earlier comparative studies into the effect that demography has on public pensions

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expenditures. The present study extends those carried out by OECD and IMF into several directions (cf. Heller *et al.*, 1986; Holzmann, 1987).

1. It facilitates the investigation of the impact of living arrangement (mainly operationalized as marital status) on social security, in addition to fertility, mortality, and international migration. Marital status is not only important for widow's pensions, but also for old-age public pensions. The reason is that entitlements, in particular those for females, are dependent on marital status in many countries, through the intermediate effect of work histories (numbers of years worked; see for instance Table 3.14 in Chapter 3 and Table 5.2 in Chapter 5).
2. Future trajectories of demographic and pension variables are analysed for various scenarios, both for demographic and socioeconomic variables.
3. It includes a number of countries from Central and Eastern Europe, in addition to western countries.
4. Pension variables are country-based, instead of scheme-based, and pension benefits are endogenous.

Which new insights did we obtain by using this extended approach? In this Chapter we evaluate the project. Section 7.2 gives substantive and methodological conclusions. Both demographic issues, public pension issues and distributional aspects are dealt with. An assessment of the project is contained in Section 7.3. In particular, we discuss the drawbacks of the approach chosen for the current project. Finally, some open research questions are taken up in Section 7.4. Strategies for dealing with issues unresolved so far are also briefly addressed.

7.2 | Substantive and methodological conclusions

7.2.1. Demographic issues

• Ageing

Much of the knowledge of demographers on population ageing originates from stable population theory. As extensively documented by, for instance, Coale (1972), we know what the effect is of particular fertility or mortality levels on the age structure of the stable population. Stable population theory assumes a constant regime of demographic components, e.g. time-invariant age-specific fertility and mortality rates. In other words, the theory considers demographic developments in a very long perspective or, if one prefers, in an a-temporal setting. As a consequence, it does not allow to account for changes occurring in the structure of a real population over a limited period of time — e.g. a few decades. On the other hand, the formal demography of time-variant populations only contains a limited number of analytical results, that are often based on rather strict assumptions regarding the time paths of the parameters. Therefore, in order to investigate the consequences of less restrictive assumptions upon a population's age structure one is forced to use simulation.

The usefulness of simulation can best be illustrated by one of the main conclusions of the comparative study. In most of the countries included in this project, there is no demographic response to population ageing at the horizon 2030. Neither a baby boom nor an inflow of migrants can rejuvenate national populations (unless fertility and/or migration reach unrealistically high levels). The reason is that in many Western countries, the movement of the large cohorts born in the 1950s and early 1960s into older age results in a very large ageing momentum. The conclusion referred to here may be contrasted with the opinion stated by Cliquet (1991), namely that a rise in fertility to levels near replacement is an appropriate reaction to the strong ageing effects many countries face in the near future. Scientific and political responses to low fertility in Europe indicate preoccupation with the negative consequences, particularly the effect of a changing age structure on social security systems and other age-sensitive public policies. Cliquet (1991, p. 137) concludes, on the basis of the discussions between European demographic experts about the desirability and possibility of a fertility recovery at replacement level, that most of the arguments in favour of restoring fertility at or nearby replacement level at the long term are related to disequilibria between active and non-active age groups. He notes a consensus about the desirability of establishing a long-term stationary equilibrium, thus avoiding excessive population ageing (and an ongoing population decline).

Our simulations indicate that the assumption that a stationary population would be an answer to problems posed by population ageing is not justified.[1] It is the age-specific pattern of mortality which determines the age structure of the stationary population, and life expectancies in EC-countries are so high that the share of the elderly in the stationary situation

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1 Table 3.4 in Chapter 3 shows that under the replacement fertility scenario (birth rates at replacement level in 2005), the old-age dependency ratio will grow, during the years 1985-2030, by between five and 15 percentage points in nine of the 12 participating countries. Although none of these countries will have attained full stationarity at that time, stationary values will not be very far from the values in 2030.

will be 5-10 percentage points higher than nowadays. Analytical results derived from stable population theory do tell us that, in the long run, a country in which the life expectancy is 75 years would need a TFR of 2.5-3 children per woman in order to keep the share of the elderly (65 or over) down to today's 10-15 per cent, see, for instance, Coale (1972, p. 53). If the TFR would be around 1.8, the share of the elderly would rise to some 20 per cent. But it is only through simulation that we can study the fine interplay between fertility, mortality, migration, and the current age structure on the one hand, and the effects of these components on the age structure of the population in future years on the other, in particular during a period of transition to stability.

When used for analytical purpose, the best of projection models can be achieved by taking a scenario approach. Provided that a suitable set of scenarios has been designed, the scenario method allows to estimate the respective influence of the different demographic factors. It also helps getting an idea of the size of uncertainties we face regarding future trends by testing for the robustness of conclusions. Both scenarios used in the comparative study and in the Dutch study have shown that, when it comes to the age structure of the population, mortality is the key factor (given the range for demographic indicators that the scenarios spanned). One gets as much ageing as one puts in the mortality assumptions of one's projections. Although the minimum ageing that populations are going to experience is relatively easy to predict, a reasonable upper limit cannot be estimated on scientific grounds. We still don't know how much ageing we will get.

To conclude on ageing, it is worth stressing two conclusions which have been gained from the comparative approach taken in the IIASA study and which might have important socioeconomic implications. First, the ageing of a nation's population will be associated with a variety of changes in the size of both the elderly population and the labour force. For instance, the 12 countries' average increase in the size of the elderly population between 1985 and 2030 would be 43 per cent under the Constant Rates Scenario, with the top three countries (Canada, the Netherlands, and Poland) growing by 83 per cent on average, and the bottom three countries (Hungary, Sweden, and Germany) by only 15 per cent, see Table 3.6. Furthermore, Figure 3.2 shows large intercountry differences in labour force growth rates, ranging from +13 and +23 per cent for Czechoslovakia and Poland, to -23 and -38 per cent for Austria and Germany (Constant Rates Scenario, period 1985-2030). A second conclusion is that the former socialist countries —Hungary excepted— will reach maximum ageing approximately 25 years later than the Western countries.

- Living arrangements

As far as marital status is concerned, a major trend which the study revealed for the participating countries is the strong increase in the proportion of single and divorced old (aged 60 or more) males, accompanied by a substantial decline in the share of elderly married males, see Section 3.1.4. In most countries the current proportion single or divorced is ten per cent or less, and none of the countries exceed the 20 per cent level (Norway and Sweden are the outliers). In 2030, however, this proportion has risen to levels between 20 and 50 per cent in nearly all countries. At the same time, the proportion of married elderly males drops with 10 to 20 percentage points between 1985 and 2030.

These tendencies are by and large shown by every scenario, and thus there is relatively little uncertainty with respect to this trend. Results from the household simulations for the Netherlands in Chapter 6 indicate an enormous growth in the number of persons living alone (Section 6.5), and more detailed results broken down by age group (see Van Imhoff and Keilman, 1991, pp. 81-97) show that the latter trend is much stronger among the elderly (both males and females) than for the total population of the Netherlands.

Increases in the proportion of elderly females who are single or divorced are also to be expected, but the growth is smaller than that for males. Changes in the proportion married and widowed are not unlikely, but these are very difficult to anticipate because of their strong dependence on possible changes in the sex differentials in mortality.

An important methodological consideration which may have influenced the elderly's age and marital status structures computed under the various scenarios is our option for mortality rates which were independent of marital status. Mortality rates by marital status were not available for all twelve countries, and in order to increase international comparability it was decided to distinguish these rates by sex and age only.[2] It is well known that age-

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[2] Fertility rates were assumed to be independent of marital status, too, but the significance for the elderly's composition by age and marital status is relatively small here, at least for the period covered by the simulations in this study, i.e. up to the year

specific mortality rates *do* depend on marital status: observations in many populations have shown that not being married is a significant risk factor. For instance, age-specific mortality rates in the Netherlands at the end of the 1980s among the non-married were between 50 and 100 per cent higher than those for married persons, in particular for ages below 60. Differences were smaller for the elderly (Van Imhoff, 1992, p. 5). For Norway (1981-85) and the Federal Republic of Germany (1986) the differences are even more marked, yet they fall with increasing age (NCBS, 1989; Gartner, 1990).

Among the reasons that help to explain mortality differences by marital status there are two that feature most frequently in the demographic literature: the protection argument and the selection argument. Marriage plays a protective role, in that married persons less often display a high-risk lifestyle (smoking, alcohol, unhealthy food, driving habits) than non-married persons. And marriage is selective: people with health problems have relatively low (re)marriage chances. Obviously, it is not a person's marital status *per se* which influences his or her mortality risk, but rather conditions such as care, family responsibilities, and unhealthy behaviour. The latter conditions are much closer linked to a person's actual living arrangement, than to his or her marital status. Therefore, it is not unreasonable to assume that, as the tendency to form consensual unions outside marriage will grow, mortality differences by marital status will diminish (other factors remaining the same). Yet they will not disappear entirely, as was demonstrated empirically by Prinz (1991) for the case of Sweden, 1986: average death rates of never married cohabitees aged between 20 and 85 were 18 per cent (females) and 35 per cent (males) higher than corresponding rates for married persons living with their spouse — for all never married persons (whether cohabiting or not) the excess mortality was 100 per cent for females and 186 per cent for males.[3]

What are the consequences for the projection results of the fact that mortality differentials by marital status were not taken into account? For those

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2050. The labour force is affected to a larger extent than the elderly, the effect gaining momentum after approximately the year 2020.

3 Although Prinz found that mortality among never married cohabitees has converged towards that among married persons during the period 1981-86, average mortality rates for never married single persons increased substantially, compared with those for married couples. This suggests a stronger selection, and/or a diverging life style of these singles.

countries for which we had mortality rates by marital status, some trial calculations were carried out on the basis of constant marital status differentials in the mortality rates (for each age/sex combination). The Constant Rates Scenario was applied throughout.

Disregarding marital status leads to an underestimation of mortality. Due to the decline in the married population —which has relatively low mortality rates— the life expectancy at birth is lower than that with marital status specific mortality, based on the 2050 death rates: 0.24 years (or 0.3 per cent) among women, and 0.72 years (or one per cent) among men (maximum 1.1 years in the former FRG[4]).

As a consequence, the size of the population aged 60+ is overestimated by some five per cent on average, the extremes being again the former FRG (+10 per cent), together with Poland (+1 per cent). The elderly married population, however, is underestimated by some three per cent on average, as the higher average mortality rate was also applied to this part of the population. This underestimation is highest in Poland (-9 per cent), but not existent in Italy (+2 per cent).

The differences reported here are generally smaller than those produced by the different scenarios, compare for instance the figures in Table 3.7. Also, the drop in life expectancy (0.24-0.72 years) is much smaller than that assumed under the Low Mortality Scenario, compared with the constant rates (8-10 years for males and 4-5 years for females, see Section 3.2.2). Therefore, one may conclude from these illustrative calculations, that the choice for mortality independent or dependent of marital status does matter for a number of countries, but that the impact generally is rather limited.[5] Differences due to a choice for a particular scenario are always significantly larger. Together with the demographic reasons for the choice of marital status independent mortality, and the unavailability of detailed mortality data for some countries (see above), these empirical findings justify our approach.[6]

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4 Marital status specific mortality for the former GDR was not available.

5 An important reason for the relatively limited impact is the fact that mortality is low at ages with high marital status differentials, and that the marital status effect is much lower at advanced ages.

6 Essentially the same conclusion can be drawn with respect to marital status specific fertility. Disregarding differentials by marital status leads to an overestimation of fertility rates. Due to the increase in the proportions single and divorced women —who have lower fertility rates— the total fertility rate is some five per cent lower

7.2.2. Public pensions issues

Future old-age benefit entitlements will be different from today's, even with unchanged public pensions arrangements and activity patterns. This is mainly a result of past changes in working behaviours. Entitlements for men will decrease, while sharp rises are to be expected for women. This will reduce the difference between male and female benefits to 20-30 per cent in many countries. When marriage looses much of its significance (such as under the Western Low Rates Scenario), the sex differential in average benefits would be reduced even more in some countries. Similar reductions in the difference of entitlements between women of different marital statuses are also to be expected when marriage rates drop further and divorce rates continue to increase.

When public pension systems remain unchanged, expenditures will increase sharply in the future: the rise over the period 1985-2030 ranges from a minimum of 40-45 per cent in Austria and the former FRG, to a maximum of more than 200 per cent in Canada, depending on the level of ageing in the countries concerned (see Section 3.2.4). This would imply strong reductions in benefits in case contributions by the working age population and other aspects of the pension systems would be left unchanged. Under constant demographic regimes, the cut in average benefits would be between 15 and 55 per cent in 2030, compared with the 1985-level. A fertility recovery to replacement level will bring some relief, but the reduction would still amount to between 10 and 50 per cent. On the other hand, a further fall in mortality rates would imply reductions of between 30 and 60 per cent.

The overall conclusion that Gonnot arrived at in Chapter 3, supported by Van Imhoff's findings for the household projections for the Netherlands in Chapter 6, is that demographic variables are of limited help to relieve the burden of future public pensions expenditures. The reason is that fertility, mortality, and international migration cannot prevent strong ageing effects for the 12 countries in the future, cf. the discussion in Section 7.2.1. One is tempted to draw the ironic conclusion that, although the problems that

(unweighted average of all countries) compared to the value which takes marital status differentials into account, with a maximum difference of -12 per cent in the Netherlands. The TFR for Poland would be two per cent higher (!). As a consequence, the total population size (population aged 15+) is overestimated by some two per cent on average (by 2050), the extremes being the FRG (+10 per cent) and Poland (-4 per cent).

pension systems in many developed countries are faced with are caused by demographic factors (i.e. the unfavourable age distribution), changing these factors cannot avoid the problems. But such a conclusion is not justified. It should be remembered that after their introduction in the 1950s or 1960s in many countries, old age public pension systems developed more or less independently of the current (and future) demographic structure of the population. The rising costs connected to public old-age pensions have been induced by a variety of forces, not all demographic: for instance, increases in average benefits, and accelerated withdrawals of older males from the labour market owing to induced or voluntary early retirement (ECE, 1992, p. 198). At present, individual benefits in many countries are much higher than at the time the pension system was introduced. Holzmann (1987, p. 420) concludes that the average annual growth (in real terms) of public pensions expenditures in OECD countries was 8.4 per cent per annum during the years 1960-75. A large share of this growth rate was due to growth in expenditures per recipient: 4.6 percentage points per annum. For the period 1975-84 the annual growth rates are 4.7 (total real growth) and 2.2 (expenditure per recipient) per cent, respectively. Hence roughly half of the growth in expenditures between 1960 and 1984 is explained by higher individual benefits. If these benefits would have remained at their 1960 level, expenditures in 1985 would have been only 42 per cent of those actually observed. In case we would have started our simulations at an expenditure level only 42 per cent of the actual level for all 12 countries in 1985, projected expenditures for the period 1985-2050 would exceed today's actual expenditures only in a few cases (Canada, Low Mortality Scenario and national scenario; Hungary, National 1 Scenario), see Table 3.15. Benefits have increased in the past as a result of overall economic growth and the development of the welfare state: old-age pensions at only 42 per cent of their current level would clearly lead to unacceptably large numbers of elderly persons in the lower deciles of the income distribution. But the point is that although the pension systems introduced after World War II were compatible with the demographic situation at that time, they are no longer compatible with the demographic situation in the future, because welfare state arguments widened the gap between the pension system as it is now, and as it was at the start.[7] Hence substantial reductions of the public pension

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7 Bengtsson and Kruse remind us in Chapter 4 of the fact that the current situation with relatively low economic growth rates, as compared to those of the 1950s and 1960s, is another factor why public pension systems have recently come under pressure.

burden have to be sought in socioeconomic measures, and not in adjusting demographic conditions.

Six types of non-demographic responses to the question of deteriorating pension funding have been investigated. The first five are reported by Gonnot in Chapter 3, and the sixth one by Prinz in Chapter 5. These are: (i) an increase in female labour force participation; (ii) a rise in the mean age at retirement; (iii) an increase in contribution rate; (iv) burden-sharing between actives and retirees; (v) a combined pay-as-you-go/capital-funded pension scheme; and (vi) to offer additional pension rights to a woman, for each child she bears. The simulations indicate that a combination of measures will probably be necessary, depending on the particular situation in each country.

Rising female labour force participation rates to levels comparable with those in the former GDR or Finland will give a clear improvement in countries where relatively few women work, or where entitlements depend only weakly on work history. Although it would not be sufficient to solve the pension problem, an important secondary effect is a strong reduction of the male/female gap in entitlements. However, it may be difficult to stimulate female labour force participation (or rather, activity rates for the female part of the working population, in which the unemployed are not included) in situations when unemployment is high.

A higher mean age at retirement has two effects: pension rights start at a later date, and the labour force participation of the elderly is increased. The former effect presses pension entitlements down, whereas the latter effect increases both contributions (through a larger labour force) and expenditures (in earnings related schemes, through a longer work history).[8] Gonnot's simulations show that for the period until 2050, a mean retirement age of 65 would solve the pension problem in Czechoslovakia and Poland under

8 The flexibility of the labour market plays an important role in determining the extent to which elderly, who would have been retired in a system with a low retirement age, would still be gainfully employed in a new system with a high retirement age. Blanchet (1991, p. 76) shows, in illustrative simulations for France, that a gradual rise in retirement age by five years over a five-year period may lead to a substantial increase in the unemployment rate. Furthermore (p. 92) he argues that labour market differences are such that in European countries it will be more difficult to create additional jobs for the elderly than in the US.

any scenario,[9] and bring great relief to the system in Austria, France, Hungary, Italy, and the Netherlands. But in Germany, the Scandinavian countries, and Canada, where the age at retirement is already relatively high, the impact is much more limited.

Our study indicates that raising retirement age is a promising possibility to help avoiding excessive burdens on the pension system in many countries. But later retirement cannot solve the pension problem entirely, unless dramatic shifts are introduced. For instance, Dooghe (1992, p. 130) computed for the case of Belgium a rise by eight years between 1988 and 2040 in order to keep the ratio between the old-age dependency ratio at its 1988 level. When corrections are made for proportions not in the labour force, the rise is even 11 years. Calot (1985) estimates a rise of 5-10 years which would be required to keep the ratio between labour force and retirees at its present level. Furthermore, one should keep in mind that the issue includes many more aspects than those addressed in the comparative study. For example, Schmähl (1990, pp. 170-172) points out that a higher retirement age is opposite the current trend in many countries. High unemployment has led to early retirement programmes, and the possibility to retire earlier within the statutory pension scheme in a number of countries. Raising the average age at retirement will probably be the result of larger flexibility with respect to retirement, i.e. not only with regard to the age at which one retires (one should be able to choose within a certain age range), but also with respect to the type of retirement (whether complete or partial). Schmähl notes that flexible schemes already exist in Sweden (see also the discussion of the Swedish pension system by Bengtsson and Kruse in Chapter 4), Denmark, and Finland. A further aspect of later retirement is the individual decision of when and how to retire. Health, family circumstances, and income are important considerations here. The interest and decisions of the employer relate to productivity, retraining, and the possibility to hire new employees. Finally, fiscal and political aspects are important, too.

Any policy which aims at balancing the system by just increasing the contribution rate, and no other measures, will most probably fail in most of the countries under study, because the levels involved are unrealistically high. Under the Low Mortality Scenario (Tables 3.22 and 3.23), the balanced contribution rate rises to at least 25 per cent in 2030, and in six of the 12 countries it would have to exceed 35 per cent.

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9 These countries would face problems after 2050.

Another possible policy reform which has been investigated by Gonnot is what he calls 'burden-sharing', namely to link pension benefits to net income, and not to gross income. Burden sharing would avoid a situation in which benefits go up just because the contribution rate grows, for instance as a consequence of increasing pension expenditures. Gonnot's computations (Table 3.26) indicate that this might bring substantial relief in Austria and Italy, but much less in France (and in Germany, to some extent).

An increasing share of supplementary capital-funded pensions (sometimes labelled as 'reserve funded pensions', or 'private pensions') will most probably be part of the solution to the pension burden in the future. This suggestion, analysed for its effects by Gonnot in Section 3.3.5, is not new, see, for example, the review of the problem carried out by the OECD (1992), and Blanchet (1988) for the demographic aspects involved. Pestieau (1992, p. 44) reports figures for the share of private pensions in gross income among elderly households in seven OECD-countries in the first half of the 1980s. For households with a head aged 65-74 the shares typically lie between ten and 20 per cent, Australia (eight per cent in 1981) and the Netherlands (28 per cent in 1983) being the exceptions. A rise in the share can be noted for those countries for which data for two calendar years are given. Hence any measure attempting to stimulate private pensions further will probably just be a continuation of this trend.

In nearly all countries included in the present project (the Netherlands is the exception, see Sèction 3.3.5), a mixed system, aiming at total individual pension benefits at their 1985 level, would perform much better than a pure pay-as-you-go system. However, it would still require a contribution rate as high as 35-40 per cent in Italy and Austria.

The trend towards greater reliance on private pensions has a number of important implications, most of which are beyond the scope of this project. But one deserves being mentioned here, namely that employers tend to use private pensions they (help to) finance to discourage job shift and to influence age at retirement (Duskin, 1992, p. 18). This, in turn, might be used as an instrument to bring relief to the public pension burden in case employees retire at a higher age, cf. the discussion above.

In his case study for Austria in Chapter 5, Prinz assumed that a woman who gives birth to one child would gain an additional five years of old-age insurance; for two children the gain would be ten years, and the maximum would be 15 years for three or more children. It was also assumed that this policy would have an upward effect on fertility rates, resulting in a rise of the TFR to replacement level, i.e. some 0.5 children per woman higher than the 1985 level. The simulations carried out by Prinz show that the future contributions/benefits ratio improves considerably, compared with that of the old system, but that the persistent ageing of the population still results in a deficit. Moreover, without an upward trend in fertility, the proposed system would still be beneficial, as general provisions for survivor pensions could be dropped. Finally, the pension reform analysed by Prinz would have clear emancipatory effects, because it provides women with children substantially higher pension benefits.

None of the different pension policy measures described above *in itself* will probably be able to counteract the implications of population ageing, but a combination of them might be the answer. The international comparative study did not include a pension scenario based on such a bundle of policy measures, but for the case of the unified Germany, Ott *et al.* (1991) investigated this issue within the framework of the current project. They find that a no change policy (unchanged demographic parameters and pension system) would lead to a balancing contribution rate of 37 per cent in 2030 in the unified Germany, up from 19 per cent in 1985. Alternatively, the balancing pension level would be only 56 per cent of the 1985-pension level. But when three different policy measures are combined the situation changes drastically. A new pension scheme based on (i) burden sharing (linking the pension to net income instead of to gross income), (ii) raising the average age at retirement by six years, and (iii) deduction of other income of survivors from their dependents' benefits would bring the balancing contribution rate down to 23-25 per cent in 2030 (depending on the demographic and Labour Market Scenario), compared with the 37 per cent level under the no change policy. The balancing pension level would be between 92 and 95 per cent of today's benefits, instead of 56 per cent. The authors conclude that such a three-fold adaptation of the German pension system appears feasible, especially if future economic growth is moderate or strong. These thoughts on economic growth concur with the suggestion put forward by Gonnot (see the discussion of Table 3.30) that a rise in productivity may be one of the many factors which together might bring relief to the expected pressure on the system of public pensions.

A more detailed account of the impact of economic growth on the performance of the pension system is provided by Bengtsson and Kruse in Chapter 4. They consider the case of Sweden, in which the pension base ('pension points') is indexed for inflation, but not for economic growth. With positive real growth (net of inflation), average wages —and thus average pension contributions— grow faster than average pension benefits. This is one of the main reasons why economic growth is beneficial to the system's performance. For instance, Table 4.6 shows that the ratio between total contributions and total benefits in the year 2050 would amount to 0.42-0.68 with zero growth, depending on the scenario chosen. But when the annual growth rate would be two per cent, the ratio would be much better, lying between 0.94 and 1.48. However, a drawback connected to economic growth is that it increases inequalities between actives and retirees, because their incomes grow at different rates.

7.2.3. Distributional effects

The main benefit of the combination of a marital status-specific demographic projection model and a country-specific pension model that makes use of all components of the demographic model is a deep insight into differentials between various subgroups of the population. Total pension expenditures are reasonably approximated even without considering marital status, but only this model combination allows us to have a closer look at the two sexes, at different (birth) cohorts, at various marital statuses, and at all possible combinations of sex, cohort, and marital status.

Comparing men and women, a most striking feature is that —on average and depending on the specific pension system— per capita pension benefits for women are between 55 per cent and 100 per cent of those for men. Women's benefits are relatively low in case of pension systems that largely depend on years in the labour force, and in particular when female economic activity is low in relation to male (such as Italy). Differences in economic activity are discussed in detail in Chapter 3 (see Table 3.13). By definition, no difference in pension benefits exists for universal pension systems (like in the Netherlands). On the other hand, from an individual perspective, men are —on average— contributing to the system twice as long as they receive benefits. For women, however, the period of retirement generally even exceeds the length of their working life, both due to their higher life expectancy and their lower activity rates.

Looking at marital status, gender differentials can be explained in much more detail than in case the demographic model would include age and sex only. While per capita pension benefits of widows are relatively high —due to the existence of survivorship pensions— benefits are particularly low for divorced and single women.[10] On the other hand, it is this group of single and divorced women whose working life period usually exceeds the retirement period. Differences in economic activity among women are again discussed at some length in Chapter 3 (see Table 3.14).

From a comparison of different cohorts we can conclude that differentials between men and women, and also between different marital status groups are going to decrease in the future (see again Chapter 3, Tables 3.13 and 3.14), mostly as a consequence of increased economic activity of women during the last decades.

The further disaggregation of the female population by marital status into groups of parities as done in Chapter 5 is also interesting. The number of children born turns out to be the main reason for differentials in economic activity of women and thus in per capita pension benefits — at least in Austria. For example, while today never married women have worked 29.5 years on average when going for retirement, married women have only worked 20.7 years. Adjusting for differences in parity, those differences disappear almost entirely (see Chapter 5, Table 5.2). The aim of the pension policy introduced in Chapter 5 was exactly thought of breaking this one-to-one relationship between economic activity and pension benefits that has led to large differentials in wealth among retirees in Austria (see in particular Table 5.12 for effects of the policy).

7.3 | Project assessment

Four important merits of the present project were listed in Section 7.1. Yet, there are also a number of drawbacks, some of them connected to the international character of the project, and others to the modelling strategy which was chosen.

An international comparison leads unavoidably to compromises. In the present project this was most immanent for the types of models we worked with. As far as the demographic aspects are concerned, we opted for a relatively simple marital status projection model. A consistent set of

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[10] Benefits for married women are also low, but those women are assumed to have additional income as a consequence of being married, be it through their husbands earnings or pension benefits.

projections of the population broken down by marital status (in addition to age and sex) has not been produced earlier, and thus is useful in itself. Yet the choice for marital status as an indicator for the more general notion of living arrangement was clearly guided by the fact that other indicators (family, household) would lead to unacceptably large data problems.[11] For the social security aspects of the project we selected public pensions (for retirees and survivors) of the pay-as-you-go type. The reason for choosing this type of pensions was guided by the fact that the relatively simple pension model described by Gonnot summarizes, for a certain country, the relevant aspects quite well. An additional private pension model based on capital funding principles would have been useful, too, but the diversity in private pension schemes is so large that no existing model, to the best of our knowledge, would be able to grasp the essential features of the 12 countries in this project.

Well aware of the consequences of these compromises, we included a limited number of extended studies in the project: one on aspects of economic growth (Chapter 4 by Bengtsson and Kruse), one on pension policies (Chapter 5 by Prinz), and one on living arrangements (Chapter 6 by Van Imhoff). These extended studies were restricted to one country each, for obvious reasons. It will be clear that the findings of Chapters 4-6 cannot be generalized to the remaining countries at this stage.

Our modelling strategy can be summarized as follows. In all chapters (3-6) there are two sub-models: one for demography and one for pensions (the model described by Kruse and Bengtsson includes economic variables as well). Demographic variables are exogenous to the pension sub-model, but *pension variables do not influence demographic parameters*. This is an important limitation of the study in this book. It is not inconceivable that demographic variables and pension variables interact mutually. For instance, when pensions for persons living with their spouse are different from those for persons living alone (cf. Van Imhoff and Keilman, 1991, p. 116), this difference may have an impact on divorce rates. However, our understanding of the backgrounds of demographic changes in industrialized countries in the past few decades is so limited that using an explicit model which endogenizes fertility and nuptiality behaviour would clearly be too much an ambitious task within the framework of an international comparative study. As an

11 Even with this choice for a relatively crude indicator we had to overcome some data problems, in that occurrences and exposures were not always mutually consistent.

alternative to *modelling* possible interdependencies between sub-models we made extensive use of *scenarios*, in the sense that alternative trajectories for future values of key parameters were formulated. Thus, the impact of demographic variables on pension variables was modelled explicitly, whereas possible feedback effects from the pension system to demographic behaviour were implicitly taken into consideration by means of various scenarios. For example, Gonnot investigates four demographic scenarios (Constant Rates, Fertility at Replacement, Low Mortality, and a Western Low Rates Scenario) and five socioeconomic scenarios (increased female labour force participation, raising age at retirement, increasing contribution rates, linking net benefits to net incomes, and complimentary capital funded pensions). Van Imhoff assumes five scenarios (High Fertility, Low Marriage, High Divorce, Low Mortality, and a Realistic Scenario) in addition to the constant rates calculations. And the way Prinz chose future values for his key fertility input parameters is a clear example of using a scenario instead of endogenizing the relevant parameters: his pension scheme was assumed to have an upward effect on the TFR, resulting in a rise by approximately 0.5 children per woman compared with the 1985 level. It will be clear that a scenario is much more subjective and permits much less detailed simulation experiments than a quantified model. However, when key factors resist quantification, when the model's fit is not satisfactory, or when the model is not stable, a more intuitive approach such as using scenarios is an attractive alternative to modelling. Such an approach can present a wider range of possible futures than quantitative techniques, which become uncertain when out-of-sample predictions are generated.

7.4 | Challenges for the future

Do we need complicated dynamic living arrangement models to trace the impact of demographic developments on social security expenditures in an international comparative study? Firstly, considering changes in living arrangements when addressing pension issues seems somewhat superfluous, especially with respect to total pension expenditures. But due to differences in work histories, the living arrangements dimension has its merits when we look at distributional aspects (by sex, by cohorts, and not the least by the living arrangement dimension itself). An example of such a distributional analysis is the study on Austria by Prinz (Chapter 5), and the topic was more generally discussed in Section 7.2.3. Secondly, a relatively simple model which includes marital status (in addition to age and sex) would cover most of the relevant demographic aspects, generally speaking. But for those countries in which marital status becomes less and less a valid indicator to describe the actual living arrangements of the population, a more complicated household model would clearly be an improvement. Take the case of Norway as an example. Data from the 1990 Census indicate that seven per cent of the never-married (all ages taken together) live in unmarried cohabitation. Among those who are formally divorced, 45 per cent lives alone, and 25 per cent is heading a one-parent household. When labour market behaviour is linked to living arrangement (in particular for women), and/or when social security benefits depend on living arrangement, marital status is a poor proxy for living arrangement, and one would prefer to use the type of household individuals actually live in. This would be particularly valuable for other types of social security than public pensions, for instance health expenditures, or support to lone mothers. A major challenge here seems to be the lack of data, both for the demographic submodel (see the discussion below) and the social security submodel.

It will be clear that a more sophisticated model which includes household dynamics would require better data than those available in most countries nowadays. Some strategies to deal with the relatively poor data situation regarding household dynamics are discussed below.

A few statistical bureaus have, over the past decade, increased their efforts to collect data on living arrangements, for instance Denmark (register-based annual household and family statistics; see Petersen, 1985, and Noordhoek, 1989), Sweden (linkage of five registers: the 1980 and 1985 censuses with information on legal marital status and cohabitation, and the registers of migrations, marriages, and deaths, see Statistics Sweden, 1992, and Prinz, 1991, and forthcoming), and the United States (survey of Income and Program Participation SIPP — with 20,000 households in the panel in 1983-84, increasing to 50,000 households in 1986). Moreover, in many countries surveys have been set up which can be used as a source of data on changing living arrangements. Klijzing (1988), Murphy *et al.* (1988), and Courgeau and Lelièvre (1988) discuss some of these sources.

Special techniques of parameter estimation may partly remedy the severe problems caused by scarce data. Of particular interest are indirect estimation techniques and methods developed in mathematical statistics.

7.4.1. Indirect estimation techniques

When thinking of possible extensions of the international comparative project to more complicated models, we are faced with a dilemma. Should we continue working with a relatively crude living arrangements model which matches the data that are available? Or should we construct a more realistic model and apply advanced estimation techniques that combine data processing and additional assumptions to find parameter estimates for the complex model? We argue strongly in favour of the second alternative. Because of the way in which family and household composition changes so drastically during the life course of an individual, a longitudinal approach using a dynamic perspective is particularly appropriate for modelling living arrangements. With a simplified, static model we would have fewer problems in estimating its parameters. In fact, the widely used headship rate approach, and many of its extensions, is so popular because it requires few data. But a static model cannot answer many of the questions which are relevant in the context of this project: what is the impact of the upsurge in divorce on living arrangements of the elderly? How do differences between males and females in age-specific partner selection affect future numbers of couples?

As a matter of fact, one of the most promising areas for further research is the development of a comprehensive set of techniques for the estimation of parameters of living arrangement models when relevant data are scarce. This would be a substantial improvement over existing methods of family and household demography, comparable to the development of indirect estimation techniques which attempt to measure values of basic demographic parameters (birth rate, death rate, TFR) under less than perfect data conditions. But indirect estimation techniques do not have to be restricted to vital events. The field of family and household demography may benefit greatly from these techniques.

As an example, consider Preston (1987) who provides useful techniques for the estimation of parameters in family and household demography based on data from two censuses. Using theory developed by Preston and Coale (1982), he is able to show how a second census substitutes for unobserved data on events, for instance death, or marriage dissolution. What remains to be done with Preston's techniques, is to generalize them to the case of several intercommunicating populations, whose events are described by multiple increment-decrement processes.

7.4.2. Statistical methods

A second promising technique is the EM-algorithm, developed in mathematical statistics (Dempster *et al.*, 1977). It gives Maximum Likelihood estimates of model parameters from incomplete data. Each iteration of the algorithm consists of an expectation step followed by a maximization step. The expectation step gives an estimation of the complete data, given the observed data and the model. The maximization step then takes the estimated complete data as if they were the observed data, and it estimates the unknown parameters by Maximum Likelihood.

There are a multitude of data collection strategies, and hence various methods to link the data to the parameters of a multidimensional model. Hoem and Funck Jensen (1982, p. 234) give an overview of several types of data, and the corresponding estimations. Below we shall suggest briefly some estimation methods, corresponding to the data types listed in Section 2.4.

A *continuous registration system* presents the least difficulties. Maximum Likelihood estimators of model intensities are obtained by taking observed occurrence/exposure rates (Aalen and Hoem, 1978). Ledent and Rees (1986) discuss the deterministic case and refer to it as the 'movement approach'. Panel data and corresponding estimation algorithms have been studied by Singer and Spilerman (1976a, 1976b), Lee, Judge, and Zellner (1970, Chapter 2), and, again in the deterministic case ('transition approach') by Ledent and Rees (1986).

Retrospective surveys give rise to what is called 'purged data' (Hoem and Funck Jensen, 1982, Section 5.2.). Life histories are purged if membership in a particular part of the state space at the end of observation is a condition for inclusion in the set of observations — the set is then purged of other types of life histories. If there is a nondifferential risk of transferring into the non-observed subset and if the latter subset is absorbing (for instance, the state of dead, or emigrated), unbiased estimators of the model parameters can be obtained. Tuma and Hannan (1984, Chapter 5) discuss ML-estimation of right censored life histories, that is life histories for which the termination date of the current state is unknown, as is the case in retrospective observations.

Several methods of dealing with *repeated cross-sections* are described by Lee, Judge, and Zellner (1970). Most of their methods are based on least squares considerations: find a set of time-constant transition probabilities that, when applied to cross-sectional structures at times 1, 2, ..., t-1 produce cross-sectional structures at times 2, 3, ..., t with highest accuracy in the sense of least squares. Therefore, the Lee-Judge-Zellner approach can only be applied when the number of observation points t is large relative to the number of unknown transition probabilities n(n-1), where n is the number of types of living arrangements. When this condition is not met, one could borrow a transition matrix from some other source, apply it to the living arrangements structure at time t=1 to find an estimated structure at time t=2, and finally adjust the initial transition probabilities so as to produce the correct observed structure at time t=2. This procedure can be repeated for t=2, t=3, etcetera. Having found the (time varying) transition probabilities, these may be converted into other model variables by applying the model equations.

Finally, the least satisfactory situation arises when one has *only one cross-sectional observation on current population structure* at one's disposal, and no data on events or transitions. In that case, not much more can be done than to borrow information on events (in the form of transition probabilities, for instance) from other sources. Does this mean that the model's behaviour would then be completely arbitrary? We do not think so. In general, and for a not too long period of time, the behaviour of the system is more sensitive to the initial structure than to the inputs describing the dynamics of the system (transition probabilities, or occurrence-exposure rates). By experimenting with the borrowed information (variant projections) one may obtain a reasonably good impression of possible future trends in living arrangements for the first few decades of the projection period. Although this strategy was not followed in the current project, some of its findings may be used to illustrate the point made above. For instance, Table 3.7 in Gonnot's chapter includes the marital composition of the elderly (60+) in 1985 and 2030 according to the Constant Rates Scenario, in which demographic rates for each country were kept constant at their 1980-84 values, and the Western Low Rates Scenario, which combines the most extreme demographic rates observed in the period 1980-85 in Western Europe to each of the 12 countries: West German fertility (1.28 children per woman), Swedish marriage and divorce (one-third never married, mean age at first marriage of 28 for women and 30 for men, one-third of all marriages ending in divorce), and Swiss mortality (life expectation 74 for men and 81 for women). It turns out that the range between marital compositions in 2030 according to the two scenarios is not larger, generally speaking, (and often even more limited) than the difference between the situations in 1985 and

2030.[12] For the year 2005 the differences are even smaller (figures not shown in Chapter 3). These findings concern the *marital status* structure of the *elderly*. A second illustration, applying to the *household* structure of the *whole population*, is to be found in the household projections for the Netherlands reported by Van Imhoff in Chapter 6. His Figure 6.3 suggests that individual household positions (child, single, couple, lone parent, and other) in the year 2035 are not very sensitive to changes in assumptions regarding household dynamics. The most extreme scenario is that assuming high fertility (TFR is increased by 0.5 child), with relatively many children living in the parental home.[13]

The two examples referred to here suggest that the consequences of choosing between national rates describing dynamics in living arrangements, or rates from some other country, are quite limited for a period of a few decades. An important condition is, of course, that accurate information regarding the breakdown by living arrangement for the population stock is available.

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[12] A clear exception is the proportion divorced in Italy, which is much higher under the western low rates scenario (ten per cent) than under the constant rates scenario (one per cent). The reason is that divorce rates were extremely low in Italy until 1985, and these rates remain at their 1980-84 level during the entire projection period under the constant rates scenario. But under the western low rates scenario, Swedish divorce rates (one-third of the marriages ending in divorce) are applied.

[13] The low marriage scenario (all marriage rates reduced by 50 per cent) results in a lower population size than the other scenarios, because the relatively high mortality rates of the non-married will get extra weight. However, the structure by household position of the population is not very different from that in the other scenarios.

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APPENDIX: COUNTRY CASE STUDY REPORTS

Within the framework of this project, the following country case study reports have been prepared as IIASA Collaborative Paper (CP) or IIASA Working Paper (WP).

WP-90-22 Socio-demographic changes and the pension problem in Austria, by J.-P. Gonnot.

CP-91-002 Demographic changes and their implications on some aspects of social security in the unified Germany, by N. Ott, Th. Büttner, and H.P. Galler.

CP-91-15 The effects of changing marital status patterns on social security expenditures in the Netherlands, 1985-2050, by N. Keilman.

WP-92-23 Demographic trends and the pension problem in Poland, by E. Fratczak and J. Józwiak.

WP-92-24 Socio-demographic changes and the pension problem in France, by J.-L. Rallu.

WP-92-30 Demographic trends and the pension problem in Finland, by J. Lindgren.

WP-92-35 Demographic effects on the Swedish pension system, by T. Bengtsson and A. Kruse.

WP-92-48 Demographic trends and pensions in Italy: An outlook for the future, by A. de Rose and A. Pinelli.

WP-92-68 Socio-demographic changes and the pension problem in Canada, by J. Ledent.

Other papers related to the project are listed below.

WP-89-34 Recent trends in living arrangements in fourteen industrialized countries, by J.-P. Gonnot and G. Vukovich.

WP-89-107 Pension systems and social security trends and national characteristics, by J.-P. Gonnot and C. Prinz.

WP-90-15 Demographic, social and economic aspects of the pension problem: Evidence from twelve countries, by J.-P. Gonnot.

WP-91-12 Marital status and population projections, by C. Prinz.

WP-92-28 Evaluating a pension system considering children born: The case of Austria, by C. Prinz.

WP-95-** Population dynamics in Poland, 1950-2050: Internal migration and marital status changes, by I.E. Kotowska.

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