Development Macroeconomics

Essays in memory of Anita Ghatak

Edited by

Subrata Ghatak and **Paul Levine**

Routledge

Routledge Studies in Development Economics

Development Macroeconomics

This work brings together a number of relevant chapters on macro-, monetary and development economics from many eminent economists from all over the world who are closely associated with the works of Late Professor Anita Ghatak of Greenwich University, UK who was an expert in the field of macroeconomics and econometrics. It comprises a variety of chapters which are highly significant in the analysis of macroeconomic policies both in developed and in transition economies.

There are several main topics covered in this book such as the test of new theories of economic growth and convergence and the use of dynamic and rigorous time-series econometric methods for analysing money demand functions in transition economies. Also included are estimations of international transmissions of shocks using GDP forecasts and a thorough analysis of the implications of public debt. This work details the meaning of economic development and the comparative analysis of the recent growth of India and China, also the modelling of the macroeconomics of poverty reduction and the monetary policy rules in transition economies. Lastly, the research analyses the Asian financial crisis, the impact of migration on investment and economic growth and international consumption patterns.

All the papers are based on original research and their findings will be of major interest to policymakers as well as students, teachers and researchers of macroeconomics and economic development.

Subrata Ghatak is Professor of Economics at Kingston University, UK. His successful textbook, *Introduction to Development Economics*, is also published by Routledge.

Paul Levine is a Foundation Research Professor at Surrey University, UK.

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Contributors

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Professor Levine now leads an internationally recognized macro-group with an international team of collaborators from the ECB, the IMF, central banks of Peru and Pakistan, and the National Institute of Public Finance and Policy in New Delhi. It recently completed an ESRC-financed research project "Robust Monetary Policy Rules for the Open Economy", 2005–2007, that was graded "Outstanding" by the ESRC. The group is now involved with two projects: one financed by the EU to develop Bayesian estimation and solution software for DYNARE and a second by the Foreign and Commonwealth Office to study monetary policy reform in India.

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Subrata Ghatak
Paul Levine

1 Introduction

Subrata Ghatak and Paul Levine

This book brings together a number of papers related to the macroeconomics of development – a topic which was dear to the heart of Professor Anita Ghatak at the time of her untimely demise in 2005. Most of the contributors were personally known to Anita. We wish to thank them all for their important contributions.

The papers in Part I of the book focus on growth, economic development and poverty – fundamental issues that were central to Anita's interests and research.[1]

In Chapter 2, Philip Arestis and Malcolm Sawyer address the timely question of the convergence and divergence of different economies in their quest for economic growth. The central question posed in this chapter is whether the economic growth process, within and between countries, has tended to produce convergence or divergence (or no general pattern). The authors begin by considering the different perceptions and predictions relating to convergence or divergence between nations (in terms of economic development as expressed in measures such as GDP per capita). They also discuss the measurement of convergence and divergence. After investigating the existing empirical work on the issue at some length, a clear-cut conclusion emerges: there is no evidence that poor countries are catching up with rich countries, and the world distribution of income is narrowing.

Chapter 3 by Srikanta Chatterjee continues the theme of growth. He argues that the rapid growth of the Chinese and Indian economies over the last quarter-century has transformed them into dominant growth engines for the global economy. The two economies have different institutional structures, and they have been following different growth strategies. The author examines the factors and forces behind the two countries' economic transformation with a view to identifying their strengths and weaknesses, and assessing how they are likely to fare in the years ahead. In particular, the contributions of factors accumulation and factor productivities to the two countries' growth processes are analysed, as is the influence of demand side factors. How the two giants measure up in terms of the well-being of their peoples – the crucial test of a country's development – rounds off the discussion.

Chapter 4, by Taradas Bandyopadhyay, argues that each of the components of the current human development index is important in evaluating the quality of life in a country; and it is also a significant improvement over the use of per capita real income alone to measure economic development. The average quality of life indeed reflects the state of economic development of a country. But, asks the author, does it really measure the true development? In two well-known indices, the physical quality-of-life index (PQLI) and the human development index (HDI), each element of these three constituent indices has equal weights – clearly a very arbitrary assumption. Furthermore, there is substantial double counting in considering increased education, rising gross domestic product and lower mortality rate, since each of these are not independent of one another. Bandyopadhyay then proposes a Hicksian type of Quality Adjusted Longevity [QAL] as a reasonable measure of economic development, an index that takes into account both 'health gaps' as well as 'health status' in measuring quality adjusted longevity.

Dr Willy Spanjers, in chapter 5 on the Asian crisis, provides a coherent framework in which the main characteristics of growth, uncertainty and crisis are connected. Within this framework, the author finds that these issues, which were so prominent in East Asia, are consequences of the chosen development strategy. Thus, a fundamental mechanism is identified that relates the high levels of per capita growth in the East Asian countries before the crisis, its fall during the crisis and the more modest growth rates thereafter. Spanjers argues that in the 1980s India followed a low development technology strategy, whereas China pursued a high technology strategy. The question of whether or not crises can be prevented in the process of economic development is also addressed and, if so, whether it is desirable to do so.

The final chapter of Part I, by Sushanta K. Mallick, develops a framework to link key macroeconomic variables with poverty. The author tests the effect of policies, namely the government-led channel of development spending and financing, that directly influence poverty after accounting for the effect of sectoral output and price ratios, using data from India spanning the last five decades. First, the policy-driven model emphasises the sectoral income distribution and inter-sectoral terms of trade as a mechanism in determining the level of poverty. Second, the chapter considers key components of fiscal spending and monetary or financial policy via the availability of credit, rather than the cost channel, to show that a strategy of government-led development spending and financing is a precondition for growth with poverty alleviation.

Part II is a collection of papers on stabilisation policy, migration and consumption. Anita made important contributions in these areas, including a chapter that appears in this volume.[2]

In chapter 7, on estimating the international transmission of shocks using GDP forecasts, Kajal Lahiri and Gultekin Isiklar measure, by using monthly data from the Consensus Economics Service Inc. over the period 1995 to 2002, the 'stickiness in the information usage' in real GDP growth forecasts using inter-temporal variance decompositions and generalised impulse responses. They find that while forecasters utilise domestic information immediately, they are slow in incorporating foreign information into their forecasts. They then propose a method to estimate the structure of the international transmission of shocks across countries using the forecast data. Using a factor structural VAR model with two common factors, they find that the Indian economy is mainly influenced by domestic shocks and Asian common shocks and it is not very sensitive to shocks from Western countries. But when they exclude the Asian crisis period from the sample, they find that the Western and Asian factors contribute by the same amount to Indian real GDP variations.

In Chapter 8, Anita Ghatak and Qing Zhang use annual and quarterly data to investigate the money demand function in China over the period from 1952 to 2000. They estimate various money demand functions using both the conventional and time series techniques. The authors also test the stability of the demand for money in the long run in two ways: first, through a comparison of estimates of three definitions of money – currency in circulation M_0, narrow money M_1 and broad money M_2 – and second, by using dummy variables to check the stability of demand for money before and after economic reform. Their estimates show that the real demand for money has a long-run equilibrium relation with real income, the real interest rate and inflation for three definitions of money. Comparing demand for three definitions of money M_0, M_1 and M_2, it is found that M_1 has a better explanation than the other two. Thus stabilisation policy should primarily aim at the narrow money, M_1.

Chapter 9, by Subrata Ghatak and Willy Spanjers, discusses the potential benefits of monetary policy rules for transition economies (TEs). It is argued that the nominal interest rate may fail to be the appropriate instrument in such rules. One reason is the amount of non-calculable political and economic risk inherent in TEs. These risks lead to a significant and volatile ambiguity premium in the interest rate over and above the normal risk premium, which makes the real equilibrium interest rate difficult to measure. Furthermore, ambiguity of the public regarding the effects of monetary policy leads to an ambiguity premium on inflation. A simple monetary policy rule based on a monetary aggregate, like the money base, is proposed, which minimises the impact of ambiguity and may therefore be the appropriate monetary policy in TEs.

In Chapter 10, Peter Jackson develops a theme by building on an important contribution by Anita with her husband, Subrata.[3] He argues that a central feature of debt management is the management of many financial risks, especially interest rate and exchange rate risks. One of the major problems facing most developing economies has been the mismatch of public sector debt structures, both in terms of the maturity of the debt and the currency in which it is denominated. If debt is short-term then it is likely that it will be rolled over frequently, feeding into the budget deficit through debt servicing costs. The public debt to GDP ratios in 2002 averaged about 70 per cent for developing countries, but there is a wide variation around this mean. Jackson then asks: what then is the impact of public sector debt upon economic behaviour and who bears the burden of the debt? How have debts been managed? What has caused them to change and what impact do they have on economic growth?

In Chapter 11, Stephen Drinkwater, Paul Levine and Emanuela Lotti examine the relationship between remittances from international migration and imperfections in labour and capital markets. They show that remittances can have two opposing effects on the labour market of the source country. First, they raise the utility of the unemployed members back home and, if a worker's bargaining power is low, this causes the unemployment rate to rise. Second, remittances available for investment will relax credit constraints. If the 'investment' effect outweighs the 'search income' effect, then remittances will reduce the unemployment rate. Their empirical analysis suggests that remittances have a small negative effect on unemployment, but a positive and significant effect on investment.

As evidenced in her PhD thesis submitted to Leicester University, Anita was always interested in the investigation of consumer behaviour.[4] In the final chapter of this volume, James Seale and Anita Regmi address a number of key problems commonly confronted in the literature on international cross-country-demand analyses. The authors fit the Florida Preference Independence (PI) model to a 114-country subset of the 1996 International Comparison Programme (ICP) data for nine broad categories of consumer goods. They estimate the system's parameters with a heteroscedasticity-correcting-maximum-likelihood procedure, and calculate and report 114 country-specific income and three types of own-price elasticities of demand for the nine categories of goods. Results suggest that low-, middle-, and high-income countries have distinct income and price responses and low-income countries are the most responsive to income and price changes.

Notes

1 Articles by Anita in this area included: 'Vector Autoregression Modelling and Forecasting Growth of South Korea', *Journal of Applied Statistics*, 10/1998, Vol. 25; 'Financial Dynamics and Economic Growth: Lessons for India', in P. Banerjee and F.-J. Richter. (Eds) *Economic Institutions in India*, Basingstoke: Palgrave Macmillan, 2003; 'Financial Innovation and Economic Growth: Some Further Evidence from the UK: 1900–2003', in Y. Kurihara, S. Takaya and N. Yamori (eds) *Global Information Technology and Competitive Financial Alliances*, Hershey Pa.; London: Idea Group, 2006; 'Foreign Direct Investment and Economic Growth: Some Evidence from across the World', (with Ferda Halicioglu), *Global Business and Economics Review*, Vol. 9, 2007.

2 Articles by Anita addressing these and related issues in econometrics include: 'An Econometric Model of Consumer Behaviour in India', *Indian Journal of Economics*, 1984; 'Output Response in Indian Agriculture' (with Ghatak Subrata), *Indian Journal of Economics*, 1985; 'Budgetary Deficits and Ricardian Equivalence: The

Case of India, 1950–1986' (with Subrata Ghatak), *Journal of Public Economics*, 1996; 'Breaking Trend Functions in Macro Variables: The Case of India: 1900–1988: Sankhya', *The Indian Journal of Statistics*, 1996; 'Unit Roots and Structural Breaks', *Journal of Applied Statistics*, 1997.

3 See Ghatak and Ghatak (1996) cited in the previous footnote.

4 See Gathak, Anita (1985), *Consumer behavior in India*, d.k. Agencies, Delhi, India.

Part I

Growth, economic development and poverty

2 On the convergence and divergence of economies

Philip Arestis and Malcolm Sawyer

1 Introduction

The central question that this chapter seeks to address is whether the economic growth process, within and between countries, has tended to produce convergence or divergence (or no general pattern). These questions were at the heart of Anita's interests and research. The chapter begins in section 2 by considering the different perceptions (and predictions) relating to convergence or divergence between nations (in terms of economic development as expressed in measures such as GDP per capita). The discussion in this section includes consideration of the measurement of convergence and divergence. Section 3 seeks to survey the empirical work on convergence and divergence. Finally, section 4 summarises and concludes.

2 Theories of convergence and divergence

The purpose of this section is to provide a brief overview of approaches to economic growth and their implications for issues of convergence and divergence between national economies.

2.1 Neoclassical growth model

The neoclassical growth model, originating with Solow (1956) and Swann (1956), had many notable features including the dominance of savings over investment and full employment assured by wage and price flexibility. It has two particularly important features. First, the equilibrium rate of growth is pre-determined (i.e. not path dependent) and equal to the 'natural rate of growth', from which it was derived that the growth of the capital stock was equal to the growth of the labour force, hence $s/v = n$ where s is the savings propensity, v the capital–output ratio and n the 'natural rate of growth' with the adjustment of capital–output ratio v bringing about this equality (in the long run). Second, there is a steady state per capita income which can be derived from $s\mathrm{f}(k^*) = nk^*$ where k^* is the equilibrium value of the capital–labour ratio $k = K/L$, and $\mathrm{f}(k^*)$ is then the steady state per capita level of income. It can be readily seen that the steady state per capita income would be $f(k^*) = nk^*/s$. A stable adjustment process is assumed such that the per capita capital stock adjusts to the equilibrium level k^*. These conclusions can be readily modified to allow for labour-augmenting technical progress of a 'manna from heaven' variety, and to express the results in terms of income per efficiency unit of labour.

The neoclassical model involved the idea of a common technology (production function) across countries (or at least access to the same technology), and the growth of income could differ in terms of population growth and technology growth, but common technology would imply the latter as equal across countries. The level of per capita income in equilibrium does depend on s and n and differs across countries for that reason. Hence in the neoclassical approach there is convergence within a country on the growth rate of n and per capita income of $f(k^*)$, which is dependent on the parameters n and s.

2.2 Endogenous growth theory

The endogenous growth theory (EGT) in its boldest form is the so-called AK model. Output Y is produced with constant returns to capital K, hence $Y = AK$ (with no mention of labour input). Investment equals savings, i.e. $dK/dt = sY$, where s is the propensity to save. Hence $(1/K)(dK/dt) = sA$ and also $(1/Y)(dY/dt) = sA$ – which is comparable to the warranted growth rate (in the sense of Harrod) since $A = 1/v$. The growth of labour force is taken as n (whereas often the growth of the labour force is taken equal to the rate of population growth). By deduction the growth of labour productivity $g_p = sA - n$, which means that provided $sA > n$ the growth of productivity can continue in perpetuity.

An elaboration to include labour does not change this basic picture. For example, take the case where the typical firm can be assumed to operate according to a production function of the form $Y_i = F(K_i, A_i L_i)$ with constant returns to scale at the firm level (cf. Barro and Sala-i-Martin 1995: 146–7). In the case where there are spillover effects from one firm to another, then A_i is proxied by K and hence: $Y_i = F(K_i, KL_i)$. The growth of consumption can be derived as :

$$\frac{\dot{c}}{c} = \frac{1}{\theta}[f^*(L) - Lf^{*\prime}(L) - \delta - \rho]$$

and the proportionate rate of change of $k = K/L$ is given by:

$$\frac{\dot{k}}{k} = f^*(L).k - c - \delta k$$

which in effect indicates that the growth rate of k is equal to the output per person minus consumption and depreciation per person.

Leaving aside the issue of the role of the size of the economy (reflected in the presence of L)[1], for a given labour force the growth rate of the economy is predicted to be independent of the level of income (per capita), and hence there is no indication of convergence in this model (or any slowdown in growth as a country becomes richer).

2.3 Technological gap and catch-up

Differences in the current use of technology and the associated technological gaps between countries creates the potential for catch-up involving the transfer of technology. 'The combination of technological gap and social capability defines a country's *potentiality* for productivity advance by way of catch-up. This, however, should be regarded as a potentiality in the long run. The pace at which the potentiality is realized depends on still another set of causes that are largely independent of those governing the potentiality itself' (Abramovitz 1986: 389–90). Depending on the translation of potential into actual, the empirical proposition would be that growth rates of productivity across countries over a relatively long period of time would tend to be inversely related to the initial levels of productivity. There are many factors controlling the rate of realization of potential. These include:

1 The facilities for the diffusion of knowledge – for example, channels of international technical communication, multinational corporations, the state of international trade and of direct capital investment.
2 Conditions facilitating or hindering structural change in the composition of output, in the occupational and industrial distribution of the workforce, and in the geographical location of industry and population. Among other factors, this is where conditions of labor supply, the existence of labor reserves in agriculture, and the factors controlling internal and international migration come in.
3 Macroeconomic and monetary conditions encouraging and sustaining capital investment and the level and growth of effective demand. (Abramovitz 1986: 389–90)

In this approach, with the emphasis on the role of the technology gap, there is the clear suggestion of convergence as growth depends on size of gap. But the convergence is clearly conditional on a range of other factors being in operation (see also, Pugno 1995 and Targetti and Foti 1997).

2.4 Cumulative causation

The broad ideas on cumulative causation are associated with Myrdal (e.g. Myrdal 1957) and Kaldor (e.g. Kaldor 1966). The general operation of market forces is viewed as tending to increase, rather than decrease, inequalities between economic areas, regions, etc. Internal and external economies, both static and dynamic and widely interpreted, boost the growth of successful regions, lowering their costs and enhancing incomes. The less successful tend to stagnate, at least in relative terms. The movement of labour and capital tends to exacerbate these tendencies. Migration of labour generally (but clearly not universally, and subject to constraints on migration) involves the movement of more skilled and more enterprising workers from poorer regions to richer regions. Myrdal (1957) suggests that 'The main idea I want to convey is that the play of the forces in the market normally tends to increase, rather than to decrease, the inequalities between regions' (p. 26). However, 'within broad limits the power of attraction today of a centre has its origin mainly in the historical accident that something once started there, and not in a number of places where it could equally well or better have been started, and that the start met with success. Thereafter the ever-increasing internal and external economies – interpreted in the widest sense of the word to include, for instance, a working population trained in various crafts, easy communications, the feeling of growth and elbow room and the spirit of new enterprise – fortified and sustained their continuous growth at the expense of other localities and regions where instead relative stagnation or regression became the pattern' (pp. 26–7).

Myrdal (1957) also spoke of 'backwash' effects which would include capital movements which 'have a similar effect of increasing inequality' (p. 28) with the investment requirements of richer areas drawing on savings of poorer areas. 'Trade operates with the same fundamental bias in favour of the richer and progressive regions against the other regions' (p. 28). But there are also 'spread effects' and Myrdal specifically mentioned that neighbouring regions 'should gain from the increasing outlets of agricultural products and be stimulated to technical advance all along the line' (p. 31). These 'spread effects' could modify the 'backwash' effects.

Kaldor (1978) argued that 'the forces making for economic change are *endogenous* . . . and the actual state of the economy during any one "period" cannot be predicted except as a result of the sequence of events in previous periods which led up to it' (p. 186). Thirlwall (2002) argues, based on what is generally termed Verdoorn's Law, that 'there exists a strong positive causal relation between the growth of manufacturing output and the growth of productivity in manufacturing as a result of static and dynamic returns to scale' (p. 41);[2] also that 'dynamic economies refer to increasing returns brought about by "induced" technical progress, learning by doing, external economies in production and so on' (p. 45).

The model of Dixon and Thirlwall (1975), which incorporates some of these ideas, leads to an outcome in which the growth rates of countries may converge but the differences in level of income are maintained over time.

3 Has there been convergence between countries?

There are a range of meanings, which can be given to the notion of convergence with respect to growth and economic development. One notion refers to the convergence of a country to some equilibrium rate of growth. This notion of convergence tends to view the equilibrium growth path as predetermined (for example, the neoclassical growth model above), and does not immediately concern us here. The form of convergence which particularly attracts attention here is whether there is a tendency for the level of per capita income (or other measures of economic development) to achieve convergence.

An initial approach to this question of convergence is to regress growth rate on initial level (usually in log form) of per capita income (or equivalently regressing log of final output per capita on initial output per capita). An initial attempt was made in the study by Baumol (1986), where an estimated relationship of the form: growth rate (1870–1979) = 5.25 – 0.75 (ln GDP per work hour 1870), with an $R^2 = 0.88$. In reporting this result, Baumol recognised a range of drawbacks with the data used. However, the main drawback is the manner in which the sample of countries was constructed, which was effectively by reference to high levels of income towards the end of the period. This was heavily criticised by De Long (1988) on the ground that Baumol's regression uses an *ex post* sample of rich and successfully developed countries, while those nations that have not converged are excluded from the sample. The reason for this exclusion is simply on the ground of their resulting present relative poverty. Finding evidence of convergence is thereby virtually guaranteed in Baumol's regression. De Long (1988) goes on to suggest that 'The forces making for "convergence" even among industrial nations appear little stronger than the forces making for "divergence". The absence of convergence pushes us away from a belief that in the long-run technology transfer both is inevitable and is the key factor in economic growth. . . . And the absence of convergence even among nations relatively rich in 1870 forces us to take seriously arguments like Romer's (1986) that the relative income gap between rich and poor may tend to widen' (p. 1148). Romer (1986) observes that, to the extent that there is no negative correlation between growth rates and the level of per capita output, then there should be no reason for the dispersion in the level of per capita income to decrease over time, and therefore, no tendency toward convergence. This contradicts a widespread impression that convergence in this sense has been evident, especially since the Second World War. Romer (1986) goes on to suggest that 'Streissler (1979) offers evidence about the source of this impression and its robustness. For each year from 1950 to 1974, he measured the variance across countries of the logarithm of the level of per capita income. In a sample of ex post industrialized countries, those countries with a level of per capita income of at least $2,700 in 1974, clear evidence of a decrease in the dispersion over time is apparent. In a sample of ex ante industrialized countries, countries with a per capita income of at least $350 in 1950, no evidence of a decrease in the variance is apparent. The first sample differs from the second because it includes Japan and excludes Argentina, Chile, Ireland, Puerto Rico, and Venezuela. As one would expect, truncating the sample at the end biases the trend toward decreasing dispersion (and at the beginning toward increasing dispersion). When a sample of all possible countries is used, there is no evidence of a decrease in variance, but the interpretation of this result is complicated by the changing number of countries in the sample in each year due to data limitations' (pp. 1012–13).

Abramovitz (1986: 391) treats the USA as the technological leader, and with GDP per person hour in the USA taken as 100, the corresponding mean for 15 other industrialised countries is calculated as :

Year	*1870*	*1890*	*1913*	*1929*	*1938*	*1950*	*1960*	*1973*	*1979*
mean	77	68	61	57	61	46	52	69	75
coefficient of variation	.51	.48	.33	.29	.36	.29	.14	.14	.15

Abramovitz (1986) recognised that his was a biased sample. This was so since the sample was comprised of countries all of whom successfully entered into the process of modern economic growth. The clear implication is that these countries have managed to acquire the educational and institutional characteristics needed to make use of modern technologies to some advanced degree. It is rather unlikely that a more comprehensive sample of countries would show the same tendency for levels of productivity to even out over the same period of time.

Baumol *et al.* (1989) use the Summers-Heston data and regress growth 1950 to 1980 on real GDP 1950 in per capita terms. They divide countries 'into 18 industrialized countries, 21 "intermediate countries," 9 centrally planned economies, and 23 less developed countries. Examination of the data points indicates that, with the noteworthy exception of the LDCs, each of the country groups exhibits the characteristic negative slope . . . the pattern in which the initially poorest countries are those that subsequently grow fastest, as is required if they are to begin to catch up with the initially wealthier countries. This statistical evidence suggests that the LDCs alone have failed to meet this necessary condition for intragroup convergence – the poorest country in the group approaching closer to the wealthiest' (pp. 97–8). More importantly, though, they argue that 'with the exception of the LDCs, real GDP per capita (RGDP) in each of the other country groups approached closer to that of the industrialized economies. For the set of all other countries the ratio of RGDP of the richest to the poorest country fell over 50%, from 15.2 in 1950 to 7.4 in 1980. For the planned economies the coefficient of variation fell from 0.44 to 0.33 between 1950 and 1980. Even more to the point, average RGDP among the intermediate countries rose 24% closer to that of the industrial nations, and in the centrally planned economies it moved 32% closer to that of the industrialized economies. The coefficient of variation for RGDP for all three groups together fell from 0.55 in 1950 to 0.42 in 1980. These country groups, then, seem to be made up of members of the convergence club (even if some of them are only second- or third-class members).' However, 'average RGDP in the LDCs relative to that of the industrial countries was actually 17% lower in 1980 than in 1950' (Baumol *et al.* 1989: 98).

Mankiw *et al.* (1992) utilise a simple and then an extended Solow-type growth model. Based on a Cobb-Douglas production function they derive (and then estimate) the following equation:

$$\ln\left(\frac{Y}{L}\right) = a + \frac{a}{1-a}\ln(s) - \frac{a}{1-a}\ln(n + g + \delta) + \varepsilon$$

where a is the coefficient on labour in the Cobb-Douglas production function, n and g the growth of labour force and of labour augmenting technical progress respectively, δ the rate of depreciation. Note, however, that s is measured by investment ratio (I/Y). Two points can be made here: savings and investment are not identical and the assumption cannot be made that all savings flows into investment (investment here includes government investment); and even if savings and investment are equal there is still the question of which is the causal factor. The addition of human capital to the production function (still in Cobb-Douglas form with constant returns to scale and exogenous technological change) leads to:

$$\ln\left(\frac{Y}{L}\right) = \ln A(0) + gt + \frac{a}{1-a}\ln(s_k) - \frac{a}{1-a}\ln(n + g + \delta) + \frac{\beta}{1-a}\ln(h^*)$$

where s_k is the proportion of income invested in physical capital formation and h^* the equilibrium ratio of stock of human capital to augmented labour. Mankiw *et al.* (1992) summarise the results obtained as follows: 'The coefficient on the initial level of income per capita is slightly positive for the non-oil sample and zero for the intermediate sample, and for both regression the adjusted R^2 is essentially zero. There is no tendency for poor countries to grow faster on average than rich countries.' However, there is 'a significant tendency toward convergence in the OECD sample. The coefficient on the initial level of income per capita is significantly negative, and the adjusted R^2 of the regression is 0.46. This result confirms the findings of Dowrick and Nguyen [1989], among others' (pp. 424–5). When measures of the rates of investment and population growth are added to the right-hand side of the regression, 'the coefficient on the initial level of income is now significantly negative; that is, there is strong evidence of convergence. Moreover, the inclusion of investment and population growth rates improves substantially the fit of the regression' (pp. 425). Furthermore, when measures of human capital are added to the right-hand side of the regression, the new variable further lowers the coefficient on the initial level of income, and it again improves the fit of the regression. Overall, these results suggest that many of the most important poor countries do not seem to be catching up to the level of income of the USA. Instead, countries have roughly maintained their place within the world income distribution over the last thirty years or so, with little tendency for reduced income dispersion, and perhaps even some divergence. The exception to this stability is some of the African countries, which have done very badly.

Bernard and Durlauf (1995) define convergence for a group of countries in terms of each country having identical long-run trends. This leads them to use cointegration techniques and apply them to a time series extending over a century for 15 OECD countries. Convergence is then rejected but there is substantial evidence for common trends. Their analysis, which examines annual log real output per capita for 15 OECD economies from 1900 to 1987, leads to two basic conclusions about international output fluctuations. First, they find very little evidence of convergence across the economies. Per capita output deviations do not appear to disappear systematically over time. Second, they find that there is strong evidence of common stochastic elements in long-run economic fluctuations across countries. As a result, economic growth cannot be explained exclusively by idiosyncratic, country-specific factors. A relatively small set of common long-run factors interacts with individual country characteristics to determine growth rates (98). As the authors note in a footnote, this is a group of *ex post* winners, which will tend to bias the results towards finding convergence.

Linden (2000) suggests utilising non-parametric time series analysis to investigate the convergence of international output per-capita gaps. Non-parametric tests are based on signs and ranks of time series properties of output differences. The methods are applied to logs of USA per capita income differences for 16 OECD countries from 1900 to 1997, to conclude that convergence of output was evident for the majority of countries. However, the trends in 1970–97 and 1987–97 are noticeably more complicated than the homogenous convergence found in the pre-1970 period. The results indicate that widening USA gaps are now more likely to emerge than steady-state or narrowing gaps.

In the estimates of Bleaney and Nishiyama (2002) of an encompassing model and when testing for regional effects, they include log of per capita income and its square. The coefficient on log per capita income is positive throughout and on the square negative. A typical result for growth (of purchasing power adjusted per capita GDP on an annual basis) is:

$$g = -32.9 + 7.36 \ln (Y) - 0.594 [\ln(Y)]^2 + \text{other variables.}$$

Hence the result is an inverted-U shape, which in this equation would indicate maximum growth achieved at ln Y = 6.2, which is Y = 490 in 1965 dollars.

Our calculations indicate that the difference between \$100 and \$500 is an additional rate of growth of 1.5 per cent (at the higher income) and between \$500 and \$1000 a reduction of 1.2 per cent (with growth higher at \$1000 than at \$100) – hence some divergence and some convergence!

Dowrick and Gemmell (1991) utilise a two-sector model ('agriculture' and 'industry') with different production functions and technological change, and provide estimation over two periods (1960–73 and 1973–85, with 43 countries and 52 countries respectively and spread over OECD, Africa, Asia and Central and South America). 'Estimation of our model of disequilibrium growth and technological spillover confirms the existence of three "growth clubs" which are distinguished by significant parameter differences. Testing the model on a sample of "rich" and "middle-income" countries over the two periods 1960–73 and 1973–85, our results suggest that intersectoral labour reallocation does make a significant contribution to GDP growth. . . . We find that rates of technical progress do differ substantially between sectors. . . . We find *industrial* sector catch-up to be strong, implying convergence of productivity levels both within and between the two groups of countries. *Agricultural* productivity levels on the other hand appear to have been diverging before 1973, but catching-up has occurred for the middle-income group relative to the rich group since 1973. . . . These results for the rich and middle-income countries are broadly confirmed when we estimate our preferred model on a larger sample for the period 1973–85. This enlarged sample contains an additional 27 of the poorest countries, mostly African. We find that their growth performance is substantially different. The estimated marginal product of capital is much lower in the poor countries and while their rate of productivity catch-up in agriculture is similar to that of the middle-income countries we find strong statistical evidence that productivity in industry is diverging within the group of poor countries and also falling behind in relation to the world leaders.' (Dowrick and Gemmell 1991: 273–4).

> These observations are indicative of a structural poverty threshold in world development. Once over this threshold countries are able to follow the route of modernisation and catch-up through industrialisation. Below this threshold it is extremely difficult to sustain sufficient growth in per capita income to generate the savings and investment, and perhaps to moderate population growth, which might allow further economic development.
>
> (Dowrick and Gemmell 1991: 274)

Dowrick (1994) finds support for 'the Abramovitz hypothesis that there is a threshold level of development, related to both technological and social capability, which has to be reached before countries are able to benefit from the advances in technology of the most advanced economies' (Dowrick 1994: 116–17).

In Amable (1993), 'the rate of labour productivity is assumed to depend on the initial technology gap and the rate of equipment investment, as well as on the percentage of the concerned age group engaged in primary education and the ratio of real government expenditure (less defence and education) to real GDP. . . . The ratio of investment equipment to GNP is supposed to be influenced by the rate of growth addressed to the country, which in turn depends on the growth of productivity. In a reduced form, the equipment investment ratio depends on productivity growth. It is also a function of innovative activity and government expenditure as a percentage of GDP. . . . Innovative activity depends on the initial technology gap and the percentage of the concerned age group engaged in secondary education. Enrolment in secondary education is a function of the technology gap . . . and primary education' (13–14). The model is estimated for a sample of 59 countries over the period 1960 to 1985 to conclude that, 'Contrary to most recent studies on the subject, a general pattern of divergence rather than convergence in productivity levels is found' (p. 1).

Pugno (1995) argues that 'the fact that the different market economies in the world do not seem to converge towards the same trend of growth and to the same level of *per capita* GDP has challenged old and new theories of economic growth' (p. 249). He re-estimates the Mankiw, Romer and Weil (1992) equations for a somewhat different data set and his results 'confirm the convergence trend on the basis of the negative coefficient of $\ln(P)_0$ [initial level of per worker GDP] although it is very small and it is not significant in the largest sample. But the re-estimations also confirm that in the non-OECD samples the labour coefficient is not significantly different from zero at the level of 5%. . . . Moreover, if the period is split into two subperiods, before and after 1973, the estimates worsen and, in particular, the labour coefficient is not significant for the OECD sample' (p. 249).

In Pugno (1995) a complete model is put forward, in which productivity growth is a function of technological gap, initial education level, GDP growth, initial manufacturing share, investment share and 'domestic innovative effort', while output growth depends on export growth, and export growth on productivity growth relative to average. It appears that the Abramovitz-Baumol approach to the 'Kaldor-Verdoorn law' seems successful. Investment and R&D expenditure seem to play a significant role, albeit in different subperiods. More precisely, the reported results confirm catching up or falling behind with respect to the US productivity level, although performing a less important role than in the simpler original model. The Kaldor-Verdoorn coefficient is highly significant and stable; indeed it is of the expected sign and lower than one, and of a size similar to that of the simpler original model.

Targetti and Foti (1997) argue that they are able to confirm the hypothesis that two factors influence the exploitation of the gap's potentiality. They suggest that 'the strength of the cumulative growth process – which in turn depends upon the degree of increasing returns, i.e. the Kaldor-Verdoorn coefficient, upon the dynamic foreign trade multiplier and upon the elasticity of exports with respect to the productivity growth differential – and the capacity of investment to introduce technical progress. Productivity in the OECD countries shows a clear tendency to converge toward the level of the leader country, the US. The stronger the cumulative growth process and the higher the share of investment, the faster the catching-up process has been. . . . As far as LDC countries are concerned, convergence may or may not take place. . . . The latter [group of fastest growing East Asian countries] has shown clear signs of convergence, while the former [group of main Latin American countries] has not. This outcome is shown by the nature of the catching-up variable in the productivity growth equation, which is significant in one case and not in the other. . . . Our interpretation is that an economic area which is growing rapidly because of dynamic economies to scale is more apt to introduce frontier technologies, while it seems dependent on the Kaldor-Verdoorn coefficient, seems not to be affected by the investment share, either gross or in equipment. . . . Both these results lead to a Kaldorian conclusion, that despite a middle-sized gap with the technological leader country and despite a high investment share, if an economic system is constrained on output growth and/or has low dynamic economies to scale, it will not be able to enjoy a high rate of productivity growth' (p. 41).

Fingleton and McCombie (1998) conclude that the question as to 'why growth rates differ' is still to a large extent unresolved. They argue that 'the preferred specification of the Verdoorn law exhibits strong increasing returns to scale and that there is a significant, but weak, diffusion of innovation effect. On the other hand, the results of the convergence analysis suggest a very rapid convergence and the question arises as to how this is to be reconciled with the findings above of substantial increasing returns and a weak effect of the diffusion of technology' (p. 102). They recognise that the difficulty is that the hypothesis to be tested is not nested and is derived from different underlying assumptions.

León-Ledesma (2002: see especially 210–11) utilises a five-equation model for 17 of the OECD countries over the period 1965 to 1994 with observations referring to business cycles and concludes that cumulative growth arises from the effect of the Verdoorn-Kaldor relationship and also from the induced effect that growth itself has on learning and non-price competitiveness. However, the diffusion of technologies arising from the productivity gap is a significant factor that counteracts these forces favouring a catch-up process.

The study of Fingleton (2000) utilises a structural model that incorporates regional effects and is fitted to cross-sectional data for 60 countries. The model integrates various strands in the literature, including the dynamic Verdoorn Law that links productivity growth to output growth. The study also includes relationships that include variables such as educational attainment, trade and innovativeness. The structural model supports the thesis that a country's innovativeness and, consequently, capital stock growth, depend on the level of technology in the 'surrounding' region. Increasing returns and cumulative causation are assumed, with the resulting parameter estimates leading to a reduced form that implies convergent rather than divergent productivity levels. The results obtained indicate that countries are converging on different levels, although a group does attain the USA productivity level.

Castellacci (2002) utilises cluster analysis applied in the case of 26 OECD countries in the 1990s. A theoretical model that combines the technology-gap approach with the Kaldorian idea of cumulative growth is utilised. This allows for a large set of possible outcomes. Convergence in productivity is only one of the possible outcomes of the model. Most importantly, the experience of the 26 OECD countries in the 1990s in terms of technological and productivity performance is rather heterogeneous. The model presented explains the diverging paths in terms of the difficulty of sustaining a process of cumulative growth based on the interactions between productivity and demand growth (see p. 345 in particular). Temple (1999) argues that it is rather difficult to arrive at definitive conclusions in this field. Returns to physical and human capital diminish, but only very slowly, but even so this is not reliable and the consensus that might be emerging is one of uncertainty.

Turning to panel-data methods, it might be noted that a wide range of empirical results has been produced (see Durlauf and Quah 1998: 284–5, where a helpful summary of the findings on this score can be found). At the same, however, the difficulties with this method should be acknowledged (especially dynamic heterogeneity: Pesaran and Smith 1995, and Pesaran *et al.* 2000; and consistency between panel estimates and country-specific parameters: Luintel and Khan 2004). 'While Barro and Sala-i-Martin (1991, 1992) defend a 2% annual rate of convergence from cross-section regressions, estimates from panel data analyses have been more varied. Lee, Pesaran and Smith (1997, 1998) conclude annual convergence rates are approximately 30% when one allows heterogeneity in all the parameters. Islam (1995) permits heterogeneity only in the intercept terms, and finds annual convergence rates between 3.8% and 9.1%, depending on the subsample under study. Caselli, Esquivel and Lefort (1996) suggest a convergence rate of 10%, after conditioning out individual heterogeneities and instrumenting for dynamic endogeneity. Nerlove (1996), by contrast, finds estimates of convergence rates that are even lower than those generated by cross-section regression. He explains this difference as being due to finite sample biases in the estimators employed in the other studies using the neoclassical growth model. The disparate results across panel-data studies can sometimes, but not always, be attributed to the different datasets that different researchers have employed' (Durlauf and Quah 1998: 284–5).

De la Fuente (2002) remarks that estimating the speed of convergence with any precision requires knowledge of the steady state, and omission of some of the determinants of the long-run position could bias the estimates of speed of convergence. He further argues, on the basis of a review of some previous empirical work, that in order to make sense of them a departure from the standard neoclassical framework is necessary with the use of a broader model that allows for convergence mechanisms other than diminishing returns. His own work is on 'the sources of convergence across the Spanish regions. We develop and estimate a descriptive growth model that allows for factor accumulation, technological diffusion, rate effects from human capital and unobserved regional factors. Our results indicate that technological catch-up, the equalization of educational levels and the redistribution of employment across regions account for most of the observed reduction of regional disparities. We also find that there remain very significant cross-regional differences in estimated TFP [total factor productivity] levels that point to the omission of important variables and to the need for a more disaggregated analysis' (de la Fuente 2002: 569).

Another recent study is by Wolff (1994). Growth of labour productivity is made a function of relative total factor productivity (relative to US), growth rate of capital–labour ratio and annual change in average age of capital stock for France, Germany, Japan, Netherlands, UK and USA using seven time periods (roughly decades plus). Interestingly enough, the coefficient value of the relative total factor productivity is now of the order of –0.04. Thus, a 50 per cent difference between a country's initial total factor productivity and that of the US is associated with about a 2 percentage point per year growth in labour productivity. A one-percentage point increase in capital–labour growth is associated with a 0.4 percentage point increase in labour productivity growth. The constant term is 0.005, suggesting an average growth of total factor productivity of about one-half of a percentage point per year. The change in the average age of the capital stock has the expected negative sign and the variable is significant at the five per cent level. The effect is surprisingly large: a one-year reduction in the average age of capital is associated with about a one percentage point increase in labour productivity growth. Wolff (1994) concludes that 'the exceptionally high labour productivity growth rates of the 1950s and 1960s among OECD countries was thus due to a concurrence of three very favourable factors. First, the extremely high technology gap caused very high rates of TFP growth in continental Europe and Japan during the 1950s and 1960s, from the catch-up effect. Second, investment was very strong. Third, the *acceleration* in the rate of capital growth caused the average age of capital to decline sharply, thus causing a very favourable vintage effect' (pp. 72–3).

Beelen and Verspagen (1994) use (1/n) sum absolute ln Y_i – ln Y^* where Y_i is per capita income in country i and Y^* weighted sample mean of some group of reference countries as measure of divergence. Over the period 1960 to 1985 and using OECD as the reference group, Africa is highest, starting at just over 2 and generally rising to just over 2.5 in 1985; Asia starts around 1.7, is roughly steady then declines from the mid 1970s to around 1.55 in 1985. Latin America shows a rising trend (around 1.2 up to 1.5) and oil exporters decline after 1973. Amongst OECD countries a tendency for slight decline is observed, where 'the convergence trend reverses to a weak divergence trend from 1975 onwards' (Beelen and Verspagen 1994: 76). Using group average as the reference income Y*, Beelen and Verspagen suggest that for Asia the differences with the previous figure are striking. Indeed, 'The local trend points to divergence rather than convergence. This is mainly due to the strong expansion of the Japanese economy over the 1960s and 1970s, which was too rapid for the other countries to catch up to, and the strong expansion of some of the NICs during the 1970s and 1980s. However, Asia as a whole was able to catch up to the global trend, which was somewhat slower. In the case of Latin-America, the OECD, the oil exporters and Africa, the trend does not change much . . . The conclusion from Figures 4.1 and 4.2 is therefore that convergence has a strong geographical dimension. In other words, whether or not one finds convergence between countries depends both on the group of countries under consideration, and to which frontier convergence is assumed to take place. In any case, convergence seems strong among developed market economies, and less strong among less developed countries' (p. 78). The same study concludes that 'on the one hand, the summary of convergence trends at the aggregate level has shown that convergence is a highly specific phenomenon, both in time and geography. Additionally, the sectoral breakdown of convergence trends has shown that there is also a sector-specific convergence element. On the other hand, the analysis with regard to other variables than just per capita income has shown that convergence is a process that affects other parts of the economic system than just growth performance' (p. 94).

4 Summary and conclusions

In this contribution we have attempted to examine whether recent performance on economic growth suggests convergence or divergence. We began by looking at the different perceptions and predictions that relate to the problem in hand for a number of countries worldwide, including the measurement of convergence and divergence. The existing empirical work on the issue is visited at some length. Two clear-cut conclusions emerge from this discussion: there is no evidence that poor countries are catching up with rich countries, and the world distribution of income is narrowing.

Two comprehensive studies reinforce these conclusions. Milanovic (2002) is one of them. It is suggested that 'Differences between countries' mean income is the most important factor behind world inequality. It explains between 75 and 88% of overall inequality (depending on whether we use Gini or Theil coefficient to measure inequality)' (88), by which it is meant Gini coefficients for inter-national inequality were 55.1 (1988) and 57.8 (1993) as compared with world inequality Gini coefficients of 62.8 and 66.0 respectively. Thirlwall (2003) reinforces these conclusions when he suggests that 'The most comprehensive study to date comes from the Norwegian Institute of International Affairs (2000) which takes 115 countries over the period 1965 to 1997, measuring living standards using purchasing power parity. . . . The study finds that the gap between the richest and poorest countries has increased and that if China is removed from the sample the Gini ratio as a measure of inequality has stayed the same at 0.59' (p. 44).

Our overall response, therefore, to the question implied by this contribution is, of course, that it is divergence rather than convergence.

Notes

1 Barro and Sala-i-Martin (2004: 224) talk of 'the puzzling scale effects'.
2 The term follows Verdoorn (1949) and was revived by Kaldor (1966), and is often referred to as 'Kaldor's second law' (see, for example, Thirlwall 2002: 202).

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3 Anatomy of the growth and transformation of the economies of China and India [1]

Srikanta Chatterjee

1 Introduction and objectives

The untimely demise of Anita Ghatak in October 2005 came as a great shock to all of us who knew her closely. When the request came to write something for a commemorative volume on Anita, I felt rather uncertain as to what would do justice to Anita's memory. She was essentially a theoretically minded economist who enjoyed using econometrics to test economic theories. In the last few years of her life, my wife and I had the opportunity to meet with Anita and her husband Subrata a few times and enjoy their warm friendship and hospitality at their home in Leicester. On each occasion we would typically discuss many subjects, but our respective teaching and research interests would always feature in the conversations prominently. I noticed Anita's enhanced interest in development issues and the case of India in particular. Her interest, I felt, was not just that of a professional economist but also of one who had an emotional connection with India. Of course, I shared with her both these characteristics! She would express doubts about India maintaining her fast economic growth of recent years, and would bring in economic theory in support of her doubts. In this chapter, I address the issue of India's recent growth experience comparatively with China's, not so much in a theoretical manner, but with data and information to underpin the points I make. I feel sure that both the subject of this chapter and the methodology I employ would have had Anita's approval.

I have endeavoured to write the chapter in a style that, I hope, will make it accessible to non-specialists. I have done this for two main reasons: first, I suspected that many of Anita's friends and acquaintances who are not specialist economists would also take an interest in the volume commemorating her, and their efforts would be better rewarded by the non-technical style of the essay. Second, the topic is one that is likely also to attract many an unknown reader with an interest in international economic events and developments. They too, I believe, would be better served by the particular style of presentation.

The major motivation behind the study is to lay bare the factors and forces that have shaped the rapid economic transformation of the two large but poor economies, in a relatively short period of time. After a long period of slow growth and policy-induced relative isolation from the world economy, both China and India initiated market-oriented reform programmes in the late 1970s and early 1990s respectively. The changes that have come in their train have begun to change the face of not just the two giant economies, but of the world as a whole. Understanding the underlying forces that have contributed to this remarkable transformation is, therefore, a worthwhile exercise in itself; it may also have lessons that other developing economies could learn from or avoid in their quest for faster growth.

After a brief introduction to the subject with some relevant factual information, the chapter goes on to examine the nature and sources of the two economies' observed growth performance, and to identify the strengths and weaknesses implied in these findings. The question as to whether the two economies can continue along their recent fast growth paths is addressed next and, again, the influences, both domestic and external, that are likely to affect the growth outcomes are identified. How the countries are responding to the United Nations (UN) Millennium Development Goals (MDG) is examined briefly next. The article concludes with references to some wider issues of a global nature, both optimistic and otherwise, in a political-economic framework.

2 Aspects of the growth performance of China and India: a broad-brush view

2a Selected indicators of growth performance

In the financial year 2006, India achieved a GDP growth rate of 9.2 per cent, just short of China's 10.4 per cent. In 2007, India's growth rate fell slightly, to just under 9 per cent, while China's grew at just over 11 per cent. Between them, these two countries account for over a third of the world's population and, since the 1980s, they have both achieved high rates of economic growth. India's per capita real GDP has more than doubled, and China's has increased nearly sevenfold over the last two decades. These changes have enormous significance not just for the 2.4 billion people living in those two countries, but for the rest of the world as well. Table 3.1 presents information on some broad indicators of how the two economies have performed in recent years.

A few quick comments on the table are pertinent: China's per capita income is over twice that of India's in price-adjusted (PPP) terms; India's population growth rate is over twice that of China's – a reflection mainly of China's one-child policy. Industry is a significantly bigger contributor to China's GDP than India's, while the service sector contributes more to India's GDP. Income inequality in (socialist) China is a lot higher than in India, but poverty is a lot lower in China. The proportion of literate persons in the adult population is a lot higher in China. China's economy is lot more

Table 3.1 The two Asian giants: a broad profile

	China	*India*
Population (2006)	1.3 b.	1.1 b.
Population growth rate (2004–2006)	0.59	1.38
GDP PPP (2006)	US$10 trillion	$4.04 trillion
GDP per capita PPP	US$7593	$3,700
GDP share by sector (%)		
Agriculture	12	17
Industry	47	28
Service	41	55
Labour force size	798 m.	509 m.
Sector share of employment		
Agriculture	45%	60%
Industry	24%	12%
Service	31%	28%
Adult Literacy	91%	61%
Percent of population living on < US$1 a day	8 (2006)	31 (2003)
Income share of top decile to bottom	18.4	7.3

Sources: World Development Indicators 2007, World Bank.

open than India's, as measured by their trade, i.e. exports plus imports, as a proportion of GDP.

One feature of India's growth experience noted above is worth paying particular attention to: it is the predominance of the service sector ahead of the more usual industrial sector. A low-income developing country tends to be dominated by agriculture and primary activity; the development process helps to enlarge the industrial sector, which attracts both labour and other resources away from agriculture and primary activities. It is only at a much later stage of development that the tertiary sector typically becomes the leading one. This is what one observes in the evolution of the Chinese economy too. India, however, with a larger agricultural sector than China's, but lower per capita income and adult literacy rate, has a significantly larger service sector share of its GDP. Some possible reasons for this unusual aspect of the Indian economy are investigated later in the chapter.

2b The institutional structures for development: a brief note

It would also be useful to note briefly in passing the institutional structure under which the two economies have functioned since the start of their independent development process. From the early 1950s to the late 1970s, both China and India used central planning as their major development strategy, although India had a large and thriving private sector, and an established culture of private entrepreneurship. Both countries used inward-looking policies over this period in an effort to promote 'self-sufficiency' as a primary national economic goal, and both achieved only modest economic growth. Under Deng Xiaoping's leadership, China embarked on a largely market-oriented reform of its economy in 1978. While neither country has abandoned planning as an instrument of development – China is into its 11th Five Year Programme, and India its 11th Five Year Plan – both have systematically increased the role of the market. Indeed, China now calls itself a *socialist market economy*. Two major government departments – the State Planning Commission and the State Economic Commission – no longer exist in China; they have been reconstituted into organisations that would facilitate the process of market-oriented growth and integration into the global economy. India too has drastically removed much of the protective structure around its domestic economy and its international trading and investment links since the early 1990s. Thus, both economies have a mixed structure, with an enhanced emphasis on the private sector, especially in China, which is in transition from a socialist economic structure.

3 Factors influencing economic growth

3a Demand, supply and growth: the China–India contrasts

Both demand- and supply-side factors influence a country's growth performance, as do its political and societal institutions and practices. The demand factors are domestic consumption and investment spending by the private and the public sectors, while external demand is reflected in the size of the net export earnings, i.e. exports less imports. The supply-side influences are availability and the quality of factors such as labour and capital; capital formation, i.e. productive investment in physical and human capital, and what is known as total or multi-factor productivity, i.e. enhanced output per unit of a composite of inputs used in the production of goods and services.

China's growth has been driven more by investment and net exports than domestic consumption, particularly since the late 1990s, as detailed later in the chapter. China's savings rate has grown from around 35 per cent in the early 1980s to about a half of its GDP in recent years. This, together with large and steady overseas investment flows, has enabled China to raise investment also to over 40 per cent of its GDP. Much of China's domestic investment has been in infrastructure and industrial development which, while improving its industrial growth rate and export performance, has kept the consumption growth rate decidedly modest. It has also led to the phenomenal growth in the size of China's foreign exchange reserves which at the time of writing stands at US$1.33 trillion. This puts pressure on the yuan, and to avoid its appreciation, China has been lending much of its external surplus to deficit countries like the US by acquiring dollar-denominated assets. While this may have helped the process of China's export-led growth, it is potentially a highly risky strategy too. A decline in the value of a currency such as the US dollar could involve substantial capital loss for China. Likewise, the strategy of export-oriented industrial growth has made about 70 per cent of the Chinese economy dependent on the world economy.

China is currently facing a unique quandary. While its export-led growth strategy would benefit from a low exchange rate, its rapidly accelerating inflation rate, standing in mid 2008 at 8.7 per cent, up six percentage points from only a year before (*The Economist*, 29 March – 4 April 2008, p. 119), would benefit from an appreciating currency. Indeed, the yuan has appreciated by just over 7 per cent in the year to January 2008. It is worth recalling too that, over the initial period of China's economic transition, the US dollar/RMB exchange rate had steadily declined from 1:1.5 in 1980 to 1:8.62 in 1994. This, combined with China's large supply of cheap labour and high rate of capital formation, helped China increase its share of world export trade significantly which, in turn, helped it raise its economic growth rate. Any attempt to encourage domestic consumption in the current phase of Chinese economic growth could exacerbate the inflation problem.

India's GDP growth has been mainly driven by domestic (consumption) demand. India's savings and investment rates have been much lower than China's and its share of world exports in 2006, at around 1 per cent, contrasted sharply with China's 8 per cent. Strong and sustained growth in private consumption, and the public sector deficits, both at the central and state government levels, have been the features of India's economic transition over the decade since the mid 1990s. This has started to change in India in recent years, as we detail below.

3b A structural break in India's growth? Some recent changes in perspective

India's annual GDP growth figures, alluded to earlier, do not quite bring out a trend increase in India's growth performance since the middle of 2003.[2] If one breaks down the period 2000 to 2007 into two subperiods, and examines GDP growth figures in quarterly terms, it emerges that the quarter-on-quarter growth rate crossed the 9 per cent mark for the first time in quarter two of 2003/04, and has remained above that level in 10 out of the 16 subsequent quarters. In the 13 quarters, starting in quarter one of 2000/01, GDP growth rate was never above 6.7 per cent, and was below 5 per cent on five occasions. Using the current national income statistics with 1999/2000 as the base year, it would appear that the Indian GDP growth rate has achieved a trend increase from an average of around 4.8 per cent to around 8.8 per cent between the second quarter of 2003/04 and the second quarter of 2007/08, an increase of some 80 per cent on the quarter-on-quarter growth rate. This is in the 80 to 90 per cent range of China's growth rate.

While that may be reason for optimism among India's policymakers, the period may be too short for one to judge just yet whether this is a cyclical upturn or a genuine structural break which can sustain itself into the future. It is worth recalling that something similar in respect of the GDP growth rate was observed over the period 1994/95 to 1996/97, only to be followed by a prolonged downturn in the growth rate (Jha and Negre 2007, p. 7).

Turning now to the observed changes to the way income in India has come to be used up, we note that over the period 2001 to 2007, India's accelerating GDP growth rate has been accompanied by a significant increase in savings from around 23 per cent in 2000/01 to over 32 per cent in 2005/06 (Jha 2007: 8). A less well-known fact about India's generally poor savings performance is that the saving rate of India's household sector, at 30 per cent of GDP in 2005, is even higher than China's 25 per cent (Bottelier 2007, p. 124). India's much lower national savings rate has historically been due largely to the corporate and public sector's low savings culture. This has started to change lately, with the corporate sector doubling its savings rate from under 4 per cent of GDP in 2001 to over 8 per cent in 2005. More encouragingly perhaps, India's public sector, generally known for its profligacy, has now emerged as a small net saver of some 2 per cent of GDP. Several reform measures aimed at improving fiscal responsibility adopted by the federal government in 2004, plus the reform of indirect taxation, including the introduction of a value-added tax at the state level, have seemingly helped improve the public sector finances. The combined debt of the central and state governments, as a proportion of GDP, has also fallen by 4 percentage points over the period 2003 to 2007.

Investment too has risen from 24 per cent to 34 per cent of GDP over the same period, making the growth process more broad-based than in the previous years. One consequence of the increased investment and the continuing high consumption, however, has been increased trade and current account deficits. In 2005/06, despite strong export growth, increased imports helped widen the trade deficit to over 6 per cent of GDP; the deficit in the current account is smaller, at 1.5 per cent of GDP. The external imbalance is being met by (autonomous) capital inflows which have also been rising. Relative to China, foreign direct investment (FDI) flows to India have been meagre over the years. The inward FDI flows have started to rise in recent years, but increased outward investment by the Indian corporate sector has tended to offset the inflows to some extent. The observed increase in capital flows has been dominated by portfolio funds and external commercial borrowings. The total amount of private equity flows has increased over three times from US$2.2 billion in 2003/04 to around US$7 billion in 2006, and US$10 billion in 2007, making India the largest recipient of private equity investment among developing economies. With this surge in total investment funds, India has started making the much-needed investment in infrastructure such as airports, railways, ports and roads; but real estate and manufacturing sectors too have attracted increased investment in the last few years.

India's overall export performance in the years since 2000 has been on an upward trend. The average annual growth rate over the period 2004 to 2007 has been around 26 per cent. As a proportion of GDP too, exports accounted for over 23 per cent in 2007, which is over 50 per cent higher than the average for the preceding five years.

While India has been experiencing these changes, the Chinese GDP growth rate has remained above the 9 per cent mark, on average, over the period 2000 to 2005, declining somewhat between 2004 and 2005, but rising again in the first half of 2007 to 11.5 percent, a rate not seen since 1994. Taking a longer-term view, however, China's GDP growth has experienced quite sharp volatilities, despite the upward trend. The rapid growth of the mid-1990s ended in a recession in 1988/89, returning to around 15 per cent growth in the early 1990s, followed by another slowdown later in that decade. Part of the reason for such fluctuations may be China's heavy dependence on exports, which are more subject to shocks arising outside the Chinese economy, as observed earlier.

4 The demand-side influences: a closer look

4a The strategy of export-led growth

Let us now have a closer look at the demand-side influences on the observed GDP growth of the two countries. Conventional wisdom in the development economics literature has favoured the strategy of what has come to be termed 'export-led growth' (ELG) strategy. This is characterised by the achievement of a high rate of net export growth that accompanies a high GDP and income growth rate. With income growth will usually come, via the marginal propensity to import, import growth, which is a negative influence on income. The extent to which *net* export can still make a positive contribution to GDP growth will of course depend on the relative strength of export vis-à-vis import growth. The issue will be examined in detail below.

By contrast, growth will be termed domestic demand-led if the growth of domestic demand influences the growth of income the most, with net export playing a weaker, if any, role. The components of total demand as observed earlier are: private and public sector consumption and investment spending, which are of domestic origin, and net exports, which comes from the external sector.

The support for the strategy of export-led growth, as opposed to domestic demand-led growth which is a variant of the import-substitution strategy, has a long history. Insights from the early works of scholars such as Chenery and Strout (1966) and Balassa *et al.* (1971), to the more recent research, including research based on endogenous growth theory (for example Helpman 1989; Romer 1990; Lucas 1988; and Barro 1991), provide ample theoretical support for outward (export) orientation as a condition for rapid and sustained income growth. The development experience of a number of East Asian countries since the late 1960s is often cited in the literature as evidence of success of this development strategy (see for example Westphal 1990 and World Bank 1993).

The Asian Financial Crisis of the late 1990s, which saw a number of the so-called miracle economies of East Asia suffer sudden and dramatic economic downturn, made scholars and policymakers question many aspects of the growth strategy used by these economies, including the ELG. In particular, scholars now question whether the ELG strategy is equally well suited to all developing countries (see for example Blecker 2002; Palley 2002; Kaplinsky 2000; and Ertuk 2001). It is also of relevance that, at the current stage of development of the global economy, when competition for a share of the world market is much stronger than, say, in the 1960s and 1970s, a strategy of ELG for most developing economies is likely to be more difficult to pursue.

4b Decomposing the demand-side influences

The Asian Development Bank (*Asian Development Outlook 2005*) has analysed the demand-side influences on the income growth process of five developing Asian economies, including the People's Republic of China (PRC) and India, over three decades starting in 1973. Their conclusions, based on their numerical computations of the relative contributions of domestic demand (DD) and net export (NE) to the income growth of China and India, are summarised in Table 3.2.

Only the last few years of the decade of 1973 to 1983 experienced the new phase that led to China's transition to market economy under Deng Xiaoping's leadership. Changes to India's established economic thinking and policies too did not really begin until the latter half of the 1980s under Prime Minister Rajiv Gandhi's leadership. It is not surprising, therefore, that in both countries domestic demand was the prime mover of growth over this period, and the contribution of net exports was negative and deteriorating. This latter result reflected the economic self-sufficiency objective pursued by both countries over the first several decades of their planned economic development referred to earlier.

Over the next decade, China had advanced significantly in the direction of

Table 3.2 The relative contributions of domestic demand and net export growth to income growth in India and China

Period	*PRC*	*India*
1973–83	DD increasing, NE negative and deteriorating	DD increasing, NE negative and deteriorating
1983–93	DD increasing, NE negative and deteriorating	DD increasing, NE negative and deteriorating
1993–2003	DD increasing, NE positive and increasing	DD increasing, NE negative and improving

Source: Asian Development Bank, *Asian Development Outlook 2005*.

a market-oriented economy, with emphasis on the external sector. This resulted in exports and imports growing at high rates; but even so, domestic demand was still the only positive contributor to income growth, and net exports were negative, and getting worse.

India's transition in this decade was still somewhat tentative and sporadic, and the economy was yet to open up. The observed dominance of domestic demand in the growth process, therefore, was not unexpected.

In the most recent decade analysed by the ADB, the decade of 1993 to 2003, China had emerged as an economy that had established strong links with the rest of the world, both in its trade and investment. Its net export had become not only positive, but an increasing contributor to its income growth.

India took major policy reform initiatives in 1991, including opening up its economy, following a short-lived economic crisis, and the improving – although still negative – net-export situation noted in Table 3.2 is a reflection of these policies. The period since 2003 has seen India's savings, investment and exports rise at faster rates than in the preceding periods, as observed earlier. India's income growth, while still domestic- demand dominated, has been undergoing two significant changes in recent years: domestic expenditure becoming more broad-based, with investment accounting for a larger share than before, and exports rising at faster rates. However, with India's trade and current account balances in a state of perpetual deficit, and imports rising at faster rates than exports, any positive contribution from the external sector is yet to materialise.

5 Sectoral growth and supply-side influences

An extensive literature exists on the relative shares and growth patterns of the major sectors, viz. agriculture, industry and services, of China and India (see for example Srinivasan 2002 and 2006; Jha 2007; Virmani 2004 and Bosworth and Collins 2007). In what follows, therefore, we cover this aspect only briefly, and then decompose the observed growth of GDP, and of the three major sectors of the two economies, to identify the sources of the observed growth.

As Table 3.2 above reports, and Figures 3.1a and 3.1b depict, the shares and the growth rates of the three major sectors of the Chinese and the Indian economies have been very different over the period covered, viz. 1990 to 2006. As observed earlier, the usual pattern of evolution of an economy as it develops is to experience a decline in the output share of its primary sector, and an increase in that of the industrial sector, and then, as it becomes more affluent, in its service sector. Employment in the three sectors also usually follows a similar pattern. Several studies in the area (Inman 1985; Kongsamut *et al.* 2001), however, have found that, with growing affluence, it is the share of services that increases more in terms of output and employment, with a decline in agriculture's share and modest increases in the share of industry. The experience of India and China over the period of their faster economic

Table 3.3 The growth experience of China and India: the broad sectors and real GDP

Average Annual Growth %

	China				*India*			
	GDP	*Agriculture*	*Industry*	*Services*	*GDP*	*Agriculture*	*Industry*	*Services*
1990–2000	10.4	4.1	13.7	10.2	6	3	6.3	8
2000–2005	9.6	3.9	10.9	10	7	3.9	7.5	8.5
2006–07(Q2)	11.5	4	13.6	10.6	9.4	2.7	11	11

GDP Shares (Value added as % of GDP)

	China				*India*			
	GDP	*Agriculture*	*Industry*	*Services*	*GDP*	*Agriculture*	*Industry*	*Services*
1991	100	22	44	34	100	33	27	40
2000	100	15	45	40	100	18	27	55
2006	100	12	47	41	100	17	28	55

Source: Handbook of Statistics of the Indian Economy, Reserve Bank of India (author's calculation).

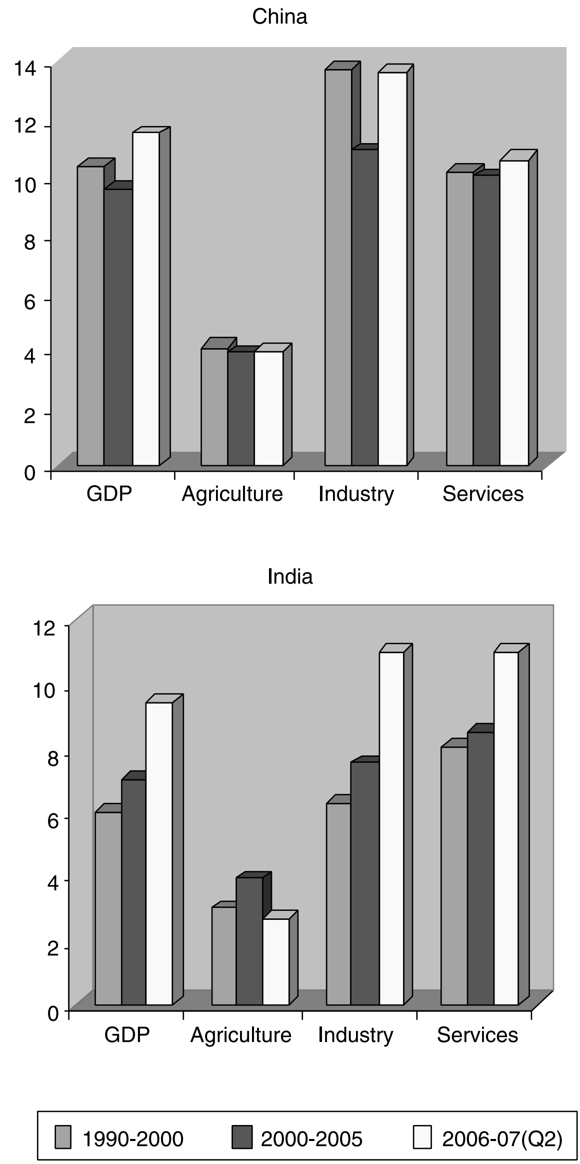

Figure 3.1a Average annual GDP and sectoral growth %: China and India.

growth has been different in several ways. First, while the output share of agriculture has declined in both countries, the fall has been faster in China; second, the employment share of agriculture in India is much higher, at around 57 per cent of the labour force, than China's 47 per cent (Bosworth and Collins 2007). While the performance of India's service sector in many

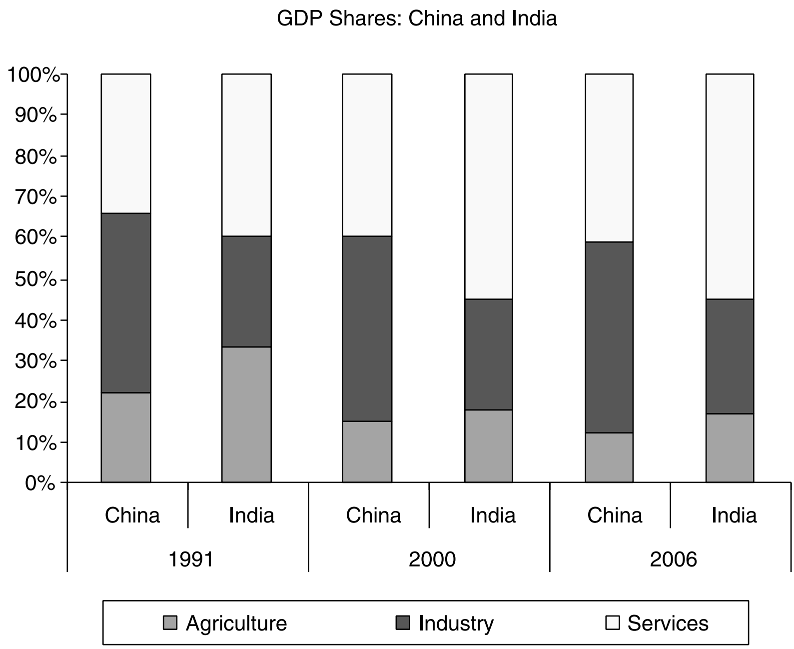

Figure 3.1b GDP shares: China and India.

ways has been quite spectacular, it has not contributed much to employment growth. This aspect of the Indian service sector is elaborated on a bit more, later in the article.

Turning to the relative shares of industry in the two countries, China has been significantly ahead of India with 47 per cent of GDP, in value added terms, against India's 28 per cent in 2005/06. Employment in India's organised industrial sector is low at around 7 per cent of the labour force, and has been in steady decline since the early 1990s (Jha and Negre 2007: 10). The employment share of non-agricultural manufacturing in India is around 22 per cent, which contrasts with around 44 per cent in China (Bottelier 2007: 134, table A4). Industrial growth too has been slow in India. More seriously perhaps, the absolute number of workers employed in the organised manufacturing sectors had declined from its peak of 6.79 million in 1995 to 6 million by 2003 (World Bank: *World Development Indicators* 2006: 216).

The shares of the service sector of China and India have also changed in different ways. The growth rate of the service sector over the decade 1990 to 2000 was 10.2 per cent for China and 8.0 per cent for India; over the next five years, 2000 to 2005, the rates changed to 10 per cent and 8.5 per cent respectively. Because of the decline in the share of the agricultural sector in both countries, GDP growth has come to be sourced more from the other two sectors. In the Indian case, however, the industry share of GDP had remained stagnant at under 30 per cent. There has been a surge in industrial growth in

2006 to 2007, but this seems to have slowed by the end of 2007 (*The Times of India*, 12 February 2008). China, on the other hand, has had a larger industrial sector, and it has grown steadily, even spectacularly, over the period 1991 to 2006. The share of China's service sector too has grown over the period, and its growth rate has been faster than India's, except in the year 2006 to 2007. (incompletely reported in Table 3.3). The GDP share of the sector, however, is significantly smaller for China.

6 Analysing aggregate and sectoral growth performance

6a Factor use and factor productivities

So, where has the observed economic growth come from? An economy grows by employing more factors like capital and labour, and by achieving efficiency gains, captured as total factor productivity.[3] Therefore, by using growth in labour employment and output per worker it is possible to decompose observed growth. Let us proceed then to compute how much of the observed growth in output per worker came from the use of physical capital per worker, and how much of it from factor productivity; one can then quantify the relative contributions of the two major components of GDP growth.

Table 3.4 presents the information on these statistics for the total output of the two countries for the period 1993 to 2004. Although several studies (See Virmani 2004; Srinivasan 2005; Jorgenson and Vu 2005, for example) have examined the performance of the two economies over earlier periods, the main reason for choosing this period here is that it was in the 1990s that India launched its major reform programme, following the 'economic crisis' of 1991, while China continued with its own reforms begun earlier. The impact of these reforms on a major macroeconomic aggregate, viz. the GDP of the two economies, is therefore of particular relevance.

The results, based on the recent and revised estimates of Bosworth and

Table 3.4 Decomposition of observed GDP growth 1993–2004 (% points)

	Output	*Employment*	*Output per worker*
China	9.7	1.2	8.5
India	6.5	1.9	4.6

Sources of output growth per worker 1993–2004 (% points)

	Physical capital	*Factor productivity*
China	4.2	4.0
India	1.8	2.3

Source: Bosworth and Collins 2007.

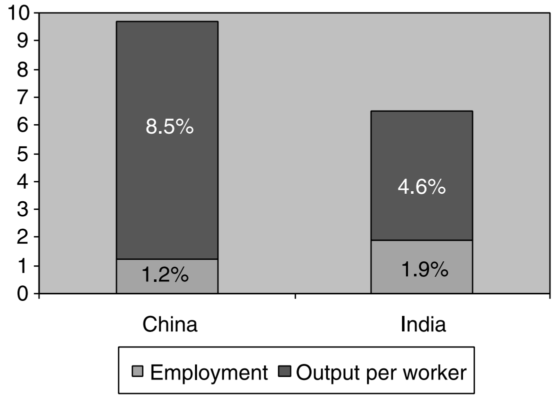

Figure 3.2a Employment and Output per capita in China and India

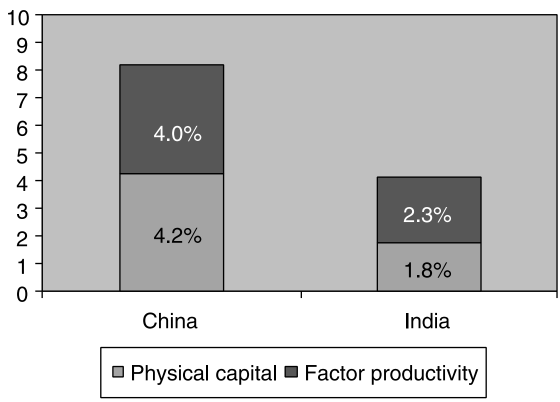

Figure 3.2b Contributions of physical capital and factor productivity growth to output growth

Collins, cited under Table 3.4, show that labour employment growth contributed more to India's GDP growth than it did to China's; while it was the opposite with output per worker – China showing a higher contribution from labour productivity. The next logical step, of course, is to decompose the labour productivity growth by quantifying the contributions of physical capital and total factor productivity (TFP), i.e. improved efficiency, to output growth. The results, reported in the bottom part of Table 3.4, clearly show that the contributions of both physical capital and TFP growth are higher for China than they are for India.

India's greater reliance on labour employment relative to China's appears to be in line with the demographic trends of the two countries. India's working age population, at 60 per cent of the total population in 2005, is projected to rise to 61 per cent by 2050, and the dependency ratio (ratio of non-working to working populations) to fall from 67 per cent to 64 per cent

(UN 2006). China's working-age population, at 67 per cent of total population, by contrast, is projected to fall to 53.3 per cent by 2050, and the dependency ratio to rise sharply from 57 per cent to 88 per cent. These trends would suggest that China will need to learn to rely less on increasing labour employment than would India to contribute to its growth process. The evidence cited in Table 3.4 would indicate that this is already happening.

Let us turn now to the decomposition of the observed growth of the three broad sectors viz. agriculture, industry and services. The following observations based on the findings reported in Table 3.5 are pertinent: first, China achieved faster output growth in all three sectors than India; second, its growth was sourced more from improved labour productivity, and less from labour employment in both agriculture and industry, but labour employment in the service sector was higher, and TFP significantly lower than India's. India's performance in agriculture was particularly poor in all respects relative to China's; in respect of labour productivity and TFP its growth rates

Table 3.5 Decomposition of growth by major sectors 1993–2004 (annual percentage change)

	Output	*Employment*	*Output per worker*
Agriculture			
China	3.7	–0.6	4.3
India	2.2	0.7	1.5
Industry			
China	11.0	1.2	9.8
India	6.7	3.6	3.1
Services			
China	9.8	4.7	5.1
India	9.1	3.7	5.4

Sources of output growth per worker 1993–2004*

	Physical capital	*Factor productivity*
Agriculture		
China	2.1	1.8
India	0.7	0.5
Industry		
China	3.2	6.2
India	1.7	1.1
Services		
China	3.9	0.9
India	1.1	3.9

Source: adapted from Bosworth and Collins 2007.

* Contributions of other factors such as land etc, have been left out.

were less than one-third of China's. It is only in the service sector that India's performance compares favourably with China's. India achieved high growth in this sector with less additional labour and less capital per worker than did China.

6b India's service sector performance: a closer look

There is considerable interest in the contemporary development literature in the role of the service sector in the development process (Bhagwati 1984; Echevarria 1997; Hansda 2002 and Kongsamut *et al.* 2001, for example), and also in India's notable success in this sector. We will discuss briefly some of the issues and factors in the debate about the service sector generally, but relating it to India's performance in the sector.

One explanation for the observed spurt in India's service sector growth is that, as per capita income and the level of affluence grows with economic development, the demand for services grows faster than the demand for commodities because the income elasticity of demand for services is greater than one. Hansda (2002) estimates, for example, that the share of services in India's private final consumption has grown nearly three times between 1950/51 and 1999/2000. This is a demand-side influence on the growth of services. A second, supply-side, explanation runs in terms of what Bhagwati called 'splintering'. This refers to the observed tendency on the part of industrial firms, as an economy grows and becomes more sophisticated, to outsource many specialised services, such as legal, accounting and security services, to specialist suppliers outside the firms. A frequently used external-sector-based explanation is that increased integration with the world economy tends to attract offshore service providers to locate themselves in low-cost developing economies. The call-centre and data processing activities that have come to be located in many developing countries, including India, appear to lend support to this explanation.

One rather curious aspect of India's success in service-oriented activities is its limited impact on employment generation, and also its limited dependence on gross capital formation. Despite its rapid growth over the decade of the 1990s, the service sector employed proportionately fewer workers – 23.5 per cent of the workforce, down from 24.4 – and less capital: gross capital formation was 39.6 per cent, down from 41.2 per cent. The growth, as observed earlier, came largely from improved labour and total factor productivity. One possible reason for this could be that growth in this sector has been concentrated in the areas of service that are more skill-intensive, and less capital- or unskilled-labour intensive (Gordon and Gupta 2003, p. 10).

7 Where are the two giants headed?

7a The growth ingredients and their future

Given the rapid growth and significant transformation of China and India in a relatively short period, the question naturally arises as to the future prospects of these economies. Can they continue along the fast-growth path, and transform themselves into high-income economies, or will their growth slow down? We examine briefly some factors and forces that might help us understand the issues that the two countries must address.

The importance of labour supply, capital formation and technological progress in the growth process is well understood. This chapter has examined in detail what the role of these factors has been in the evolution of the two economies in recent years. It was observed in this connection that China faces the prospect of declining labour supply and a rising demographic dependency ratio. China's growth has been underpinned by high industrial growth and high net export growth. To sustain the former against the backdrop of a declining active population, China will need to transfer labour from the other sectors such as the primary (including agriculture) and the service sectors. Since almost half of China's labour force is still in agriculture, and the GDP share of it is declining, such a scenario would seem at least feasible. However, such transfers are neither costless nor instantaneous. Retraining agricultural labour and fitting them into industrial, usually urban, jobs would involve investment. In any case, a scenario of labour shortage always involves rising real wages which, in turn, could adversely affect industrial competitiveness.

India's demographic prospects are more favourable as its population will continue to grow in a manner that will keep the economically active labour force rising even around 2050. This has sometimes been referred to as India's 'population dividend'. Around 60 per cent of India's labour force is employed in agriculture and related activities, as observed earlier. The industrial sector of the Indian economy is smaller, and has grown at a slower rate, than China's. Therefore, it has not absorbed India's growing labour supply; neither has the large and faster-growing service sector of the Indian economy. Both of these sectors would need to grow in a manner that uses labour, but it is not easy to prescribe how that can be achieved. The much talked-about greening of India's population, therefore, is a major policy challenge facing India in the years to come.

Turning to the prospects of capital availability in the two countries, it has already been observed that China has been more successful than India both in generating domestic savings and in attracting foreign direct investment. Indeed, China's growth has been sustained largely by domestic investment and net export growth. With rising affluence levels, marginal domestic consumption is likely to rise, for a while at least, putting pressure on savings and therefore domestic-sourced investment. Especially with an ageing population (the median age of the Chinese population is about 33 years; it is 24 years in

India – Bardhan 2006, p. 6), it would be more difficult to encourage postponing consumption to generate additional savings. China's heavy reliance on inward FDI has been a notable feature of its fast growth process. Much of such investment, however, has been from China's large diaspora, who have been investing in foreign- investment enterprise (FIE) type businesses that are unable to raise finance domestically. These investments have financed 'contract production' on behalf of the foreign investors. There is also increasing international competition for available FDI, and the prospects of risk-adjusted return in destinations other than China would determine how much of such investments continue heading China's way.

India's performance in respect of both domestic savings and investment has been a lot poorer relative to China's, as observed earlier. Of late, however, there have been marked improvements in both of these, as has also been reported earlier. To sustain GDP growth rates of 8 to 10 per cent, as talked about by policymakers, is likely to require the national investment rate to be higher than the current rate of 34 per cent, which itself might prove difficult to sustain. As a capital-scarce country, India has been in an unusual position of being a net capital exporter in the years 2003/04 and 2004/05, as Indian businesses take up offshore investment opportunities. From the point of view of employment generation, the major drawback of India's development process, it may be argued, has been the stagnation of India's organised manufacturing sector discussed earlier. It is only this sector that has the potential to absorb the rising number of relatively unskilled workers that characterises the economy. Without significant investment in this sector, faster growth won't materialise. The Bosworth and Collins study observes (2007, p. 20) that current rates of capital accumulation can support a GDP growth rate of near 7 per cent.

Technological progress has always been a major ingredient of economic growth. The nexus between growth and technological progress is a two-way one. Both India and China have experienced an improved contribution from technology, as reflected in their labour productivity and TFP performance records, reported earlier. China's achievement, however, has been more in the industrial sector, while India's has been in the service sector. Over the period 1993 to 2004, China achieved nearly a 10 per cent increase in industrial output per worker by significantly improving the contributions of both increased capital per worker and TFP. India's notable success in the service sector was achieved with a modest increase in the contribution of capital per worker, and a significant improvement in TFP, as detailed in Table 3.5. A somewhat broad measure of the efficiency of capital use in production processes at the aggregate level is the incremental capital-output ratio, i.e. the ratio of additional capital investment to the increase in GDP. This ratio is currently 4 for China and 3 for India (Bardhan 2006, p. 9), indicating a more efficient use of capital by India. Both economies would need to enhance their technological capabilities to sustain their growth at high rates.

Among the other factors that affect a country's growth performance are the extent and quality of its physical infrastructure, such as roads, transport and communication, power supply and so forth; and societal infrastructure such as education, health and the legal and administrative institutions. India's physical infrastructure is significantly behind China's in every respect; in education and health too China has achieved better outcomes than India (Bardhan 2006: 6–8; Bottelier 2007, p. 127). India's democratic political system may make its legal framework somewhat more transparent than China's and that, in turn, might make for better protection of property rights in India than in China. However, as revealed in the various reports of the corruption monitoring body Transparency International (www.transparecy.org/publications), entrenched corruption at all levels continues to characterise both Chinese and Indian economic, social and political institutions. The inefficiency and wasteful use of resources that corruption engenders must affect the growth process adversely in both countries.

7b Can India ever catch up with China?

An interesting question in regard to the recent growth of these two most populous countries must be whether their per capita GDPs can converge in the foreseeable future. By its very nature, of course, the answer to the question must largely be speculative. China has the advantage of its early start (1978) in respect of economic reform, and was already at a higher level of per capita income when India embarked on its major reform programme in 1991. This higher base has then progressed with higher annual growth rates; so the compounding mechanism has made China gain even more ground in the 'race'. Where each country will be at any particular point in the future will depend on many variables, among them the growth rates of inputs like labour and capital, TFP growth and catch-up, and the diffusion patterns of technology from developed to the developing countries. One study that has attempted this projection, with various assumed scenarios with regard to the factors just mentioned, projects China's GDP to overtake North America's in 2022 and Europe's in 2027, and India's in 2042 and 2043 respectively (Guest and McDonald 2007: 15). With India's population projected to rise well into this century, it looks distinctly unlikely that India will catch up with, let alone surpass, China in the foreseeable future.

8 How do the giants measure up in terms of the well-being of their peoples?

The ultimate aim of economic development is to improve the living standards and the general well-being of people. So, with the rapid growth that China and India have achieved over recent years – China longer than India – how has the well-being of their respective populations been affected?

The answer to this question must of necessity be multidimensional. To gain some idea of the state of well-being of the peoples of these two countries, we examine some selected aspects of their lives in line with the ideas of the

Millennium Development Goals (MDG) set out in the UN Millennium Declaration of 2000. The MDG set includes 8 goals, 18 targets and 40 indicators, which are to be used to assess progress in world development over the period 2000 to 2015 (UN 2000, 2004).

The Asian Development Bank (www.adb.org/india; www.adb.org/prc) has used four of the goals as indicators of where China and India currently are. The four goals are: (i) percentage of population living on less than $1 a day; (ii) percentage of population living below the national poverty line; (iii) under-5 mortality rate per 1,000 live births; and (iv) percentage of population with access to safe water.

China's scores in three out of the four areas are better than India's. Only 8 per cent of the Chinese population live on less than $1 a day (2006), as against 30 per cent of Indians (2003); the figures for indicator (ii) are 2.3 per cent (2006) for China, and 28.5 per cent for India (2005); for indicator (iii) China's 27 compares with India's 74 (both 2005), and for indicator (iv) China's 77 compares with India's 86 (both 2004).

China and India are both poor developing countries, as indicated by their GDP per capita figures cited earlier; they have both been seeking to achieve a reduction in their poverty levels. China's success in this respect has been significantly greater than India's. If the poverty level is set at (ppp adjusted) $1 a day, the number of poor people in China has dropped steadily from 634 million in 1981 to 308 million in 1987 and 212 million in 2001; India's figures for the same years are 382 million, 370 million and 359 million respectively (Chen and Ravallion 2004).

If the poverty line is set at $2 a day, the number of poor in China has fallen again from 876 million to 731 million and 594 million in the three selected years; the comparable figures for India are 631 million, 697 million, and 826 million in the three selected years – a large *increase* in the number! Indians are seemingly getting out of abject poverty, but only into slightly less abject poverty.

Indian policymakers have long used calorie deficiency as a measure of 'deprivation', or poverty, among its population. The inability to achieve a minimum per capita daily calorie intake of 2,400 in the rural areas, and 2,100 in the urban is considered as deprivation. Using this norm, the World Bank (2004) estimated that 62 per cent of the Indian population suffered deprivation in 1990, 53 per cent in 2000, and expected that this figure will fall to 31 per cent by 2015. Other studies (Chatterjee *et al.* 2007; Patnaik, cited in Jha and Negre 2007: 22), however, suggest a much higher, and rising, level of deprivation.

It is sobering to accept that, with all the encouraging signs of India's improved economic performance over recent years, as elaborated in this chapter, India continues to be the largest single source of dire poverty in the world. The benefits of economic development are clearly yet to reach the vast number of very poor people in India, and a smaller, but significant number, of poor people in China.

The UN Development Programme has, since 1990, been using the Human

Development Index to rank countries according to their performance in three key indicators of development, viz. health, education and average income, each measured in a consistent manner. The latest figures (2007) show India's rank, out of the 177 countries, pretty low at 128, two positions lower than the year before. China, on the other hand, is placed much higher, at 81. This difference signifies that the Chinese, on average, are healthier, with better educational opportunities and a higher living standard than the Indians, on average.

9 Concluding observations

This chapter has examined a large number of issues relating to the growth and development patterns of the world's two most populous nations in recent times. The findings help explain the factors and forces that have shaped the two countries' economic performance. There are some obvious lessons to be learnt from the experiences of China and India, both by the two countries themselves, and by other developing countries.

There are many issues the chapter has not addressed, such as for example the impact on the world's resources, particularly non-renewable resources, as the two large economies keep absorbing larger proportions of them. Likewise, what are the likely consequences of these two giant economies' rapid development on the world's physical, social and cultural environments? The present geopolitical configuration of the world must also alter to accommodate the two Asian countries in the interest of world peace and harmony.

Notes

1 Over a relatively long gestation, this research has been presented at various gatherings including those at the China Europe International Business School in Shanghai, Vietnam Economics University in Hanoi, Vietnam National University in Ho Chi Minh City, Postgraduate Commerce Faculty, University of Calcutta, India, Charles Sturt University in New South Wales, Australia and the New Zealand Asian Studies Society Conference at the University of Otago, Dunedin, New Zealand. Comments and criticisms received at these presentations have been taken into consideration in this revised and extended version. Responsibility for any remaining blemish, however, is solely my own.
I wish to place on record my appreciation of Subrata Ghatak for his constructive criticism and suggestions which have helped improve the final version. Thanks are also due to Shrabani Saha, a doctoral student at Massey University, for her skilful and prompt research assistance.
2 Many of the statistical details used in this subsection are taken from various issues of *The Economic Survey* of the Ministry of Finance, Governmemt of India; and *The Handbook of Statistics of the Indian Economy*, published by the Reserve Bank of India.
3 Total or multifactor productivity is a composite of both labour and capital; it measures part of the output growth that cannot be attributed to the growth in labour and capital input in the production process. It reflects growth due to improvement in the efficiency of a firm's operation which may come from technological advance, innovation in management systems and so forth that enable the producing of more output with identical labour and physical capital inputs.

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4 On measuring economic development

Taradas Bandyopadhyay

On measuring economic development

Economic development is one of the objectives of any country, rich or poor; and it is the primary objective of most of the nations in Asia, Africa and Latin America. The term "economic development" is not quite understood as its frequent use may suggest. When people from South Asia, Africa or Latin America visit any OECD countries, usually they observe residents who are well fed, well clothed, have houses with toilets and bathrooms with clean running water, whose children have the opportunity to get education, who have access to health care and possess access to a wide variety of commodities. The visitors immediately recognize that the host country is a developed country in comparison with the home country. The home country in question is perhaps characterized as under-developed, less developed or developing. Since the problems of development are fundamentally different in the less-developed (or developing) and developed countries, it may be prudent to use the term "economic development" solely to characterize the economic progress of the less-developed or developing countries. The question is how one would measure economic development! It is indeed very important to have a metric for the policymakers to determine the necessary steps that are to be taken to achieve their objective.

In this essay first we will evaluate the criteria that are being used to measure the economic development of a country or a region. Then we will make cases for an alternative measure and will propose a metric which has no serious shortcomings compared to what are being used.

Real national income

For a long time national income, or per capita national income, has been considered to be the sole or at least the most important measure of development of a country. Kuznets (1948), in particular, advocates the idea that economic development can be measured in terms of national income growth or in terms of the total output produced by the residents of a country at constant prices. This view is further reinforced by Hicks (1958), as he writes that the best way of measuring the economic development of a country is to convert national income in terms of real goods. For measuring economic development one needs to know the change in real national income. If one insists only in terms of change in national income over time, then the distinction between economic growth and economic development disappears. This led Kuznets (1955) and Lewis (1955) and others to focus on economic growth in studying the developments of a country. Although at the beginning of the twenty-first century there are countries that are yet to experience a sustained rise in per capita income, "modern economic growth," the term first coined by Kuznets, began in a few countries at the end of the eighteenth century and then these were joined by many others by the end of the nineteenth century. Following the Kuznets–Lewis tradition, the literature on development economics developed largely by utilizing national income or per capita gross domestic product as a metric to measure development.

Based on the per capita income criterion, countries have been classified by the World Bank into high income, middle income and low income in terms of the U.S. dollar with two exceptions. The five countries, Oman, Libya, Saudi Arabia, Kuwait and the UAE are categorized as the "capital-surplus oil exporters," although these countries have high per capita income. In spite of high per capita income, three countries, Israel, Singapore and Hong Kong are not categorized as high-income countries. So the income criterion (measured by U.S. dollars) appears to be an unhelpful metric in measuring economic development.

Economic growth is a continuous change in national income (or output), a single-dimensional phenomenon. Economic development, as observed by a visitor from a less-developed country, is a discontinuous qualitative change. It has multiple dimensions as it is concerned with income as well as structural changes. In fact, growth is still possible without development where national income increases due to an increase in the export of primary goods which are produced by foreign-owned companies. For example, Libya has experienced a huge rise in the real per capita income over the last 50 years or so that resulted from the discovery of crude oil reserves, which are extracted largely by foreign corporations and foreign technicians and exported to the developed countries.

So, economic development is not simply about the national income or per capita national income; it is also about the source and the composition of national income. A household's real income is a measure of the command it has over goods and services. It measures only marketed goods and services, and does not take into account the goods and services produced by the household for its own consumption. The word "development" by definition is about change. A change can be measured only if the reference (or starting) point is known. In many parts of the world, for example in India, a significant percentage of the product of the informal sector is produced by the households. A family which is producing food on a small plot of land, catching fish during the rainy season or collecting green leaves from public land for its own consumption, is not taken into the national income accounting. About one third of India's population, living in remote areas, is tribal. Almost the entire amount of their fuel for cooking comes from fuel-wood that is collected by the family members from public land; and so is the water consumed by them. These items are not counted for national income in India. Furthermore, in many less-developed countries, households walk for five or more hours every day simply to collect water (e.g. in sub-Saharan Africa) or to collect fuel-wood (e.g. in India). Clearly, from the standpoint of national income accounting, there is a serious problem of underestimation. Thus, a discovery of a well or a source of fuel within easy reach in the neighborhood would not change the real income of those households in the national income accounting although it may increase their well-being (Ghai 1987). This national income metric does not tell us what goods are available to the household and how much of each good a household can acquire. This notion of real income is subject to the institution of market and property rights; and then following this notion, households in a hunter-gatherer society didn't have any real income!

Besides national income accounting there is a serious conceptual difficulty in measuring real national income. The essence of the real income measure is to compare the vector of quantities of different goods and services at constant prices. If the prices in question are the one ruling in the market, then the measures are given by the market institution, in what Sen (1979) called the "institutional approach" to real national income. For real national income there are two fundamental distinctions as noted by Hicks (1940): one deals with the comparisons of production possibilities and the other with the comparisons of welfare.

Following the Hicksian distinction, the institutional approach implies a particular underlying theory. For example, the ratio of market prices of any pair of goods must be equal to incremental rates of transformation of that pair of goods. Since for a change in real national income, the values of goods and services are compared at constant prices, it implies that a technical progress experienced by the country must be unbiased. This is clearly far from reality if one studies the economic progress around the world over the last two centuries (Kravis *et al.* 1978; Kravis 1984). In fact, the notion of unbiased technical progress is merely a theoretical construct. For real national income in terms of welfare, the market price ratios must be equal to each person's marginal rate of commodity substitution. No one asserts that the assumptions behind any of these theoretical constructs are indeed correct. The production possibility approach to real national income comparisons operates independently of the welfare approach. In one case price ratios indicate the local (product) transformation rates, and in another case they indicate the local (commodity) substitution rates. In either of the two approaches, it is not necessary to assume that the incremental or marginal conditions of optimality prevail in the form of substitution rates equaling transformation rates (Sen 1979). Furthermore, in the welfare approach, real national income can be measured assuming the prevailing distribution holds. Following the works of Lewis and Kuznets in the 1950s, it has been established that economic development leads inevitably to greater inequality in the distribution of income, until relatively high levels of per capita income are attained. Thus measuring national income at constant prices has serious problems also in the welfare approach.

The welfare approach itself has various problems, as noted by Samuelson (1950), Sen (1976) and others; it also has some deeper conceptual problems since this approach in essence is utilitarian. In this approach, among other things, the domain of the function is the commodity space. For example, the domain of the utility function of an individual is assumed to be that of goods and services. But someone's utility depends not only on the commodity bundle, but also on the manner in which this bundle of goods is being given. For example, the utility that a person receives by choosing an item from a menu in a restaurant may not be the same if that exact item is assigned to that person. Suppose, in a given economic environment, a person chooses to work eight hours every working day at a given wage rate in a specific job in a particular town. Now, instead of free choice, a dictator compels the person to work eight hours every working day at the same wage rate in that specific job in that town. For many people, these two cases will not be equally attractive. Surely, the joy a person gets by volunteering to participate in a project is not comparable to when he is forced to do the same. This seems to suggest that the domain of preferences over commodities only is very restrictive; the domain needs to be rich enough to include the institutions of distribution as well. If one accepts this idea of enlarging the domain of preferences, then the economic policies must also be in the domain. Then real national income in terms of welfare can no longer be a metric to measure economic development in order to choose the correct development policy to adopt.

It is indeed true that a country which experiences a significant growth in real output over a very long period of time ensures an economic dynamic that trickles down the benefit, however uneven, to almost every segment of the population, and gives rise to a situation which is consistent with the experience of visitors from a less-developed or developing country as described in the opening paragraph. The expanding economy increases the demand for labor in the growing sector, which results in migration from the traditional sector, which in turn increases average wages in the economy. At the same time new techniques in production require the job-specific skill and that over time leads to the expansion of general education which in turn improves sanitation and provides a better sense of hygiene and health. The policy that trickles down the benefit to the population at large takes many decades, if not a century or so, to make its impact in living standard and well-being. This happened where countries did not have any national economic policy to achieve the higher living standard of other nations. In the presence of a large number of developed countries, and the international institutions like the International Monetary Fund and World Bank, every less-developed or developing country has some national economic policy for its development.

Given the difficulty associated with the real national income, it is argued that for a national economic policy, a social indicator could be a proxy for economic development (Chenery and Taylor 1968).

Life expectancy

It is argued that perhaps the best indicator to measure economic development is the change in life expectancy, which gives the expected time remaining to live. Although one would expect a positive relationship between life expectancy and per capita income, the correlation is far from perfect. For example, according to the U.N. World Development Report (U.N. 1986), the life expectancy in China and Sri Lanka (with relatively low per capita income) is higher than many upper-middle-income countries such as Brazil and Iran. It shows that growth of output is not sufficient to increase longevity. In other words, similar levels of social development can be achieved at very different levels of economic development. Life expectancy at birth is a mathematical expectation of a random newborn baby's longevity at the date of birth, assuming the prevailing age-specific mortality rate at that time will persist. In other words, life expectancy at birth is defined as the average age at death that would be observed in a group of individuals who experience, over the course of their lives, the age-specific death rates observed during the time period.

Let $p(x,t)$ be the probability of surviving from age x to $x+t$ and $q(x,t)$, the probability of dying between age x and $x+t$. The life expectancy at age x, LE_x, is then calculated by adding up the probabilities to survive to every age, i.e.:

$$LE_x = \sum_{s=1}^{\infty} p(x,s) = \sum_{s=0}^{\infty} s\,p(x,s)\,q(x,s)$$

Life expectancy has been calculated with no allowance for expected future changes. So it is not an appropriate measure for calculating how long any given individual of a particular age is expected to live. Rather it only summarizes the current health status of a population.

The life expectancy at birth has limitations as an index. In a country with a high infant mortality rate, the life expectancy at birth is very sensitive. As a consequence, the data shows that variation across countries in life expectancy at age 5 is much less than its variation at birth. The early childhood is more vulnerable to deprivation in food, health care, absence of proper sanitation and the poor quality of drinking water. Nutrition and hygiene during the first five years of life are indeed more crucial. Furthermore, life expectancy at birth across genders differs among most of the countries. A World Bank study shows that the population ratio of females to males is less than one for children under the age of 5 in almost all countries. Finally, since the life expectancy is measured on the persistence in the prevailing age-specific mortality rate, the increase in life expectancy becomes more difficult as life expectancy itself rises. Thus comparing the economic development of two countries in terms of life expectancy at birth, where both countries achieve a five-year increase in life expectancy, but one was achieved from 40 to 45 years and the other from 55 to 60 years, may be misleading.

The key problem in constructing the life expectancy is the data on mortality, which usually comes from civil registries that hardly exist in the developing countries except in some major urban areas. In its absence, an indirect method is adopted by choosing a representative sample from a single country; then estimating mortality rates from the representative sample; it is applied to other countries that have similar socio-economic conditions. The crucial assumption is that the distribution of mortality over the population age has been converging over time. However, the recent empirical evidence refutes the assumption of cross-country convergence.

Poverty

It is argued that life expectancy at birth is not a true measure of development, since it is measured with a serious upturn and downturn of the economic cycle, and one should look into the incidence of poverty (Adelman 1986). But how would one assess poverty? Is it something absolute? Sen (1983) has argued that there is an irreducible absolute core to the notion of poverty. If someone is suffering from hunger, he is poor even if everyone is having the same suffering. It is very difficult to argue against the notion of absolute poverty in terms of hunger. This absolute notion of poverty is measured by some notion of calorie intake necessary for adequate nutrition, usually in terms of meeting a calorie norm of around 2,000 calories a day, as suggested by nutritional experts at the Food and Agricultural Organization of the United Nations (Sukhatme 1978, 1982). Dasgupta (1993) describes the process that converts food into calories. The nutrients in our food can be divided into two broad categories: macro-nutrients such as proteins, carbohydrates and fats, and micro-nutrients such as vitamins and minerals. Humans obtain their energy indirectly from food. The molecules of carbohydrates, fats and proteins store the energy and the oxidation of ingested food transfers the energy into work. This energy is measured in kilocalorie (or kcal) units. In the process of conversion of chemical energy into mechanical work, a significant portion of energy is used up in chemical work in regulating and maintaining the temperature of the body. Different macro-nutrients have different conversion rates and have unique functions in the body. For example, every cell in the body contains protein molecules and is subject to continuous wear and tear, thus the proteins from food that generates energy is used both in maintaining molecules in cells as well as converting to mechanical work. Thus the calorie requirement alone cannot be a good guide for necessary nutrition in defining absolute poverty either. If calorie needs are met then, due to the nature of diets in certain parts of the world, the protein requirements are usually met. This is true for the countries where the staple food is wheat and maize. However, in countries where the staple food is rice, yam or cassava, the necessary calorie intake will not meet the protein requirements. Furthermore, calorie requirements vary among people. Children and pregnant (and lactating) women must have different calorie requirements. Even among adult men, calorie requirements must vary across different occupations; the case in point is agricultural labor. Usually urban people are more sedentary than their rural counterparts and so their calorie requirements cannot be the same. Finally, the human body is capable of adapting in number of ways.

Initially, the cost of calories is calculated by determining the smallest amount of money that is needed to buy a bundle containing 2,000 calories at the given prices of all foods in the market and the calorie content of each food. This does not take into account of the fact that besides nutrients, people care about variety and flavor and that is reflected by their preferences and culture. Alternatively, calories can be converted into money by determining the per capita actual expenditure of a household that ensures, on average, 2,000 calories. Clearly, defining a measure of absolute poverty as a metric for economic development is indeed challenging.

There is no consensus that "poverty" is indeed an absolute concept. But one does not need to be hungry to be considered as poor. It is the inability of a person or family to fulfill its necessary requirements. According to Adam Smith, "necessities" were determined by "customs" as he wrote, "By necessities I understand not only the commodities which are indispensably necessary for the support of life, but whatever the custom of the country renders it indecent for creditable people, even of the lowest order, to be without" (Smith 1776: Bk 5, Ch.2). The commodity requirements to fulfill a socially defined custom necessarily rise with average prosperity. So poverty is a relationship between people; and it is relative. Thus the incidence of poverty can largely be measured by the inequality of the distribution of income and wealth (Ahluwalia 1976).

Inequality of income

The inequality of income and wealth cannot be a metric for economic development either. The economies of extremely primitive people such as the bushmen of the Kalahari desert, the aboriginals of Australia and hunter-gatherers in the forests of Latin America are generous in sharing their possessions among themselves and are essentially egalitarian. The top 20 percent of the population in India share about 50 percent of its gross national product. If one takes the ratio of the top (rich) quintile to the bottom (poor) quintile of the population, the average income of the rich is thirty times more than those of the poor in a country like Brazil and Peru, whereas the multiplicative factor reduces to less than six between the richest to the poorest in Sri Lanka (Griffin 1989). Thus the distribution of income cannot be a suitable metric for economic development. Following Kuznets (1955), a long-held view is that inequality of income increases with economic development in the early phase, and then with the attainment of relatively high per capita income, the inequality in the distribution of income decreases (Reynolds 1983). In the initial phase of development, the inequality of income increases as a result of a shift of the labor force from the traditional or agricultural to the modern or industrial sector, and that is accompanied by an increase in capital labor ratio in the modern sector which results in higher profits relative to wages (Kuznets 1955; Knight and Sohot 1983). In addition, the expanding sector causes an increase in growth of demand for skilled and educated labor which in turn widens the income differentials among the wage earners. So the inequality of income increases in the initial phase together with a rise in average income (Paukert 1973).

It is argued that even in the initial phase of development, the degree of inequality is not correlated with the per capita income; it depends on the strategy of development (Griffin 1989). In particular, the nature and expansion of educational opportunities, the distribution of land and other productive assets, infrastructure development and adaptation of the nature of factor intensity are the crucial factors in determining the extent of income disparities to emerge with economic development. In any event, since there is no one to one relationship between economic development and the change in income inequality for the entire path of development, it cannot be used as a metric for economic development.

In development economics, public policies are usually assumed to be directed at resource allocation among households. However, studies on intra household allocation on the health, education and earning abilities of various members of the families, and studies on fertility behavior suggest that there are inequalities in allocation of food, education and health care within the family. Even among the children within a family in Asian countries, the male children receive a larger share than the females. This household inequality magnifies the extent of inequality in the distribution of income (Dasgupta 1993).

Occupational structure

A distribution of the labor force in various occupations is also argued to be a measure of economic development. In the literature of development economics, the occupational structure is divided into three sectors: primary, secondary and tertiary. The primary sector includes agriculture, fisheries, forestry and extracting natural resources; the secondary sector deals with manufacturing, trade and construction; and the tertiary sector includes services, banking, transport, etc. According to Clark (1940), the shift in labor force from primary to secondary and tertiary sectors indicates an economic development. Thus the decline in the percentage of the working population in the primary sector and an increase in population in other sectors can be a metric to measure economic development. In the early stage of development, the tertiary sector activities are inadequate and very restrictive. Furthermore, in a globalized world, a country does not have to have a working population to be engaged in activities in all three sectors. Gains from trade may warrant different sectoral activities depending on comparative advantages.

Multi-dimensional approach:

(i) Physical-quality-of-life index

Since low life expectancy at birth, high incidence of poverty, extreme inequality of the distribution of income as well as low per capita gross domestic product and a high rate of illiteracy are features of an underdeveloped country, any one of these in particular cannot be a true metric for measuring the economic development of a nation. This observation led to the idea of developing an index in which the measures of life expectancy, literacy, infant mortality and gross domestic product were taken into account. One such index, called the physical quality-of-life index (PQLI), was developed by David Morris in 1976 for the United Kingdom's Overseas Development Council (Larson and Wilford 1979a). PQLI is a simple average of literacy rate, indexed infant mortality rate and indexed life expectancy at age 1. It is a summation of complex social interrelationships on which no theoretical explanation imposes any given weights/biases. It has been criticized for not taking into account other impacts of gross domestic product that manifest in quality of life as well as the possibility of considerable overlap between infant mortality and life expectancy. Using principal components methodology to estimate PQLI for 150 countries, Larson and Wilford (1979b) test for the statistical relationship between the PQLI and an index of per capita gross national product and show that both provide essentially similar welfare rankings. Due to inter-correlation between the variables in the PQLI, the first principal component explains about 95 percent of the generalized variance.

(ii) Human development index

The limitations of PQLI led to the development of an alternative index, known as the human development index (HDI). To define human development, three essential factors are for people to live a healthy life, to acquire knowledge and to have access to resources needed for a decent standard of living. If these essential choices are not available, many other opportunities remain inaccessible. Accordingly, HDI is once again a simple average of three indices: longevity (L), education (E) and gross domestic product (G). Longevity index, L, is developed to take into account of life expectancy at birth (LE). Education index is a weighted average of literacy index (LI), with two-thirds weighting, and the index of combined primary, secondary, and tertiary gross enrollment (EI), with one-third weighting. The literacy index, LI, measures the adult literacy rate (LR); and the gross enrollment index, GE, measures the combined primary, secondary and tertiary gross enrollment ratio (GR). GDP index, G, is measured by the natural logarithm of GDP per capita at purchasing power parity in US dollar.

In order for these three indices to be added together, each variable or measure, say life expectancy at birth, is needed to be transformed into a pure or unit-free number that lies between 0 and 1. Thus, for a variable or measure, say x, x-index is equal to the ratio of [x-$min(x)$] and [$max(x)$ – $min(x)$]. Following this rule of transformation, it is immediately the case that longevity index, L, is equal to the ratio of [LE – *min*(LE)] and [*max* (LE) – *min*(LE)]; literacy index, LI, is equal to LR/100; gross enrollment index, GE, is equal to GR/100; and GDP index G is equal to the ratio of [*log* (*pc* GDP) – *log* (100)] and [*log* (*max*(*pc* GDP) – *log* (100)]. Note that education index, E, is the sum of two-thirds of LI and one-third of GE. Finally, human development index is the sum of one-third of L, E and G.

Each of the components of human development index is indeed very important in evaluating the quality of life in a country; and it is also a significant improvement over the use of per capita real income alone to measure economic development. The average quality of life indeed reflects the state of economic development of a country. But does it really measure the true development? In both PQLI and HDI, each element of these three constituent indices has equal weights. The rationality of having equal weights is not very clear; rather it is very arbitrary. Perhaps to minimize the controversy of having unequal weights, equal weights turns out to be the best option to adopt. The substantive problem in equal weight is that three components have different means and variances. Furthermore, there is substantial double counting in considering increased education, rising gross domestic product and lower mortality rate since each of these are not independent of one another. There is a large literature on evaluating and extending the human development index and some of the most important contributions, among others, are made by Cahill (2005), Cervellati and Sunde (2005), Fukuda-Parr (2005), Haq (2005), Mazumdar (2003), Neumayer (2001) and Sen (2005).

An alternative proposal

Since the relation between education and income is very well established, let us first examine the relation between education and health or longevity. The economist's view of education is as a tool of developing human capital since the profession is obsessed with the production of goods and services or simply generating income. Almost thirty years ago health economists found that investing in education over a long period of time has a better anti-aging effect than good medical care. It is observed that people with greater levels of schooling report themselves to be significantly healthier (Case and Deaton 1999). It is reported that an eight percent reduction in mortality is associated with each additional year of schooling for men in the U.S. A similar observation is made by Arendt (2005). This point is reinforced by Lleras-Muney (2005) in a seminal work showing that the life expectancy at age 35 increases by 18 months with an additional year of education in the U.S. In addition to physical activities or exercises, lifelong learning stimulates the frontal cortex and helps to build cognitive reserves that improve the memory skill and brain efficiency. James Smith (2007) observes that the single most important factor that is consistently linked to longer lives in every country where it has been studied, is education. A few extra years of school are associated with extra years of life; in addition, it vastly improves health even years later. Furthermore, it is now well established that those who keep their minds engaged in active education live longer and have reduced levels of memory loss in their old age – confirming Aristotle, who said, "Education is the best provision for old age."

In every country where children have been compelled to spend a longer time in school, it has resulted in better health (Kunst and Mackenback 1994). This is because less-educated people are less able to plan for the future and delay gratification. Perhaps that also explains the differences in smoking rates between more educated people and less educated people. Becker, Philipson and Soares (2005), Soares (2007a, 2007b), and Cutler, Deaton and Lleras-Muney (2006) argue that improvements in life expectancy have largely occurred independent of per capita income growth. It is reported in two important studies by Becker, Philipson and Soares (2005) and Goldman and Smith (2005) that the improvements in life expectancy are closely related to new medical technology and to the accumulation and diffusion of health-related knowledge. Soares (2007a) emphasizes the importance of education, showing the effectiveness of the understanding of technologies and other health-related knowledge in the production of health; "more educated individuals have higher survival advantage in diseases for which medical progress has been important." This point was further strengthened by a cross-country study by Cutler, Deaton and Lleras-Muney (2006). A higher level of education within the family enhances the longevity of its members since it affects the understanding of treatments, assessing risks incurred with hazardous behavior and taking preventive measures (Lekdawalla and Goldman 2001). The higher the aggregate level of education in the country better is the quality of health services since it improves the society's absorptive capacity for medical technology and ideas. Using the data across 71 countries, Ricci and Zachariadis (2008) have shown that a country's "tertiary education attainment is important for longevity, in addition to any role that basic education plays for life expectancy at the individual level."

It is well known that growth in per capita gross domestic product and an increase in life expectancy are interdependent (Preston 1975). A country with higher per capita gross domestic product is usually associated with better life expectancy, though the correlation is hardly perfect. A decline in mortality rate also affects growth, since it raises the savings rate and thereby increases the rate of physical capital accumulation; in addition it reduces loss in human capital (Lagerlof 2003; Acemoglu and Johnson 2008). For decades there have been attempts in the public health sphere to understand the ultimate non-medical sources of ill health such as education, social standing and income inequality. It is now well established that increase in inequality of income has an adverse effect on health (Deaton 2003). In a landmark study of employees in the five grades of the British Civil Service, where all had access to health care, Marmot (1995) examined the mortality rate among males aged 20 to 64, and showed that civil servants at the lowest grades suffered heart disease at about three times more compared to the workers at the top tier. Furthermore, between the top two tiers, the highest category had half of the incidence of heart disease of the next tier. Lynch and Kaplan (1997) investigate the relation between income distribution and health by considering epidemiologic studies in the U.S., and shows how income inequality is related to age-adjusted mortality within the 50 states, even after accounting for absolute levels of income. Discussing psychological, social and behavioral pathways through which income distribution might be linked to health status, he shows that the distributional aspects of an economy are important determinants of health. This may well provide one of the most pertinent indicators of overall social well-being. Wilkinson (2001) provides a novel Darwinian approach to the question, and shows that countries such as the U. S., with big gaps between rich and poor, have higher death rates than those with smaller gaps such as Sweden and Japan.

Irrespective of many shortcomings, the human development index, physical quality of life index and many other indices like the human poverty index provide some measure of well-being. However, given the interdependence of life expectancy, education and per capita gross domestic product (Chakraborty and Das 2005), the human development index appears to be a poor metric for economic development, no matter how good it is to measure the well-being of a nation. The question remains about its suitability to measure economic development per se. One could perhaps argue that a country pursues a national economic development program because it is a means to achieve something dear or fundamental to its members. The most fundamental among all is indeed the preservation of life. This very desire to preserve life compels a death penalty convict to appeal for life imprisonment without the possibility of parole, even when living could be extremely challenging. Throughout history, this desire to survive causes the absence of collective action that in turn helps to preserve violent oppressive regimes for a very long time.

Quality adjusted longevity

Given the limitation of human development index as a metric for economic development, and following the underlying rationality of that index, it appears that some quality-adjusted value for length of life alone could be a better measure (Hicks 1997). An increase in gross domestic product, expansion of education, reduction of poverty, etc. ultimately help to improve the quality of life and in turn, on an average improve longevity. Many economists would feel uneasy thinking about quality-adjusted longevity as a measure of economic development since happiness or satisfactions in life are not taken into account. However, everything else remaining constant, on an average people who are happy in life live longer, i.e. probabilistically a happy or a satisfied person can count on more years of life than an unhappy person *ceteris paribus* (Deeg and Zonneveld 1989; Gerdtham and Johannesson 2001). Cohen and Brody (1981) have thought of two processes that might play a role in the hypothesized relationship between happiness and longevity. The first process is the direct relationship of cause and effect – unhappy life leads to accident proneness and suicide, resulting in a premature death. The second process, relevant for older populations, is an indirect relationship where unhappiness causes chronic disease, and its severity or duration results in an inability to deal with problems presented in life. Among other works, the empirical evidence presented by Deeg and Zonneveld (1989) is compelling. They took eleven variables that are very important to happiness or satisfaction with different aspects of life, the majority of which showed a significant univariate correlation with longevity. Having control over symptoms and indicators of ill health, they find in a multivariate model that happiness is an independent predictor for longevity. The vast literature in medical science on this issue essentially establishes that any improvement in quality of life of a population reflects in its health status which in turn improves the average length of life (Gerdtham and Johannesson 2001).

The Global Burden of Disease (GBD) project of the World Bank, World Health Organization and Harvard School of Public Health developed a metric known as disability-adjusted life year (DALY). It combines mortality and morbidity into a single year to measure the magnitude of premature death and non-fatal health outcomes. These are either attributable to proximal biological causes, including diseases and injuries, or attributable to more distal causes such as lack of access to good-quality water, use of tobacco or drugs, inequality of income and social status. This metric is a combination of years of life lost to premature mortality from specific causes and years of life lived with disability attributed to specific conditions of ill health. In calculating this metric, GBD has proposed to break down the population in age or cohort, sex and the type of diseases. For the purpose of evaluating the impact of an economic policy to measure the sensitivity of increase in income or education, the population can also be divided by income class and attainment in levels of education. For example, in the GBD project, the population was divided into eight age groups: 0–4, 5–14, 15–29, 30–44, 45–59, 60–69, 70–79, 80+ for each gender. One can easily incorporate household income class and the level of education, such as four-year college graduate, in defining DALY for each subpopulation.

DALYs for a disease or health condition are calculated as the sum of the years of life lost due to premature mortality in the population and the years lost due to disability for incident cases of the particular health condition. Following the GBD projects methodology, we consider a population of cohort (or a set of individuals in an age group) c in gender h, income group i, education level j, with disease d. Let n^{hc}_{ijd} be the number of deaths in that population; and le^{hc}_{ijd} be the life expectancy in years at the age of those deaths. Then the product of n^{hc}_{ijd} and le^{hc}_{ijd} is defined as the years of life lost in that population, i.e., $yll^{hc}_{ijd} = n^{hc}_{ijd} .le^{hc}_{ijd}$. Now for the same population, let m^{hc}_{ijd} be the number of cases of diseases d in that population, and l^{hc}_{ijd} be the average number of years a person in that population would live with diseases d and w^{hc}_{ijd} be the weight assigned to disease d. The product of m^{hc}_{ijd}, w^{hc}_{ijd} and l^{hc}_{ijd} is defined as years of life lived for that population, i.e., $yld^{hc}_{ijd} = m^{hc}_{ijd} .w^{hc}_{ijd} .l^{hc}_{ijd}$. Then disability-adjusted life years for that population, $DALY^{hc}_{ijd}$ is the sum of yll^{hc}_{ijd} and yld^{hc}_{ijd}. The DALY for a country now is the weighted average of population of all cohorts, where weights are the proportion of population for each subpopulation to the total population.

In defining DALY, the appropriate measure of the effects of chronic illness is time. It is the time lost due to premature death and time spent as disabled by disease. One DALY, therefore, is equal to one year of 'healthy' life lost. It can be thought of as the burden of disease. DALY is a measurement of the gap between current health status and an ideal situation where everyone lives into old age, free of disease and disability. It is important to note that it uses the same "disability weight" for everyone living in a specified health state for a year. The metric DALY actually measures the health "gaps" as opposed to health "state" in life expectancy. Since in our measure of DALY, the income class and the education level are taken into account in dividing the population, the effect of a change in income distribution or advances in education can be investigated from the distribution of $DALY^{c}_{ijd}$, where $DALY^{c}_{ijd}$ is the weighted average of $DALY^{hc}_{ijd}$'s over all diseases. Anand and Hanson (1997, 1998), among others, have made major contributions for a critical appraisal of DALY.

In order to complement the "health gap" measure with a "health state" measure, the World Health Organization has developed a metric, called health adjusted life expectancy (HALE), which is life expectancy over and above the years of life lost to disability. Thus, HALE measures the number of years the average person in a certain population can expect to live in a state of full health. Following the WHO method of construction of HALE (Lopez *et al.* 2000), once again, we consider a population of cohort c_x of ages between x and $x+t$, in income i, education level j. For that population, let w^{cx}_{ij} be the weighted prevalence of disability/diseases, and a^{cx}_{ij} be the average duration of the disability/diseases. The product of w^{cx}_{ij} and a^{cx}_{ij} is defined as the years of life lost to the disability in the cohort c_x in income i and education level j population, i.e. $yld^{cx}_{ij} = w^{cx}_{ij} .a^{cx}_{ij}$. Now yld^{cx} is the weighted average of yld^{cx}_{ij} over income groups and education levels, and weights are the proportion of population in each subcategory of income and educational level of the cohort population c_x. Then, given the total years of life lived by the life table population, as developed by WHO, between age x and $x + t$, ll_x, the years of healthy life lived in that cohort, $yhll_x$, is the product of ll_x and $(1 - yld^{cx})$, i.e.

$yhll_x = ll_x.\ (1 - yld^{cx})$. Given the number of survivors at age x, n_x, HALE at age x is defined as $HALE_x = \Sigma_x^z\ yhll_x\ /n_x$, where z is the last open-ended life (table) interval.

It is immediately clear from our construction of HALE that the population of every age group can be divided according to gender as well. Thus, in addition to income and education, HALE combines measures of both age- and sex-specific health status, and age- and sex-specific mortality, into a single statistic. It represents the number of expected years of life equivalent to years lived in full health, based on the average experience in a population of every age group. In some sense, HALE provides a measure of quality of life in addition to a measure of quantity of life. In contrast to conventional life expectancy, which considers all years as equal, to calculate HALE, years of life are weighted by health status.

It appears that to measure the healthy life of a population, both the number of years lost due to premature death and disability as well as the number of years lived in full life must be taken into account. This suggests having some convex combination of DALY and HALE to measure the quality-adjusted longevity of life. Following the rule of thumb used in constructing the human development index, one can define quality-adjusted longevity, QAL, as a weighted average of DALY and HALE with weights of one-half for each component.

QAL takes into account both "health gaps" and "health status" in measuring quality-adjusted longevity. Many studies in medical science have established that, keeping other things equal, on average a happy person or one who is content in life has better longevity. Thus instead of considering per capita real national income or education, since each of these two presents some serious difficulty in measuring, it may be prudent to use the average years of healthy living, i.e. the quality-adjusted longevity, as a metric to measure economic development. Healthy living is the final outcome; everything else can be viewed as primary or intermediate input. Our proposal is a logical extension of the human development index. Every component that is used to construct the human development index enhances "quality of living." So, we propose simply to use it directly as a metric to measure economic development. From the very construction of QAL, one can easily identify the effect of a policy change since in constructing DALY and HALE the population is divided on the basis of income, education, age, sex, disease, etc. Of course, empirical studies are needed to test our proposed metric.

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5 The Asian crisis and macroeconomic development

The impact of ambiguity[1]

Willy Spanjers[2]

1 Introduction

When casually contemplating the intricacies of improving the standard of living in developing and emerging economies, the terms 'growth', 'uncertainty' and 'crisis' are among the first that come to mind. To improve standards of living, economic growth is a necessity. The outcomes of the policies devised for achieving growth are subject to all kinds of uncertainties. And if things fail to work out as planned, one may end up with a full-blown economic crisis. A particularly powerful combination of growth, uncertainty and crisis has been provided by East Asia. After a prolonged period of extraordinarily high growth, in 1997 a sudden and unexpected bout of uncertainty led to the reversal of international financial flows and caused an unprecedented crisis.

The purpose of this chapter is to provide a coherent framework in which the main characteristics of growth, uncertainty and crisis are connected. Within this framework, we find that these issues, which were so prominent in East Asia, are consequences of the chosen development strategy. Thus, we identify a fundamental mechanism that relates the high levels of per capita growth in the East Asian countries before the crisis, its fall during the crisis and the more modest growth rates thereafter. We address the question whether or not crises can be prevented in the process of economic development and, if so, whether it is desirable to do so.

The approach of this chapter differs from the usual perspective on the East Asian crisis which relates to the well-established literature on currency crises. In this literature, different mechanisms that may trigger a currency crisis are identified, often with the intention of developing early warning systems as to when a crisis may be imminent. The different types of mechanisms are distinguished in different 'generations' of models. The first generation models follow the seminal paper by Krugman (1979), according to which a currency crisis occurs when the specified dynamics make such a crisis inevitable. The second generation models, in the spirit of Obstfeld (1986, 1996), argue that some crises are not inevitable, but rather the consequence of a self-fulfilling prophecy, i.e. of equilibrium selection and coordination problems. More recently, third generation models following Morris and Shin (1998) remove the multiple equilibrium aspects by assuming a lack of common knowledge among investors. In the survey article of Breuer (2005), a fourth generation of models is identified, which focus on institutions and loss of confidence as potential causes.

In many respects, the above-mentioned research relates to models of bank runs in the spirit of Bryant (1980) and Diamond and Dybvig (1983), in which bank runs are suboptimal and should be prevented. The desirability of preventing bank runs in a setting with risky assets, however, has recently been challenged by Allen and Gale (1998) and Spanjers (1999, Chapter 3). When the likelihood of a bank run is low and its costs are limited, while the opportunity costs of preventing a bank run are high, it is better to accept the occasional occurrence of bank runs, rather than prevent them.

In this setting the impact of incalculable risk, also known as Knightian uncertainty or ambiguity, is analyzed by Spanjers (1999, Chapter 5). The typical results in the presence of calculable risk are confirmed. But in addition it is found that the updating of ambiguous beliefs regarding returns introduces dynamic inconsistency in the behaviour of investors. When banks choose their reserve policies, it is difficult for them to distinguish between investors being exposed to subjective calculable risk and investors facing ambiguity. If banks wrongly interpret the investors to be exposed to calculable risks when they actually face incalculable ambiguity, the dynamic inconsistency appears to cause investors to 'overreact' and 'panic' in the face of bad news, unexpectedly causing a bank run.

Spanjers (2008) shows that these results also hold for currency crises. In particular, it is shown that the stylized facts of the East Asian crisis match the mechanisms and conclusions of the model. It is argued that the crisis was shaped by a loss of confidence of investors, caused by a combination of perceived incompetence of key policy makers, bad news, and incalculable political risk. In the language of the model, the dynamic inconsistency associated with the incalculable risks wrong-footed central banks, which were not aware of its presence. Investors seemed to 'overreact' and to 'panic', reversing international financial flows to an extent that was previously unimaginable. For a comprehensive description of the East Asian crisis see Williamson (2004).

The current paper takes a different approach to the East Asian crisis. Rather than modelling the investment opportunities as high-yielding illiquid assets, the analysis is based on different strategies for economic growth and development. It incorporates the impact of globalization, recognizing the effects of both international financial liberalization and of the internal and external increasing returns to scale that characterize modern production technologies. In particular, the effects of a low-technology development strategy are compared to those of a high-technology strategy.

In line with modern decision theory, the uncertainty involved in development strategies for emerging countries is understood to include both (calculable) risk and (incalculable) ambiguity in the tradition of Knight (1921) and Keynes (1921). Decision-making under ambiguity is modelled by a basic version of the approach pioneered by Schmeidler (1989). A prominent area of recent economic applications of ambiguity and incalculable risk is monetary policy. Ghatak and Spanjers (2007) discuss the impact of ambiguity on monetary policy rules in transition economies; in a more general monetary policy context applications can be found in e.g. Hansen and Sargent (2003, 2007), Levine and Pearlman (2008) and Spanjers (2008).

In the setting of the current paper we analyse the impact of ambiguity on the decision which development strategy to follow. Here ambiguity can take the form of incalculable political risk or of unpredictable reverses of international financial flows. Our theoretical analysis indicates that risk neutral but ambiguity averse investors and policymakers may be tempted to implement a low-technology development strategy in the face of ambiguity, where a high-technology strategy would be appropriate.

A brief examination of growth rates of per capita GDP for selected countries from East Asia and other parts of the world illustrates the theoretical argument. This leads to policy recommendations that focus on either reducing incalculable risks or insulating the high-technology strategy from its impact. The recommendations not only question the appropriateness of what seems to be a cautious economic development strategy in the selected East Asian countries. They also highlight the importance of reducing the incalculable political risks in the Middle East and in Russia. Regarding the incalculable risk of a reversal of financial flows, a combination of high currency reserves and appropriate reform of the IMF is recommended.

The remainder of the chapter is structured as follows. Section 2 discusses agglomeration and cluster effects and describes the basic features of both a low-technology and a high-technology development strategy. In Section 3 an intuition for ambiguity is provided, along with a basic description of the associated decision-theoretical model. The implications of ambiguity in the presence of decreasing and increasing returns to scale are also discussed. Section 4 focuses on the analysis of the growth rates generated by the two development strategies. In this context the behaviour of risk neutral but ambiguity averse policymakers and investors is discussed and analysed, followed by a brief examination of the per capita growth rates of selected countries over the period 1975 to 2005. The final section, Section 5, contains policy recommendations.

2 Agglomeration effects and development strategies

The breathtaking development of the Asian ‘tiger’ economies during the past three decades benefited strongly from the process of globalization. Indeed, the international economy as a whole has been subject to momentous changes, some triggered by globalization, some fuelling it. Changes in the international institutional structure did much to support global economic integration, but the forces that were released are of a more fundamental nature.

Globalization can best be understood as a reaction to fundamental changes caused by technological progress. It is the shift from production technologies that exhibit internal and external decreasing returns to scale to technologies that are characterized by internal and external increasing returns to scale that has shaped the ongoing processes of economic globalization. The 'Asian experience' provides an excellent illustration of this.

Of course, external increasing returns to scale in the form of agglomeration and cluster effects were relevant for past processes of economic development. But the reasons for agglomeration were more strongly linked to the proximity to specific resources or the presence of geographical features. Geographical features could provide a location advantage in terms of protection against destruction by wars or in terms of the ease with which a cost-effective transportation infrastructure could be provided. For more recent technological progress, agglomeration and cluster effects are no longer linked to exogenously given geographical structures. Rather, they are endogenous results of the choice of location of production sites. This is the distinguishing feature between the 'old' and the 'new' economic geography, as discussed, among others and from different perspectives, in Neary (2001), McCann and Shefer (2005) and Fujita and Mori (2005).

The agglomeration and cluster effects related to external increasing returns to scale are driven by direct and indirect positive externalities of production. Such synergy effects may range from the efficient use of local physical infrastructure to the availability of a pool of skilled labour. But they may also relate to the ease with which communication may take place, improving the functioning of financial markets and facilitating cooperation in research and development. The success of the financial centres of, for example, New York, London and Hong Kong is an illustration of how powerful agglomeration and cluster effects can be for financial markets. Silicon Valley is an example of their potential impact in the area of research and development. Many more examples can be found that illustrate the potential advantages of geographically concentrating the production of specific sectors.

When contemplating which path to follow for developing their economies, policymakers are aware of the importance of external increasing returns to scale. But there are still trade-offs to be made, as strategies that aim to exploit external economies of scale may have disadvantages in other respects.

For simplicity, we consider only two prototypical economic development strategies: a low-technology strategy and a high-technology strategy. As indicated below, these development strategies differ with respect to internal and external economies to scale, financial requirements, governmental policies, and vulnerability to calculable and incalculable risks. The government chooses which policy to pursue with the instruments available to them.

Low-technology strategy

The first development strategy is of a more traditional nature and focuses on established low-technology sectors, of which agriculture is an important example. Such technologies typically have either decreasing internal returns to scale or relatively small optimal sizes. They tend not to rely on elaborate and expensive physical infrastructure of traffic, utilities and communication networks and make modest demands on the non-physical infrastructure, including the judiciary and educational systems.

Although they may produce for foreign markets, these low-technology sectors are relatively independent of globalization. Their economic success is only moderately linked to the speed and direction of the liberalization of international trade. The low level of technology also reduces the need for protection of intellectual property rights and makes the impact of their violation on technology transfer an issue of secondary importance. The tried and tested technologies do not involve significant levels of calculable or incalculable technological risk. Similarly, the modest financial requirements of developing these sectors reduce both the importance of financial liberalization and the impact of volatility of international financial markets.

The impact of the decreasing external returns to scale of the low-technology development strategy is not restricted to the economic sphere. It also has consequences for the economic geography and the role of the government. Because of the decreasing external returns to scale, the clustering of economic activity tends to be counter-productive. The more geographically concentrated production is, the higher the average costs of production will be, all else being equal. In a decentralized economic system, uncoordinated individual decision-making will tend to result in a geographically even distribution of economic activity. So disparities in geographical patterns of economic growth and income will tend to be small and there will not be a tendency towards excessive migration pressures. This greatly reduces the need for regional income redistribution or for elaborate regional economic policies.

As a consequence, the low-technology development strategy does not require a strong and efficient political governance structure. The services a government may provide are, from an economic perspective, not overly important. There is no strong need for enhancing human capital through education or for providing a relatively up-to-date infrastructure. Nor is there a need for the regional redistributing of income or for regional development policies. The relative insulation from the effects of globalization also reduce the need for a competent and forward-looking foreign policy on trade and other issues. Finally, the low dependence on financial resources and foreign technologies reduces the reliance on international investors and the need to pay attention to their nervousness regarding various forms of political risks.

High-technology strategy

For a development strategy that focuses on the adoption and development of high-technology production processes the opposite holds. These processes, which are often knowledge intensive, show the increasing internal returns to scale that are normally associated with research and development. High-technology sectors also have increasing external returns to scale, partially because of their reliance on a well-developed physical and non-physical infrastructure. The demands on physical infrastructure relate to swift and reliable connections with the rest of the world, both physically through roads, railways, harbours and airports, and virtually through modern information and communication technologies. The need for experts requires the presence of a high-quality merit-based education system. There is a need for well-connected and internationally recognized universities and research institutes that are able and willing to communicate relevant scientific progress to the local industry.

Given the global character of high-technology sectors, embracing globalization is crucial for this development strategy. It requires governments to accept and implement global treaties on trade and on intellectual property rights. As high-technology sectors typically produce for international markets, trade liberalization and an internationally level playing field are important for the success of the strategy, despite the efforts of some governments to protect their domestic markets in an effort to grow national champions in specific sectors. Furthermore, the importance of international cooperation in research and development makes the adherence to treaties on intellectual property rights crucial, as this is a prerequisite both for the exchange of knowledge and ideas and for the transfer of technology.

Financial liberalization and openness are also important for a high-technology-oriented development strategy. Not only does this strategy require a substantial amount of financial resources, which some countries may find difficult to accumulate through domestic savings, but the high levels of calculable and incalculable risk also make it sensible and efficient to use the risk-sharing opportunities of the international financial system. This risk sharing leads to an increased dependence on international financial flows, both in the form of portfolio investment and in the form of foreign direct investment.

A disadvantage of the geographical clustering caused by a high-technology development strategy is that it creates disparities between regions within the country that may be difficult to manage. These disparities can include differences in income, employment, access to education, health services, local infrastructure, and individual freedoms. The disparities of such a dual economy tend to lead to migration and self-selection effects that reinforce existing differences. Left to its own devices, uncoordinated individual decision-making is likely to result in an economic and social structure that is full of tensions that can easily get out of control.

Therefore, apart from the economic requirements, a high-technology development strategy requires a strong, competent government, which is capable of devising and implementing policies that reduce tensions and bridge the internal divide. The government must efficiently supply the appropriate infrastructure within the agglomerations, provide adequate education and create an environment in which internationally mobile experts feel comfortable and at ease. It needs to engage in development strategies for the regions of the country that are not part of the successful clusters and implement a regional redistribution of income. It must direct internal migration flow in ways that support the growth and development of clusters, rather than hamper it.

There also will be a need to build consensus for and conduct a foreign and trade policy that embraces the process of globalization, e.g. by skilfully negotiating and adhering to international, regional and bilateral trade treaties. Given the reliance of the high-technology development strategy on international finance, there is a need to provide a transparent and stable governance structure. International investors' nervousness with respect to political risk needs to be taken seriously, as a reversal of financial flows may have catastrophic effects on the success of the development strategy.

Given the different requirements the two development strategies make on the government, weak and instable governments may be justified in their preference for following isolationist impulses and for setting unambitious targets for economic growth and development. Their weakness creates an environment in which an ambitious high-technology development strategy would suffer from the political and policy risks and, therefore, would be inappropriate. Strong, competent and stable governments, on the other hand, may well be encouraged to embrace globalization and the chances it offers for achieving the high growth rates that are associated with a high-technology-oriented development strategy.

The main characteristics of the two development strategies are illustrated in the diagrams in the next section. Before turning to the graphical analysis, the intricacies of decision-making under the uncertainties involved in the two development strategies are discussed.

3 Political risk and ambiguity

When speaking about uncertainty, economists almost without exception refer to calculable risk. This reflects the usefulness of the separation of beliefs from the evaluation of outcomes that characterizes the subjective expected utility approach. The possibility of such a separation on the basis of an objective axiomatic foundation was convincingly shown by Savage (1954) and Anscombe and Aumann (1963). On the basis of their work one can easily be led to believe that for all practical purposes uncertainty can be represented by subjective probability distributions. The refutation of the 'Sure Thing Principle' by the thought experiment in Ellsberg (1961) would seem nothing but one of many irrelevant oddities and paradoxes. In reality, it shows a systematic aversion for situations in which probabilities are unknown and, therefore, risks are incalculable.

In the Ellsberg Paradox choices need to be made between bets with known probabilities and bets with unknown probabilities. For this purpose, consider an urn containing 90 balls. The colours of the balls are blue, red or yellow. The urn contains 30 blue balls; the remaining 60 balls are red or yellow in an unknown proportion. In the first instance, the choice is offered between two bets, B_1 and B_2. B_1 pays £100 if the ball drawn from the urn is blue, and nothing otherwise. Similarly, B_2 pays £100 if the ball is yellow. When faced with the choice between B_1 and B_2, B_1 is typically chosen, implying that the subjective probability of a blue ball exceeds that of a yellow ball.

	Blue	*Red*	*Yellow*
Number of balls	30	60	
B_1	£100	£0	£0
B_2	£0	£0	£100
B_3	£100		£0
B_4	£0	£100	

Next the bets B_3 and B_4 are considered, where B_3 pays £100 if the ball is either blue or red and nothing if it is yellow. B_4 pays £100 if the ball is either red or yellow. Once again, faced with a choice between B_3 and B_4, the bet with the known probabilities, B_4, is chosen. So the subjective probability of {either a red or a yellow ball} exceeds that of {either a blue or a red ball}. This implies that the subjective probability of a blue ball must be less than the subjective probability of a yellow ball, contradicting the result of the first comparison. Therefore, the decision maker cannot have been a subjective expected utility maximizer.

Compelling as thinking of the Ellsberg Paradox as an irrelevant oddity may seem, it misses the point. The difference between (calculable) risk and (incalculable) ambiguity, as discussed in an early stage by Knight (1921) and Keynes (1921), is more than a mirage. It is this fundamental difference that is reflected in the Ellsberg Paradox. What is more, after the work by Schmeidler (1989) the type of solution proposed by Ellsberg (1961) can no longer be criticized as 'ad hoc'. Rather, Schmeidler provided it with a decision-theoretic foundation as solid as that of the subjective expected utility approach.

Uncertainty: risk and ambiguity

So what exactly is meant by incalculable risk or ambiguity? Perhaps the clearest explanation is provided by Keynes (1937). Keynes states:

> By 'uncertain' knowledge, let me explain, I do not mean merely to distinguish what is known for certain from what is only probable. The game of roulette is not subject, in this sense, to uncertainty [. . .]. The sense in which I am using the term is that [. . .] there is no scientific basis on which to form any calculable probability whatever. We simply do not know.
>
> (pp. 113–14)

Keynes then continues to discuss its implications:

> Now a practical theory of the future [. . .] has certain marked characteristics. In particular, being based on so flimsy a foundation, it is subject to sudden and violent changes. The practice of calmness and immobility, of certainty and security, suddenly breaks down. New fears and hopes will, without warning, take charge of human conduct. The forces of disillusion may suddenly impose a new conventional basis of valuation. All these pretty, polite techniques, made for a well-panelled board room and a nicely regulated market are liable to collapse. At all times vague panic fears and equally vague and unreasoned hopes are not really lulled, and lie but a little way below the surface.
>
> (pp. 114–15)

To him, these implications are not without consequences for economic theory:

> [T]he fact that our knowledge of the future is fluctuating, vague and uncertain, renders wealth a peculiarly unsuitable subject for the methods of the classical economic theory. This theory might work very well in a world in which economic goods are necessarily consumed within a short interval of their being produced. But it requires, I suggest, considerable amendment if it is to be applied to a world in which the accumulation of wealth for an indefinitely postponed future is an important factor; and the greater the proportionate part played by such wealth accumulation the more essential does such amendment become.
>
> (p. 113)

When facing the decision between a low-technology development strategy and a strategy that focuses on high technology, policymakers face various forms of (calculable) risk and of (incalculable) ambiguity. Some of the ambiguity is inherent in the development and implementation of high-technology processes, as the country may not have had the opportunity to gain experience with them. Indeed, the lack of relevant past experience on the basis of which to form reasonable (subjective) probability estimates is what Knight (1921) considers the basic cause of ambiguity.

Another source of ambiguity, which is most relevant for developing and emerging economies, is political uncertainty. It is easy to imagine how changes in the confidence of international investors in the behaviour and stability of governments can lead to unpredictable reactions of international financial markets. It may lead investors, seemingly without proper regard for the unchanged fundamentals, to radically change their valuation of assets or reverse long-standing financial flows. In similar ways incalculable risk may affect the behaviour of other decision makers directly or indirectly involved in the implementation of the chosen development strategy.

To develop an intuition for how the impact of (incalculable) ambiguity on the decision process may differ from that of (calculable) risk, we compare both situations below. For this purpose we consider a variation of the familiar risk premium, which equals the difference between the expected value of a random variable and the certain value which leads to an outcome the decision maker considers as equally good. It is compared with an overall uncertainty premium, which also takes ambiguity into account. The difference between the two premiums reflects the impact of ambiguity.

The risk premium

When one has found a way to make incalculable risk, i.e. ambiguity, calculable, defining the counterpart of a risk premium is a straightforward task. Focusing on the effect of ambiguity by considering a risk-neutral decision maker was done in Spanjers (1999, Section 8.4). The same approach is followed in this chapter to analyse the impact of ambiguity on the evaluation of the two development strategies outlined above.

Consider a risk-neutral decision maker who faces two possible outcomes for the amount of financial resources available for implementing the development strategy. This amount is either low, x_{min}, or high, x_{max}. The valuation of the two strategies is depicted in Figure 5.1.

In Figure 5.1 we have two indirect production functions. The function f depicts the output of a low-technology development strategy as a function of the financial resources available. It is an *indirect* production function. It implicitly incorporates the equilibrium of the interactions between both private sector and political decision makers for an overall amount of available financial resources x. This equilibrium comprises behaviour in all relevant aspects under the assumption that the low-technology strategy is followed. Similarly, the function g is an indirect production function depicting the output when a high-technology strategy is pursued and financial resources x are available.

The ratio of probabilities with which the financial resources x_{min} and x_{max} are obtained corresponds to the ratio of the distance between x_{max} and $E\{x\}$ to the distance between x_{min} and $E\{x\}$. The loss in average output caused by the risk regarding the availability of financial resources, as compared to the output that would be obtained if the average financial resource was available with certainty, is obtained on the vertical output axis as

$$f(E\{x\}) - E\{f(x)\}.$$

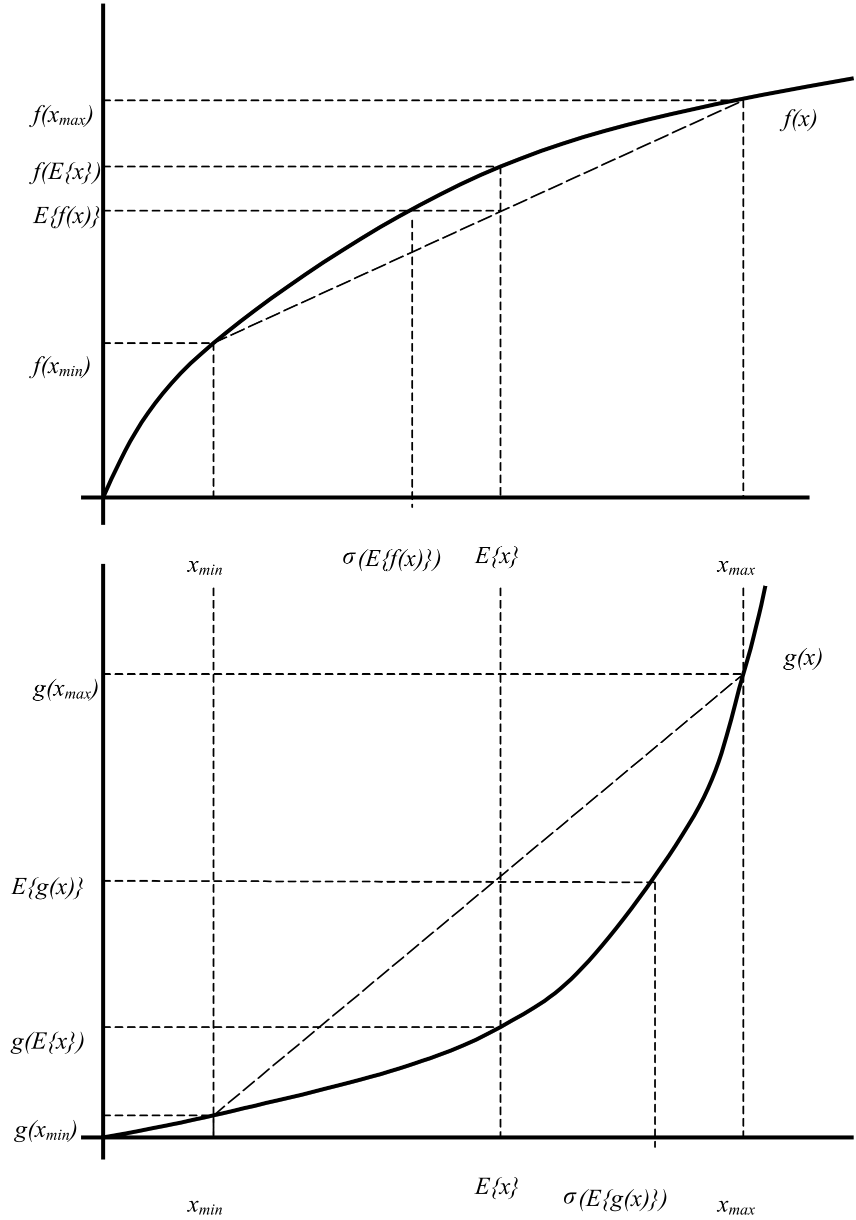

Figure 5.1 Low-technology strategy vs high-technology strategy under risk.

If the return for the risk-neutral investors is proportional to output generated, the risk has a negative effect on returns when the low technology strategy is followed. This is the direct analogue of the expected utility of a risk-averse investor for an investment strategy with has a linear indirect production function.

The same expected output could have been obtained when financial resources of $\sigma(E\{f(x)\})$ would be available with certainty, the counterpart of the certainty equivalent for a risk-averse investor. Similarly, we obtain the analogue of the risk premium for the low-technology strategy as

$$E\{x\} - \sigma(E\{f(x)\}),$$

reflecting loss due to the risk, expressed as a reduction in available financial resources.

The lower panel of Figure 5.1 depicts the high-technology strategy. Its indirect production function has increasing returns to scale. As before, the impact of risk on the investors' return is obtained as the difference between the output for the average financial resources available and the average of the risky output, i.e.

$$g(E\{x\}) - E\{g(x)\}.$$

Since the indirect production function has increasing returns to scale the average return of the high-technology strategy exceeds the return of the average of the available financial resources.

Denoting the analogue of the certainty equivalent of the high-technology strategy by $\sigma(E\{\mathrm{g(x)}\})$, we obtain

$$E\{\mathrm{x}\} - \sigma(E\{g(x)\})$$

as the (negative) equivalent reduction in available financial resources due to risk, i.e. the equivalent gain in available financial resources due to risk. Therefore, the presence of risk increases the average return of the risk-neutral investors in the same way as risk increases the expected utility of a risk-loving investor.

Evaluating ambiguity: the Choquet expected value

The above discussion does not answer the question of which strategy is preferred by a risk-neutral investor or policymaker. The decision depends on the level of output or, in a dynamic context, the level of growth that is obtained for the competing strategies. This issue is addressed below in the discussion of Figure 5.3 in Section 4. But first we turn our attention to the impact of ambiguity, which is depicted in Figure 5.2.

Before we can sensibly discuss the impact of ambiguity on the evaluation of the outcomes of the different development strategies, we have to describe the way in which ambiguity enters the trade-offs made by a decision maker.

In the case of risk, a decision maker is assumed to maximize his expected utility, i.e. the expected value of the von Neumann-Morgenstern utility index u over the outcomes of the random variable described by the pair $(p;y)$, where p describes the probabilities and y the outcomes for the states of nature. The decision maker's expected utility function is now obtained as

$$U(p;y) = E_p\{u(y)\}.$$

When the decision maker is risk-neutral, as in the case we considered above, the von Neumann-Morgenstern utility index is a linear increasing function and the expected utility function U is equivalently represented by taking the expected value of y, i.e. to

$$E_p\{y\}.$$

When considering decision-making under ambiguity, the situation is more complex. The beliefs of the decision maker are no longer described by a vector of probabilities and, therefore, it is no longer possible to take an expected value of the von Neumann-Morgenstern utility index over the state-contingent outcomes y.

In the simple case of two possible outcomes, each associated with one specific state of nature, the decision maker's ambiguous beliefs can be represented by the plausible lower bounds he places on the probability that the financial resources equal y_{min} and the probability that they are y_{max}. In particular, the assumption is abandoned that the sum of these lower bounds on the probabilities equals one. Therefore, this representation is more general than that of a (subjective) probability distribution. In the context of this simple example, the available financial resources will be either y_{min} or y_{max} as before.

An example of the first method to specify of such beliefs assumes that the probability that the available financial resources will be y_{min} is at least 0.25, whereas the probability of y_{max} is at least 0.5. Or, to put it differently, the decision maker considers all probability distributions in the range from

$$0.25 \leq \Pr\{y = y_{min}\} \leq 0.5 \text{ with } \Pr\{y = y_{max}\} = 1 - \Pr\{y = y_{min}\}$$

to be plausible.

Now that we have stated how the decision maker's ambiguous beliefs can be represented, the next question is how they can be used to evaluate outcomes.

Obviously, there are many different ways in which a decision maker may choose to evaluate this kind of vague or 'fuzzy' beliefs. As a general rule, however, it seems plausible to expect the decision maker to act cautiously, i.e. pessimistically. In the presence of a multitude of equally plausible probability distributions, this can be achieved by considering the lowest expected utility value that is compatible with one of the probability distributions that is considered to be plausible. The extreme version of this is the 'Hurwicz Principle' (see Hurwicz 1951 and Arrow and Hurwicz 1972), and its result is known as the *maxmin value* for the *multiple priors model* axiomized by Schmeidler and Gilboa (1989). Here the decision maker chooses his actions $z \in Z$ to maximize the minimum value of his expected utility over the set of admissible 'prior' probability distributions P, i.e.

$$\max_{z \in Z}[min_{p \in P} E_p\{u(x(z))\}].$$

An alternative approach would be to order the possible outcomes in a decreasing sequence with respect to the values they generate for the von Neumann-Morgenstern utility index u. Now one assigns the first, i.e. highest, utility value the minimum probability with which it is obtained. Next, one assigns the minimum remaining probability to the second utility value in the sequence etc. This leads to the *Choquet expected value* of the von Neumann-Morgenstern utility index as axiomized by Schmeidler (1989).[3]

So how do these two approaches apply to our example? When following the maxmin approach, it is obvious that the higher the probability associated with y_{min} is, the lower the associated expected utility value will be. Therefore, the ambiguity-averse decision maker will assign $\Pr\{y = y_{min}\} = 0.5$ and will evaluate the outcome as

$$0.5\, u(y_{min}) + 0.5\, u(y_{max}).$$

According to the Choquet expected utility approach, y_{max} is the first outcome in the decreasing sequence and y_{min} the second. Therefore, y_{max} will be assigned its lowest possible probability, which is 0.5. So now turn to y_{min}, which will be assigned the minimum with respect to the remaining probabilities. But because the assigned probabilities must add up to one, the only remaining probability is 0.5, which for that reason is also the *lowest* remaining probability. Therefore, the Choquet expected utility is obtained as

$$CE\{u(y)\} = 0.5\, u(y_{max}) + 0.5\, u(y_{min})$$

Regarding this example two remarks are in place. Firstly, in this specific case the maxmin approach and the Choquet expected utility approach lead to the same valuation of the ambiguous beliefs. This in not generally the case.[4] Secondly, it is easy to see that a decision maker who has to pay y, rather than receiving it, would evaluate the outcome as

$$CE\{u(-y)\} = 0.75\, u(-y_{max}) + 0.25\, u(-y_{min}).$$

This property, that a change in the ranking of the outcomes obtained in different states of nature may affect the weights assigned to them, is a general property of evaluating outcomes in the presence of ambiguity.

Now that we have seen how decision makers' beliefs are represented and outcomes are evaluated in the presence of ambiguity, we return to the evaluation of the different development strategies.

The uncertainty premium

The impact of ambiguity on the evaluation of the two development strategies by a risk-neutral and ambiguity-averse decision maker is illustrated in Figure 5.2. This diagram contains the information of Figure 5.1, but extends it by including the Choquet expected value of the available financial resources and of the attained output.

On the horizontal axis, the Choquet expected value of the available financial resources, $CE\{x\}$, is less than their expected value in the absence of ambiguity, $E\{x\}$. As outlined above, an ambiguity-averse risk-neutral decision maker puts the weight associated to x_{max} at the lower bound of its plausible probability value and, therefore, assigns the remaining probability mass to the only remaining outcome, x_{min}. The Choquet expected evaluation of the output for the low-technology strategy, $CE\{f(x)\}$, and for the high-technology strategy, $CE\{g(x)\}$, are obtained in a similar way.

As in the case of risk, the decreasing returns to scale of the indirect production function f cause the Choquet expected value of the output to be less than the output for the Choquet expected financial resources. The additional presence of ambiguity, as compared to risk, leads to a difference between the output for the expected value of financial resources and the Choquet expected value of the output of

$$f(E\{x\}) - CE\{f(x)\}.$$

Thus, the difference due to the presence of ambiguity is

$$E\{f(x)\} - CE\{f(x)\}.$$

The certainty equivalent for the Choquet expected value of the output is indicated in Figure 5.2 as $\sigma_C(CE\{f(x)\})$.

For the analogue of an uncertainty premium – which reflects the losses due to both the risk and the ambiguity expressed as a reduction in available financial resources – one obtains

$$E\{x\} - \sigma_C(CE\{f(x)\}).$$

For the low-technology strategy, the presence of ambiguity reinforces the effects of risk for a risk-neutral and ambiguity-averse decision maker.

As the lower panel of Figure 5.2 indicates, this is not the case for the

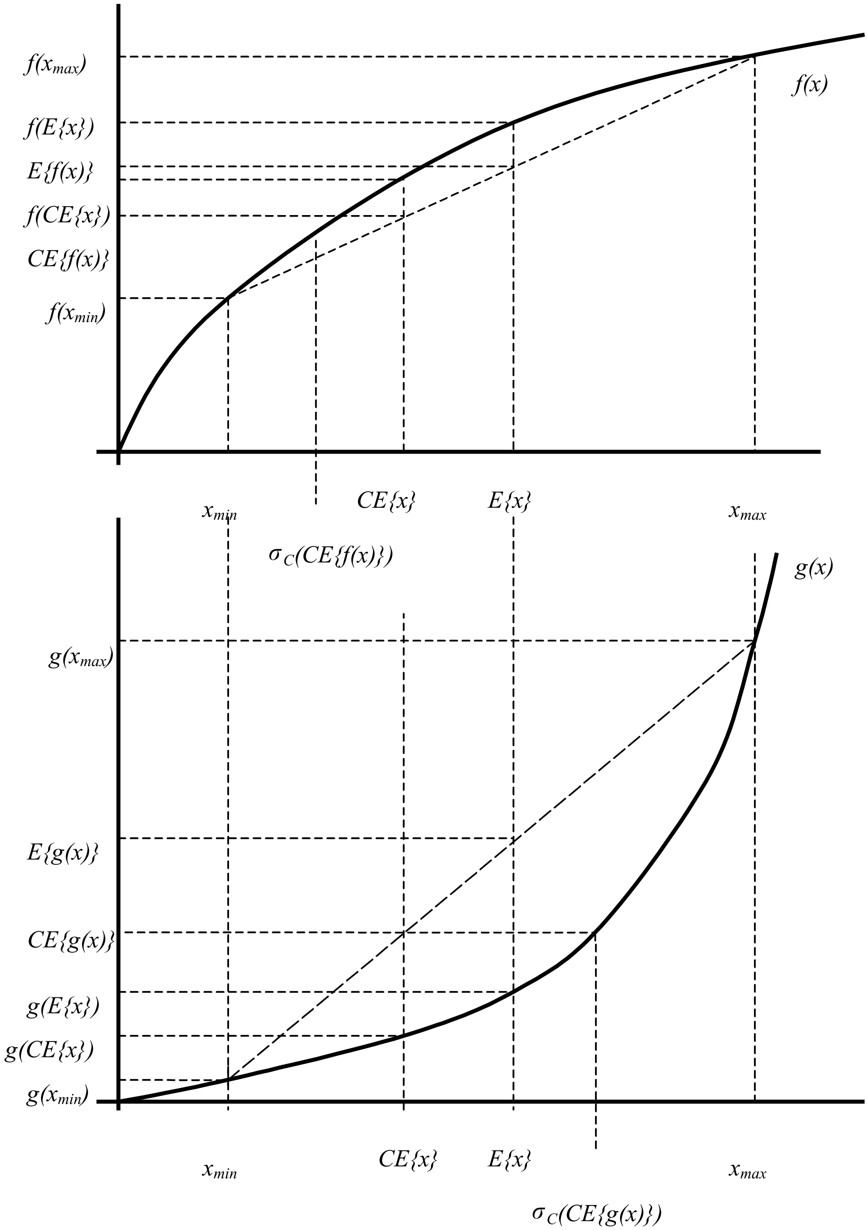

Figure 5.2 Low-technology strategy and high-technology strategy under ambiguity.

high-technology strategy. For the indirect production function g for the high-technology development strategy, which has increasing returns to scale, the difference between the output for the expected value of the available financial resources and the Choquet expected value of the output is

$$g(E\{x\}) - CE\{g(x)\}.$$

So the difference due to the presence of ambiguity is

$$E\{g(x)\} - CE\{g(x)\}.$$

The certainty equivalent for the Choquet expected output is denoted by $\sigma_C(CE\{g(x)\})$. For the analogue of an uncertainty premium – which reflects the loss due to both risk and ambiguity expressed as an equivalent (possibly negative) reduction in available financial resources – one obtains

$$E\{x\} - \sigma_C(CE\{g(x)\}).$$

As the diagram indicates, for the high-technology strategy the presence of ambiguity counteracts the (positive) impact of risk.

The intuition for this is that the increasing returns to scale of the indirect production function g has a similar effect as a risk-loving von Neumann-Morgenstern utility index would have. The valuation of the output of the risky financial resources exceeds that of the output for their expected value. The ambiguity aversion, however, reduces the valuation of the ambiguous output below the valuation of the output in its absence. Therefore, the impact of ambiguity is qualitatively different from that of risk.

The above discussion of the impact of ambiguity on the indirect production functions of the low-technology and the high-technology strategy focused on a static analysis of output levels. The main interest of policymakers and investors, however, is in the middle- and long-term effects of these strategies, which requires an analysis in a dynamic setting. In order to address these effects, the next section focuses on growth rates.

4 Growth

In this section we focus our attention on growth rates. We start by extending the above discussion of the impact of ambiguity to the growth of output. Then we present per capita growth rates of selected developing and emerging countries from different parts of the world. In this data we look for indications that the data is in line with our theoretical findings, both regarding the two prototypical development strategies and regarding the potential impact of ambiguity on the choice of development strategy.

Ambiguity and growth

The growth rates associated with the two development strategies are depicted in Figure 5.3. In line with the previous section, the diagram displays the growth rate as an indirect function of the available financial resources. The functions F and G are indirect growth functions. Thus, $F(x)$ is the growth rate that results from the interactions of the relevant decision makers when financial resources of size x are available and a low-technology development strategy is followed. Similarly, G is the indirect growth function associated with the high-technology strategy.

The impact of individual developing and emerging economies on worldwide technological progress is limited. Although technological progress is largely exogenous for these countries, they can benefit from worldwide technological progress. This is reflected in the shape of the indirect growth functions.

The growth rate generated by a low-technology strategy is assumed to be positive but not very high. This seems reasonable, as technological progress in low-technology sectors is likely to be slow and to be characterized by marginal reductions in production costs. If the country does not have the financial resourses to upgrade to the newest technology, one would expect that profit margins and wages would fall. But variable production costs would remain below the international price level and production would continue. A temporarily limited access to financial resources would reduce growth, perhaps even making it negative, but it would be unlikely to trigger an economic crisis. Similarly, an abundance of financial resources would create the opportunity of increased growth rates, but only to a limited extent. Even considerable additional investments would be unlikely to result in a significant increase in competitiveness and would be unlikely to cause competitors to significantly reduce their output or leave the market.

The properties of a high-technology strategy are in sharp contrast to this. The growth obtained through a high-technology strategy is likely to be high when the strategy is successful, but failure may well result in an economic crisis. The technological progress in high-technology sectors is likely to be both rapid and revolutionary, meaning that new production technologies make existing technologies obsolete.

As long as a country following a high-technology strategy has access to sufficient financial resources, it will be able to keep up with technological progress. It will be able to maintain its position in the international market and to benefit from generous profit margins. But if the access to financial resources is temporarily limited, this may have serious consequences. The crucial ongoing research and development will be interrupted, causing a rapid loss of market share. As a result of the increasing internal and/or external returns to scale average production costs increase, reducing competitiveness even further.

An abundance of financial resources, on the other hand, may increase the

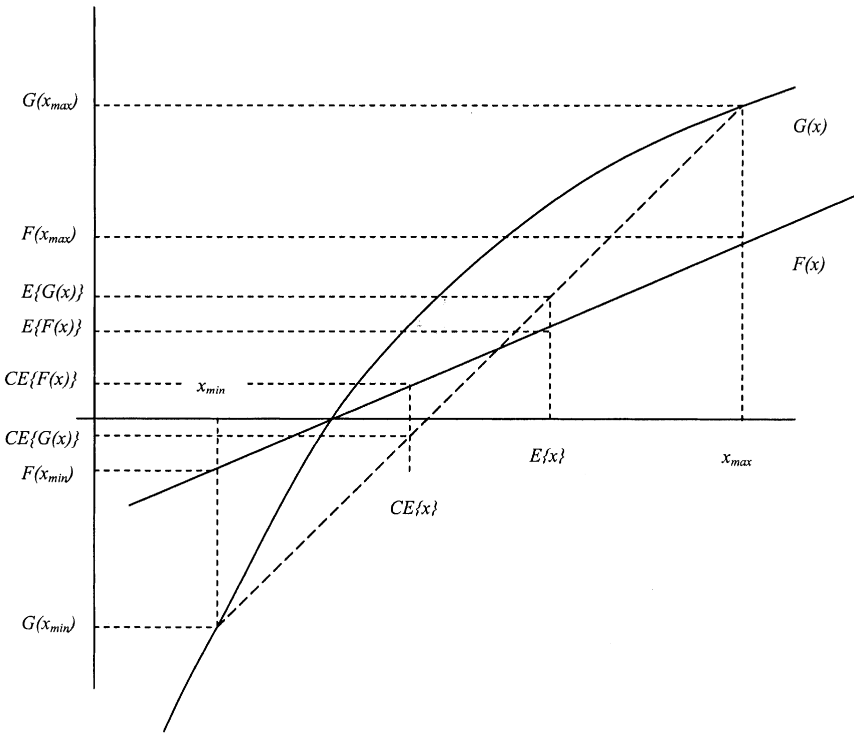

Figure 5.3 Growth for the low-technology strategy and the high-technology strategy under ambiguity.

growth rate above its already high level. This increase, however, will be at a decreasing rate. When the production frontier is approached, further increases in growth rates require large financial commitments. Furthermore, the processes and infrastructural projects that lead to external increasing returns to scale take time to plan and implement. The time-span of the temporary abundance of financial resources may be shorter than the implementation lags associated with these projects and processes.

The shape of the indirect growth functions F and G in Figure 5.3 reflects these considerations.

Figure 5.3 depicts a situation in which a policymaker with the objective of maximizing expected growth rates chooses a high-technology development strategy. The expected growth rate of such strategy, $E\{G(x)\}$, exceeds that of a development strategy that focuses on low-technology sectors, $E\{F(x)\}$. As discussed above, a drawback of the high-technology strategy is its vulnerability to unfavourable international developments. The growth rate is more volatile and every once in a while an economic crisis will occur. The policymaker may be tempted to follow a low-technology strategy, 'prudently' avoiding economic crises. In a situation as depicted in Figure 5.3, the cost of avoiding economic crises, however, is high. In the long run, the associated reduction in the growth rate leads to a standard of living that is less than it could have been.

When risk-neutral but ambiguity-averse policymakers and investors face ambiguity in the form of incalculable political risk, the situation becomes even worse. In their decision-making, these decision makers put an increased weight on bad outcomes. In the situation depicted in Figure 5.3, the weight on x_{min} is increased at the expense of the weight assigned to x_{max}. Therefore, the resulting Choquet expected growth rate is reduced for both development strategies. But this is not the only consequence of the presence of ambiguity. The reduced availability of financial resources associated with x_{min} 'merely' leads to a reduced growth rate, $F(x_{min})$, for a low-technology strategy, whereas it leads to a full-blown economic crisis if a high-technology strategy is pursued, indicated by $G(x_{min})$. As a consequence, the presence of ambiguity can reverse the order of the valuation of the two development strategies. It may cause a low-technology development strategy to be pursued where a high-technology strategy would have been better, the distortion being caused by the pessimism and excessive cautiousness of the risk-neutral but ambiguity-averse policymakers and investors.

This possibility that the presence of ambiguity, as caused by incalculable political risk, may lead policymakers and investors to pursue inappropriate development strategies, is sufficiently worrying to warrant a brief examination of selected annual per capita GDP growth rates, looking for indications that this actually happens in real-life decision-making.

Growth rates of selected countries and regions

We will examine annual per capita GDP growth rates in our search for indications that the presence of incalculable (political) risk has a distorting effect on the development strategies of emerging countries. We focus on emerging countries rather than low-income developing countries, as they are more likely to satisfy the basic prerequisites for a high-technology strategy. Emerging countries are more likely to have a real choice between a low-technology and a high-technology development strategy.

Four groups of countries are considered. The first group of countries is from East Asia. For the purpose of comparison we also look at two groups of countries of from other parts of the world, viz. South America and North Africa. The fourth group consists of the BRIC countries excluding Brazil (which is included in the group of South American countries), viz. China, India and Russia. For each of these groups we examine the World Bank's World Development Indicator data on the annual growth rate of per capita GDP for the period from 1975 to 2005.

For the geographical area of East Asia we focus on Indonesia, Korea, Malaysia and Thailand. The per capita growth rates for these countries are depicted in Figure 5.4. Interestingly, in the period before the East Asian crisis of 1997, the growth rates of these countries are well above the average of the middle-income countries. Before the 1990s the growth rates also show a fair amount of volatility, as would be expected for a high-technology strategy. From the early 1990s until the crisis in 1997, the growth rates were stable and well above the average of the middle-income countries. Once again, this is in line with what we would expect for a high-technology-oriented development strategy.

After the crisis, however, we find that growth rates have stabilized and no longer exceed the average of the middle-income countries. Our theoretical analysis makes it tempting to interpret this as the consequence of an increase in the perceived incalculable risks of global financial flows. It would be capable of reversing the valuation of the two development strategies, causing a shift from a high-technology to a low-technology development strategy.

The second geographical area we look is South America, where Argentina, Brazil and Mexico are selected. During the last three decades South America has seen many economic crises, which could potentially be a consequence of a high-technology strategy. Our theoretical analysis suggests that if such a strategy is followed, these countries would be vulnerable to crises, but would also display periods of high economic growth. The annual per capita growth rates for these countries are depicted in Figure 5.5.

The data in Figure 5.5 provide no indication that a high-technology strategy has been followed. In particular the growth rates of Brazil and Mexico are below, rather than above, the average per capita growth rates for middle-income countries. Besides, from the beginning of the 1990s these growth rates are relatively stable, suggesting that the two countries follow low-technology

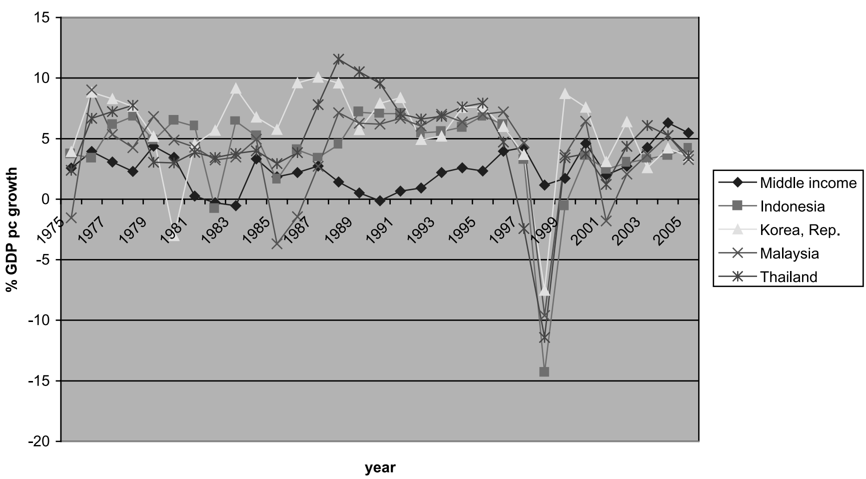

Figure 5.4 Per capita GDP growth rates for East Asia.

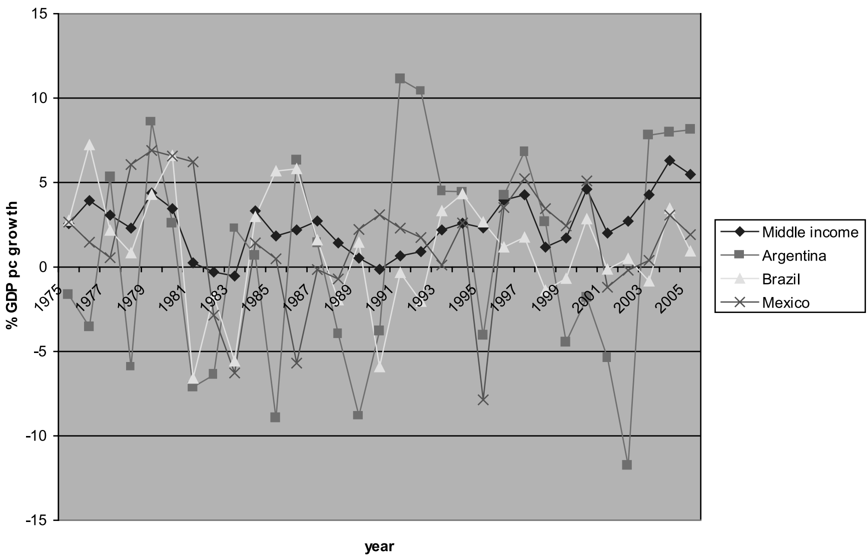

Figure 5.5 Per capita GDP growth rates for South America.

development strategies. Only Argentina exhibits high and volatile growth rates in the period from the early 1990s onward. But the high growth in the early 1990s may well be a rebounce from the economic crisis in the preceding years, whereas the crises at the beginning of the twenty-first century lasted longer than one would be led to expect.

For North Africa, the per capita growth rates of Algeria, Egypt, Morocco and Tunisia are depicted in Figure 5.6. With the exception of Tunisia, where the growth rate was volatile, the growth rates of the selected counties are more or less in line with the average of the middle-income counties and relatively stable. This suggests that these countries are following a low-technology strategy. The decision in favour of a low-technology strategy may well be driven by the incalculable political risk related to the Middle East. Ambiguity-averse policymakers would be expected to follow such a strategy, even if the proximity to and treaties with the European Union would seem to make a high-technology-oriented development strategy a more than promising alternative.

Finally, we take a brief look at the per capita growth rates of the BRIC counties excluding Brazil, viz. Russia, India and China. From Figure 5.5, it seems that from the early 1990s onward the growth rate of Brazil is relatively stable and more or less in line with the average growth rate of the middle-income countries. Figure 5.7 suggests that the same holds for India from the beginning of the 1980s onwards. Both countries seem to follow a low-technology development strategy. The growth rates for China, by contrast, seem to indicate that since the early 1980s it has been following a high-technology-oriented development strategy.

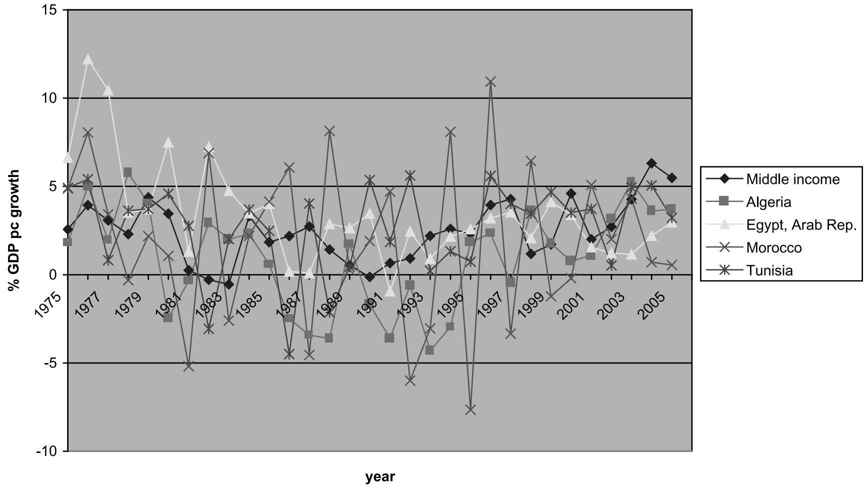

Figure 5.6 Per capita GDP growth rates for North Africa.

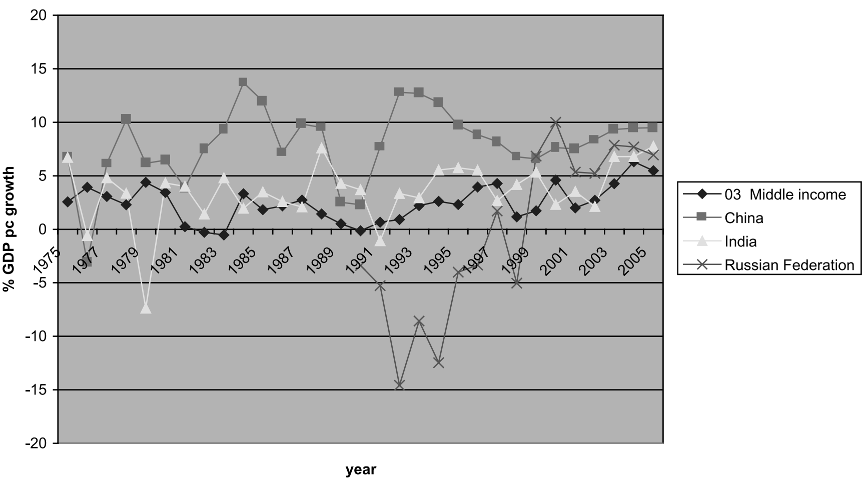

Figure 5.7 Per capita GDP growth rates for China, India and Russia.

From the data in Figure 5.7 it is difficult to judge whether Russia is following a low-technology or a high-technology strategy. The growth rates of the early 1990s may well be dominated by the effects of the collapse of the Soviet Union. The growth rates in the twenty-first century are slightly above the average for the middle-income countries but seem rather stable. In the light of our theoretical arguments, this would be compatible with a low-technology development strategy with enhanced growth rates due to increases in the price of oil. As in the case of North Africa, this may be the consequence of incalculable political risks. Given the geographical proximity to the European

Union, it would seem that in the absence of this ambiguity, a high-technology development strategy would be warranted.

The above discussion of growth rates seems to illustrate our theoretical arguments. This is particularly true for the impact of ambiguity, be it caused by incalculable political risk or by the possibility of unpredictable reversals of international financial flows.

5 Policy recommendations

The brief and superficial inspection of growth rates illustrates the general theoretical analysis of this chapter. It suggests that the presence of ambiguity distorts the decisions of policymakers and investors in a number of countries and regions. For these countries and regions the presence of ambiguity may have led to low-technology-oriented development strategies where high-technology strategies would have been more appropriate. Is this inevitable, or are there ways of correcting this unfortunate situation?

The first sort of policy measures one would be looking for are measures that either remove the sources of ambiguity or insulate the development strategies from their effects. Therefore, the answers may depend on the source of the ambiguity.

In the case of the incalculable political risks in the Middle East, which seem to affect the development strategies of the countries in North Africa, a comprehensive peace agreement would tackle the problem at its root. This, however, is an issue of international politics, the solution of which lies outside the realm of economics. Given the cause of this ambiguity, there seems to be little in the way of devising (international) economic institutions that can remove its impact. Indeed, some may argue that low-technology-oriented development strategies in this region respond to the calculable risk of the conflict escalating, rather than mere ambiguity.

Something similar may apply to the incalculable political risks in Russia. Although some form of the rule of law has been re-introduced under the Putin presidencies, it is generally believed that the independence of legislative and judicial spheres from the executive has not yet been established. This is where the root of the incalculable political risks in Russia lies, and which makes it vulnerable to the political risks that are associated with individual persons and their supporters. The re-introduction of the rule of law has significantly reduced the incalculable political risk associated with the Yeltsin presidencies. Still, the removal of the remaining political risk is likely to be a long-term project for Russian politicians and governments. Integrating Russia in regional and (strengthened) international governance structures would be likely to help, but it is difficult to see how (international) economic institutions can be devised that reduce the impact of the current incalculable political risks.

This leaves us with the ambiguity that is caused by unpredictable reversals of international financial flows, which seems to affect the East Asian countries.

This incalculable risk is inherent in the process of globalization, but it can more easily be dealt with than the political risks discussed earlier. Our theoretical analysis suggests that it is a temporary shortage of financial resources that leads to crises like the East Asian crisis of 1997. It may be difficult to prevent a panic among investors – be it enhanced by speculators or not – but it is possible to develop national policies and international institutions that are capable of cushioning the impact of a sudden and temporary reversal of financial flows.

A tried and tested national policy to reduce the impact of a reversal of financial flows is the accumulation of large currency reserves, a policy that is currently being implemented by most East Asian countries. On the international level, there already exists an institution whose task it is to cushion the impact of sudden and temporary reversals of financial flows, viz. the International Monetary Fund. Unfortunately, the instruments it currently has at its disposal seem to be inadequate for the task. An appropriate reform of the IMF would do much to reduce the impact of the ambiguity caused by unpredictable reversals of international financial flows. It would potentially encourage some countries in East Asia and beyond to abandon their current low-technology-oriented development strategies for more promising high-technology strategies.

For sure, this kind of 'insurance' against the sudden reversal of financial flows would lead to higher volatility and to an increase in the number of economic (almost) crises involving emerging economies. But this would not be the despicable consequence of a moral hazard problem. Rather, it would bring the amount of economic crises closer to its optimal level by removing a source of ambiguity that leads to excessively cautious behaviour by international investors and policymakers.

Notes

1 Helpful comments and suggestions by Subrata Ghatak, Paul Levine and Joachim Stibora are gratefully acknowledged.

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3 Formally, consider beliefs over a finite state-space S that are described by a set-function $v: S \rightarrow [0,1]$, such that (i) $v(\emptyset) = 0$ and $v(S) = 1$ and (ii) for all A and B, subsets of S with A containing B, we have $v(A) \geq v(B)$. Such a set function v is called a *capacity*. Consider a real-valued function h that assigns each state $s \in S$ the value $h(s)$. Consider a permutation $t_1, \ldots, t_S$ of states of S such that $h(t_1) \geq \ldots \geq h(t_S)$. Now the *Choquet expected value* of the function h with respect to the capacity v is obtained by taking the Choquet Integral of h over v and reads: $CE\{h\} = v(t_1)h(t_1) + [v(\{t_1,t_2\}) - v(\{t_1\})]h(t_2) + [v(\{t_1,t_2,t_3\}) - v(\{t_1,t_2\})]h(t_3) + \ldots + [1 - v(S)]h(t_S)$.

4 In general, the multiple prior approach and the Choquet expected utility approach may lead to different outcomes, but for ambiguity-averse decision makers and specific shapes of the set of priors P – as considered in this chapter – the results of the approaches coincide. Because the Choquet expected utility approach is easier to

generalize, it is the preferred approach for deriving theoretical results. But as the multiple prior is more intuitive, it is the preferred approach for the purpose of exposition. A discussion of both approaches is provided in Spanjers 1999, Chapter 7. For an exposition of the intuition of the Choquet integral see Spanjers 1999, Section 7.2. A mathematical treatment of the Choquet integral as a 'horizontal' integral as compared to the 'vertical' Riemann integral is provided in König 1997.

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6 A macroeconomic policy approach to poverty reduction

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1 Introduction

Linking macroeconomic and financial sector policies to poverty reduction is a difficult and challenging task from the policy perspective. The evidence in the poverty literature is mixed with claims that economic growth path in developing countries has been pro-poor (see Dollar and Kraay 2002).[1] On the contrary there are studies reporting the role of redistributive policies aiding poverty reduction whenever poverty skyrocketed including in the aftermath of a crisis (see, for example, Alesina and Rodrik 1994; Dagdeviren *et al.* 2002). The policy issue is not whether growth is or is not good for the poor, but what policy measures can make it most effective for the poor. The macroeconomic impacts can be both direct and indirect. The direct impact works through prices, and public spending on the poor (supply of public goods directly targeting the poor; opportunities provided for the poor such as education), whereas the indirect impacts of macroeconomic policy on poverty work through its effect on growth. So the literature remains dominated by a paradigm of growth being necessary for poverty reduction but it may not be sufficient if the relevant development policies are not in place. Although economic growth can contribute to the reduction of poverty, the mechanisms by which an improvement in general economic performance promotes poverty reduction are by no means universally agreed (Agénor 2004). Macroeconomic policies such as contractions in public expenditure, revenue-raising measures, exchange rate realignments and more restrictive monetary policy are usually designed to create the conditions for stability with growth, but these policies can have negative consequences on poor households. So increased government spending (Squire 1993) or access to assets and opportunities (Birdsall and Londono 1997) has been emphasised to be the logical extension of the argument that growth does not ensure the elimination of poverty. Poverty results either due to permanent non-availability of two square meals a day because of lack of work and income, or due to shocks such as ill health or crop failure. These shocks can be temporary if the households have assets to sell or access to credit, otherwise these households can eventually be pushed below the poverty line.

Although there exist many studies on the measurement and definitions of poverty, there is still limited focus on policy measures on how best to reduce poverty.[2] So evaluating what kind of policies may reduce poverty and the channels of transmission is interesting. In general, macroeconomic policies primarily contribute to maintaining macroeconomic stability, which in turn helps economic growth and hence may contribute to poverty reduction. The objective of macroeconomic policies is to overcome permanent shocks and to weather temporary shocks. When it comes to economic development as a long-term goal, there is a need to identify macroeconomic policies that have distributional and allocational properties.

Fiscal policy constitutes one of the key distributional channels which can work to the benefit of the poor. As contractionary fiscal policies can affect the poor negatively, it is important to think in terms of a target level of development expenditure for the goal of poverty reduction. Similarly, monetary and financial sector policies can work in improving the allocation of resources in order to foster access of the poor to credit. Thus growth alone is not sufficient for poverty reduction – growth associated with progressive distributional changes will have a greater impact on poverty than growth that leaves distribution unchanged (Ames *et al.* 2001). Policies that improve the distribution of income and assets within a society, such as land tenure reform, pro-poor public expenditure, and measures to increase the poor's access to financial markets, should form essential elements of a country's poverty reduction strategy. This implies that poverty can be explained in terms of deficiency of assets, both human and non-human. Land reforms in developing countries are often aimed at improving the poor's access to land, which can contribute to poverty reduction (see Besley and Burgess 2000). In other words, giving property rights to the slum dwellers can help them to possess collateral and borrow and invest to improve their well-being.

Because macroeconomic policies, i.e. public expenditure and development financing policies, can affect people differently as individuals face different incentives and constraints at the micro level (see Galor and Zeira 1993), we put together a two-sector model, namely agriculture and non-agriculture, to examine possible linkages between the rural and urban economy. In recent years, the contribution of agriculture to the economy has started declining rapidly in many low-income countries, where a big part of the population (600 million out of over one billion people in India) rely on agriculture for their livelihood. As the size of the agricultural sector declines in the process of development, relative wages may not increase given the excess supply of labour. At the core of growth and poverty reduction, job creation is the key channel, but jobs are not created automatically or instantaneously, and demand for labour does not increase in line with the supply of labour (see Stiglitz 2004). To improve the livelihood of people engaged in low-growth sectors such as agriculture, there is either a need to modernise agriculture via higher infrastructural investment in the sector (which is declining as well) or industrialise the rural economy[3] to create jobs that can in turn improve the income of the poor. In this context, it is worth comparing China and India; while China has been investing heavily in fixed physical capital, namely in infrastructural development, India has been concentrating only on policy reforms without creating a strong infrastructure base that can help sustain the current pace of growth. The next issue that arises is whether there is a market (or demand) for the goods produced in the rural sector. Without access to markets, the rural economy cannot be integrated with wider markets, thus keeping this sector at a low-level equilibrium. This is where a need for government intervention is required to create institutions and markets to coordinate a linkage between the bigger markets in the urban areas with the goods produced in the rural sector.

In the context of India, Gupta (2000) finds weak links between economic growth and poverty alleviation, taking into account some socio-economic and demographic variables, and concludes that no macro policy of market-led growth will be successful in dealing with the problem of either poverty or employment. This finding is based on the argument that appropriate social, demographic and economic policies will have to be developed to upgrade the skills of the poorer sections of the population to a reasonable level to enable them to enter the mainstream market activities.

Given the mixed unsettled pieces of evidence, we examine the relationship between poverty rate and macroeconomic performance and policies using annual time series data from India over the last five decades on several macroeconomic sectoral and policy variables. We use the rural poverty rate, as there is a higher concentration of poverty in rural India where there is higher dependence on the agricultural sector. We find that rural poverty has declined with a rise in aggregate per capita real income and the sectoral distribution of such aggregate output. Once we combine this basic model with policy variables, the impact of such aggregate variables is no longer important with the ratio of sectoral outputs being insignificant and the relative prices of agriculture being significant in influencing poverty. In addition, both types of fiscal spending, namely government current (consumption) and capital spending, have a poverty-reducing effect. While government consumption can reduce poverty via the demand-side effect, government capital spending can have a supply-side effect on poverty reduction. A similar poverty-reducing effect is found with higher credit supply to the agricultural sector. To sum up, poverty reduction via distributional and allocational channels can be more permanent when an economy experiences a decline in its traditional sector leading to higher relative prices.

The organisation of the chapter is as follows: Section 2 analyses the debate on poverty and change in the macro economy. Section 3 provides the empirical analysis of poverty where the rate of poverty is presumed to depend upon GDP ratio, terms of trade, and changes in development spending and financing. In the Indian context, the implications of sectoral growth and different macroeconomic policies on poverty are discussed. Section 4 concludes the chapter.

2 A sectoral model with pro-poor macroeconomic policy

The success of economic growth in reducing poverty cannot be taken for granted as it depends on a number of factors, in particular the sectoral composition of growth, sectoral terms of trade, development spending and development financing policies. These are the key factors that can contribute to improving the standard of living of the poor. Although growth is undoubtedly necessary for poverty reduction, it may not be sufficient if other policies are not in place. Thus, the policy issue is not whether growth is good for the poor, but what policies can make it better for them, although the mechanisms underlying these processes remain a subject of debate.[4] Several studies, for example Dollar and Kraay (2002), argue that structural reforms have favoured the poor, but this is disputed by Agénor (2004), and by Alesina and Rodrik (1994), who found that redistribution contributed more directly to poverty reduction. As a correlation between two variables says nothing about the direction of causation, there is the possibility that some other intervening factors may be driving the association between poverty and growth, namely macroeconomic policies over time to address negative consequences of growth following stabilisation and structural reforms. Changes in agricultural terms of trade (the ratio of agricultural to non-agricultural prices) have ramifications for the intersectoral transfer of resources, rural welfare, rural–urban migration, and farmers' resource allocation decisions.

As rural poverty is usually deeper than urban poverty and poor people are often landless or have very little land, the question is to examine whether the prospects for the people depending on agricultural income have improved in terms of their standard of living. Besides considering the aggregate per capita income as an indicator of standard of living, it is also important to examine the sectoral distribution of total income. Dasgupta (1997, 1998) examines the possible poverty traps in poor countries, where certain identifiable groups of people in an economy can get caught even when the economy in the aggregate experiences economic growth. This is where there is a need to look at the distribution of growth with a sectoral composition when there is a shift towards non-agriculture. Also, as the informal sector appears to be decoupled from the rest of the economy (Patel and Srivastava 1996), it is important to look at the ratio of the sectoral GDPs to uncover the effect on people engaged in the informal sector.

A basic idea underlying policy packages of international monetary and development institutions has been that the fruits of economic growth trickle down to the bottom levels of the society and reduce poverty and inequality. Hence there is a danger of this 'trickle-down' view (see Deaton 2006), as the growth at the bottom levels of income distribution may not be as rapid as the overall growth. There is little research on any direct connections between macroeconomic and financial policies and poverty reduction. In recent years, there has been a significant amount of technical research either looking at how to measure poverty or emphasise micro rather than macro issues. For example, it is important to eliminate child labour, so that such children go to school and accumulate human capital, which in turn can help improve the standard of living of the members of their household. Before that happens, it is equally important to improve the standard of living of the household by providing work opportunities for the adult members of the household, who can then decide the future of their children by allowing them to go to school. This issue of opportunity to work can be addressed by macroeconomic policies and hence poverty reduction can be dealt with at the macro level. In this context, the current trend of globalisation may open the door for some new opportunities, but it remains a macro issue.

No growth is even worse. So what we need is economic growth with redistribution that can in part be addressed via government spending and development financing policies. To the extent the poverty impact of financial development policy has been considered, it has been assumed that the contribution of financial development to poverty reduction will occur indirectly, through the 'trickle-down' effect of economic growth. Jalilian and Kirkpatrick (2002) find evidence of a connection but do not identify the channels through which financial development reduces poverty, other than indirectly through economic growth. Burgess and Pande (2005) show that the geographical spread of banks had a significant impact on rural poverty in India, primarily in areas where banks were required to establish new branches. Using aggregate time-series data, they argue that the bank nationalisation programme brought about by rural branch expansion in India significantly reduced rural poverty. With regard to the bank (loan) market, there is a need to distinguish sectoral allocation of credit, namely priority sector lending, from aggregate credit (as a percentage of GDP) as normally used in this literature.

Further, as credit rationing is present in most developing economies including India, a country's monetary policy can be used to expand the supply of credit to the private sector. Such expansionary monetary policy can be seen as a way of reducing the extent of credit rationing, for example the use of priority sector lending to inject credit in India. Espinosa-Vega *et al.* (2002) show that such a government-led credit policy increases long-run production if and only if the economy is in a development trap. As the poor remain delinked from the formal credit market, higher incomes for the poorest quintile cannot be guaranteed, even with prudent monetary policy. In recent years, the financial needs of the poor, once left to the informal system, are partly taken care of in the micro-credit market which is growing in size. One could argue that by locking the poor into the micro-credit system, they are being excluded from the mainstream macro-financial system. So delivering financial services to the poor is important in order to reduce poverty. In other words, should there be a distributive role of monetary policy or is rural financial market development the key to greater financial deepening? In this context, extending agricultural credit promises to be an effective method for channeling much-needed production credit to small farmers (see Mallick 1993). Such credit can act as a crucial input in the production process if it gets channelled by the banking sector for productive economic activities in the rural sector. Stiglitz and Greenwald (2003) suggest a new paradigm for the conduct of monetary policy focusing on the role of credit in facilitating economic activity, as opposed to a monetary theory based on transactions-demand-for-money. Bennett and Dixon (2001), within a three-sector general equilibrium model, showed that policies that boost industrial exports tend to reduce welfare in the agricultural sector, where poverty is concentrated.

This chapter therefore analyses the problem of poverty primarily from a macro-economic perspective, tracing the poor people's economic status to their low share in the low growth sector, i.e. rural economic growth with agriculture as the main source of GDP is more important to poverty reduction than urban economic growth with the non-agricultural sources of GDP. Thus in order to capture poverty in a macro model, there is a need to identify the poor in relation to the output of the rural sector, where most poor people are engaged. It is in this context that macroeconomic policy and performance can play a role in contributing to poverty reduction. Let us classify the economic activities in terms of skill levels required by the labour employed in production. Let y_A and y_N denote the outputs produced in the unskilled (agricultural) and skilled (non-agricultural) sectors respectively. It is common knowledge that the agricultural sector employing unskilled people distributes less income to the workers than the non-agricultural or skilled sector. Unskilled workers are endowed with labour only, and no human and financial capital. First we characterise the macroeconomic setting by assuming that there are two production sectors as in dual economy models (see Temple 2005): agricultural goods (y_A) and non-agricultural goods (y_N). Non-agricultural goods include industrial products and services. The aggregate output can be written as follows:

$$y = \theta y_A + (1 - \theta) y_N$$

By considering y_N as a numeraire, we write the above equation as follows:

$$\frac{y}{y_N} = (1 - \theta) + \theta \frac{y_A}{y_N} \tag{1}$$

where the subscripts A and N denote agricultural sector with uneducated (poor) labour and non-agricultural sector with mainly educated labour respectively.

With policy reforms being directed towards the development of non-agricultural sectors, the share of the agricultural goods producing sector in the economy is declining. In other words, there is some degree of substitution between the two sectors. Thus sectoral imbalances can worsen poverty through inflation, or in other words, economic contractions or downturns can raise unemployment and thus poverty. So besides the changing sectoral income distribution of aggregate GDP, we intend to consider the effect of sectoral prices to reflect the purchasing power of people engaged in the agricultural sector and assess its impact on poverty.

P is the cost-of-living index associated with the Cobb-Douglas function in goods:

$$P = aP_A + (1 - a)\,P_N \tag{2}$$

where P_A and P_N are the respective money prices of agricultural and non-agricultural goods. By normalizing against non-agricultural goods prices, the above equation can be written as:

$$\frac{P}{P_N} = (1 - a) + a\left(\frac{P_A}{P_N}\right) \tag{3}$$

The prices of the agricultural goods in relation to non-agricultural goods can capture the change in relative prices against the non-agricultural sectors or in favour of the agricultural sectors. The poor workers are concentrated more in agricultural sectors and concentrated among the less educated. Thus any change in relative prices can have important redistributive effects. The positive correlation with poverty cannot be considered as a distributional effect, as higher agricultural prices can have the potential to reduce the real agricultural income, unless there has been an increase in agricultural output on the back of higher food prices (see Ravallion 2000). To control for this effect, we take account of the sectoral. GDP ratio in this chapter. Also there is an interdependence between the agricultural and non-agricultural sectors, which can be captured via the relative prices whether the intersectoral terms of trade are favourable for the agricultural sector. So the poverty relation can be written as a function of the two ratios derived above:

$$H = f\left(\frac{\overset{-}{y}}{y_N}, \frac{\overset{+}{P}}{P_N}\right). \tag{4}$$

Substituting (2) and (3) in (4), the poverty equation can be written as follows:

$$H = (1 - \theta) + \theta\left(\frac{y_A}{y_N}\right) + (1 - a) + a\left(\frac{P_A}{P_N}\right) \quad 0 < a, \theta < 1 \tag{5}$$

As is common with a Cobb-Douglas production technology, there is a need to consider the effect of capital in equation (5). Also Aghion and Bolton (1997) formalise a mechanism through which increased wealth accumulation by the rich can have a trickle-down effect on the poor in the sense that as more capital is accumulated in the economy, more funds may be available to the poor for investment purposes. They illustrate that the process of capital accumulation initially has the effect of widening inequalities but in later stages it reduces them, generating a Kuznets curve. So it is the capital accumulation of the rich, which can lower the interest rate on loans, thus allowing the poor to take on high-yielding ventures (also see Blackburn and Bose 2003). In what follows we introduce a standard capital stock equation in which investment (I) can raise capital accumulation:

$$K = (1 - \rho)\, K_0 + I \tag{6}$$

where ρ is the rate of depreciation of capital stock and K_0 is the initial capital stock. As in Mallick (2001), total real investment is decomposed into real private investment (I_p) and real public investment (I_g):

$$I = I_p + I_g \tag{7}$$

Investment in agriculture takes place by both public and private sectors. Private investment in agriculture is predominantly in groundwater development, land improvement, machinery and equipment (including tractors & pump sets), and livestock. Public investment is concentrated in irrigation infrastructure, public services (research and extension), conservation and commodity development programmes. As there has been a deceleration in agricultural investment during the 1980s (see Mallick 1993) and also in the 1990s, the impact of such investment and growth in agriculture on a reduction in rural poverty needs to be examined. Agricultural growth and public capital formation may have been the important contributing factors for poverty reduction in rural India in recent decades.[5] There has been a general consensus in the literature that the split between public and private components of investment can exert a differential impact on economic growth (see, for example, Khan and Kumar 1997). Storm (1994) found that, in achieving growth, public investment in irrigation is more effective than fertiliser subsidisation and procurement pricing. Even in the nineties, investment in the agricultural sector received inadequate attention in the macroeconomic policy formulation. As there is a need to free up funds for badly needed investment in infrastructure and social development by the government, it is important to curtail government's huge consumption expenditure[6] that in turn can help finance public capital spending.

The private investment function can be assumed to depend on exogenous public investment in agriculture and allied sectors that can have a growth-enhancing or poverty-reducing effect, including other policy variables.

$$I_p = \omega_0 + \omega_1 I_g + \omega_2 CD_{ps} + \omega_3 DE_g \tag{8}$$

where ω_0, ω_1, ω_2 and ω_3 are the parameters, CD is the credit supply to the so-called priority sector including agriculture, and DE is the current development expenditure that can stimulate private investment. Budgets that include more expenditures directed at helping the poor are more pro-poor than other types of fiscal policies. Fan *et al.* (2000) estimated the effects of different types of government expenditure on rural poverty and productivity growth in India over the period 1970 to 1993 and found that greater infrastructural spending has higher potential to reduce rural poverty. Capital spending of government augments real public capital formation, whereas government consumption can have a direct impact on private consumption behaviour, which in turn can foster investment activity in the private sector. Also government current development expenditure is included as another control variable. Finally we also take account of financing of the agricultural sector by the banking sector and its possible effect on improving standards of living.

By adding capital in equation (5) and substituting equations (6) to (8), the reduced form poverty equation can be written as follows:

$$H = \phi + \theta \left(\frac{y_A}{y_N}\right) + \alpha \left(\frac{P_A}{P_N}\right) + (1 - \rho)\, K_0 + (1 + \omega_1)\, I_g + \omega_2 CD_{ps} + \omega_3 DE_g \qquad (9)$$

where $\phi = \omega_0 + (1 - \theta) + (1 - \alpha)$.

We have two different price indices for two groups of labour (uneducated largely involved in the agricultural goods sector and educated mainly in the non-agricultural goods sector), as their consumption bundles are different. People who are poor mainly demand essential commodities to survive, although the saturation level of such consumption will vary between the two groups of workers.

As we consider both sectoral relative price and sectoral relative income effect, we are effectively capturing both supply-side and demand-side effects respectively in a macroeconomic sense. Besides, we now consider two key policy variables from fiscal and monetary sides – the key policy instruments to address poverty. Mallick (2006) provides evidence on the role of credit as a factor of production and its role in affecting the supply side of a developing economy, suggesting that a restrictive credit policy can have greater adverse effects on output growth and less effect on price inflation. The credit channel can also take account of the gradual process of financial reforms with regard to the bank (loan) market in India. We emphasise the sectoral allocation of credit, by considering lending to the priority sectors, in particular the agricultural sector, instead of aggregate credit (as a percentage of GDP) as normally used in this literature. In India, the objectives of monetary policy have been not only to maintain price stability, but also to ensure provision of adequate credit for productive purposes. India's sectoral focus in credit flow is emphasised in its so-called 'priority sector' lending, which is now restricted to highly employment-intensive sectors such as agriculture, small industry, educational loans for students and low-cost housing. Cost of credit is less important in the context of a rural economy. Thus the focus is on the availability of rural credit rather than cost per se. Scheduled commercial banks (SCBs) constitute the predominant segment of the credit market in India.

The idea is to develop channels through which the model can be estimated with alternative policy variables. We will be using data from India to test the hypotheses formulated in this section. Despite the economic reforms that have removed many policy impediments, the pattern of development has not changed, with a leading service sector and a skill-intensive rather than labour-intensive manufacturing sector (see Kochhar *et al.* 2006). The sectoral importance of the agriculture and allied sectors, which provide the majority of the population's livelihood, was largely left untouched by reform measures (see Kalirajan and Sankar 2001). During different Five-Year Plans in India, the poverty alleviation agenda went through different phases, namely first, land distribution and food security through the Green Revolution (1950s, 60s), second, income and employment generation (1970s, 80s), and the last phase (1990s) of market-led growth and structural adjustment with a focus on basic needs. This chapter attempts to analyse the effect of different policies alongside the poverty-reducing impact of sectoral GDP distribution via considering the ratio of the agricultural and non-agricultural GDP in order to assess its relative impact on poverty in the rural sector.

3 The data, empirical strategy and results

The definition of poverty and its measurement has been the source of intense debate in the literature (see Zheng 1997; Banerjee and Duflo 2007). The most important tool for monitoring poverty has been the Household Consumer Expenditure Surveys conducted by the National Sample Survey (NSS) organisation. Among the various methods used to measure poverty with this NSS data, the head count index (HCI) has been commonly used as the standard indicator of the extent of income poverty. We employ this index as a proxy for poverty in order to examine the effect of pro-poor policies that directly influence poverty after accounting for the effect of sectoral distribution of growth and terms of trade. Data sources and definitions of variables used in this chapter are discussed in detail in the appendix. Estimation is carried out on the basis of a sample of 54 annual observations pertaining to the period 1950 to 2004.

The magnitude of rural poverty is larger compared to urban poverty in India (see Table 6.1). As in most developing countries, the incidence of poverty in India has historically been higher in rural areas than urban areas (Datt and Ravallion 2002). Since poverty measures have responded more to rural economic growth than to urban economic growth (Ravallion and Datt 2002), we focus on how rural poverty has been influenced by sectoral GDP ratio and relative prices, with other conditioning variables. One can assess the impact of these two macroeconomic policies after having controlled for the impact

Table 6.1 Official poverty in India (proportion of population below poverty line)

	1951–52	*1961–62*	*1973–74*	*1977–78*	*1983*	*1987–88*	*1993–94*	*1999–00*	*2004–05*
Rural India	47.4	47.2	55.7	53.1	45.7	39.1	37.3	27.1	28.3
Urban India	35.5	43.6	48.0	45.2	46.8	38.2	32.4	23.6	25.7
National	45.3	46.5	54.1	51.3	44.5	38.9	36.0	26.1	27.5

Sources: World Bank Poverty Database; and NSSO, Government of India on GDP distribution into GDP_A and GDP_N, as the urban-biased strategy of development seems to have contributed to higher non-agricultural growth. Hence it is important to consider the GDP ratio and relative price ratio to examine the intensification of rural poverty.

Given time-series data on GDP in agriculture, GDP in non-agriculture, and policy variables, the following relation is estimated:

$$POV_t = \alpha + \beta \left(\frac{GDP_A}{GDP_N}\right)_t + \gamma \left(\frac{P_A}{P_N}\right)_t + \delta ACOR_t + \lambda PK_A + \mu GE_D + \omega CD_A + u_t \tag{10}$$

where POV is rural poverty, GE is the government current development expenditure. We also include total government size reflected in government total consumption expenditure and government capital expenditure (all expressed in real terms). Average capital–output ratio (ACOR) in agriculture is used as a proxy for initial capital. Also we control for the impact of irrigation on agricultural performance and thus poverty reduction via using a proxy on gross irrigated area (GIA). The higher the irrigated area, the less reliant farmers will be on rainfall and thus higher agricultural production in poor areas and poverty alleviation. The importance of irrigation in Indian agriculture has been emphasized in Mallick (1993). The higher the investment in new irrigation facility, the higher will be the return from agriculture, even if one discounts for increases in capital and production costs. So GIA can be a proxy in the place of government capital expenditure.

To verify whether the included variables yield valid long-run equilibrium relations, we would subject the equation to univariate cointegration analysis and test whether this yields economically plausible parameters. The cointegration approach of Phillips and Hansen (1990) and Hansen (1992) is used to obtain consistent estimates of the parameters, employing the fully-modified OLS (FM-OLS) procedure. The Phillips-Hansen FM-OLS procedure is chosen over the much well-known Johansen-Juselius cointegration technique, because the FM-OLS cointegration procedure corrects for endogeneity and contemporaneous correlation. Further, from a theoretical point of view as discussed in the previous section, the implied economic structural relationship for the determinants of poverty requires the use of a single-equation cointegration procedure. We also test for parameter stability as outlined in Hansen (1992), following the procedure implemented by Carstensen (2006).

An informal examination of the data through plotting the series may be useful to give a preliminary idea of the time series properties of the variables. The graphs of the series in levels (see Figure 6.1) confirm that non-stationarity is apparent in all the series. The starting point is to test for integration properties of the individual series using the Augmented Dickey-Fuller (ADF) tests. These tests allow us to test formally the null hypothesis that a series is I(1) against the alternative that it is I(O). In order to determine

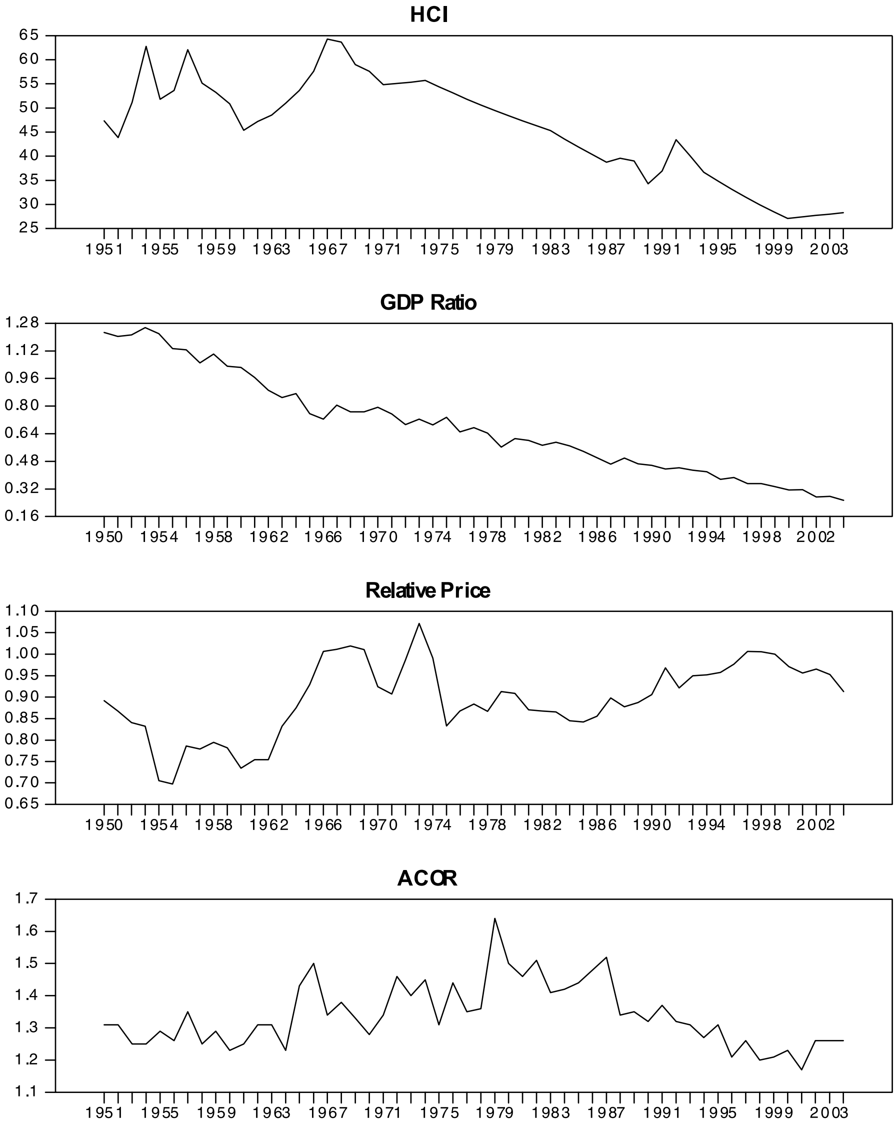

Figure 6.1a Time series plots of variables.

the order of integration, we must apply the test to the levels of the variables. These results, which are reported in Table 6.2, clearly show that the null hypothesis of a unit root cannot be uniformly rejected. We therefore conclude that the variables under consideration are well characterised as non-stationary or integrated of order I(1). Based on the unit root tests for all the variables, the existence of long-run cointegrating equilibria can be tested in the next stage.

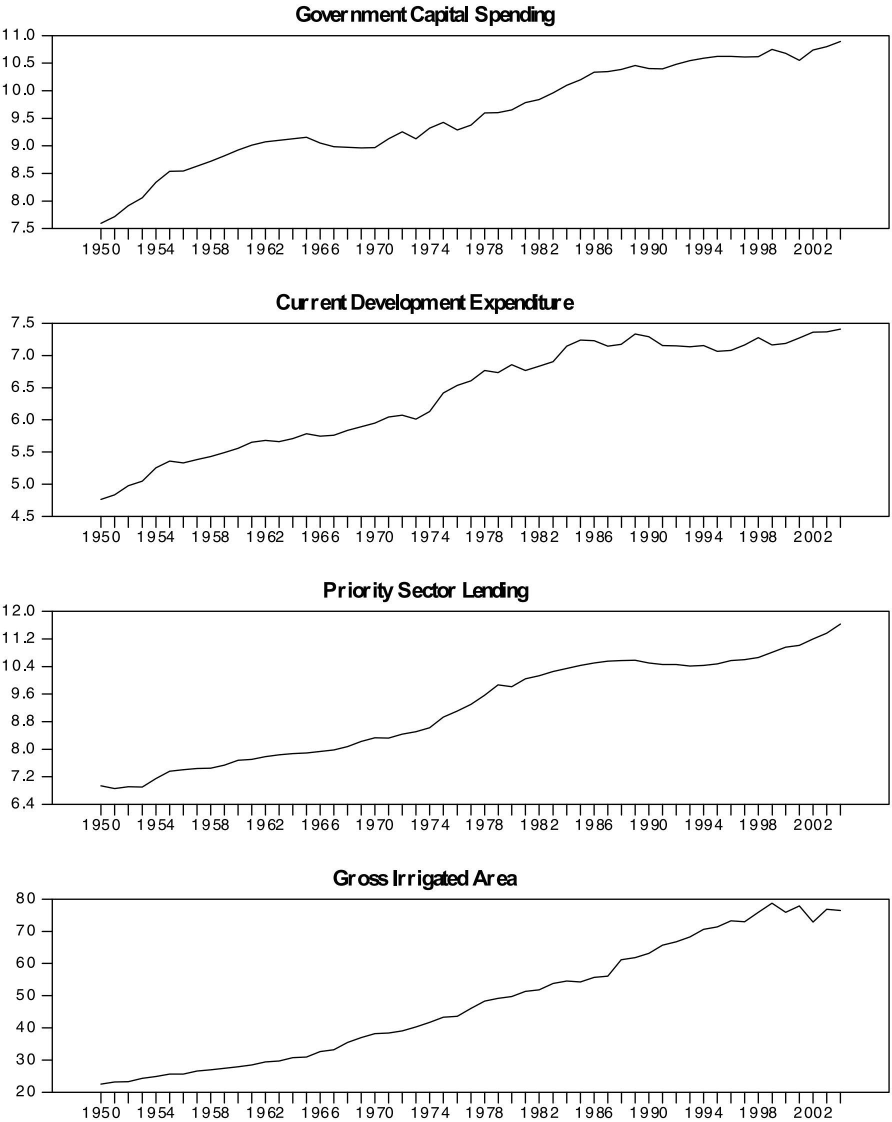

Figure 6.1b Continued.

When the series are I(1) and some of the regressors are endogenous, the OLS estimator is asymptotically second order biased (estimation in finite samples is biased and hypothesis testing over-rejects the null). This is why instrumental variable (IV) methods can be used. However, IV approaches, although better than OLS in term of efficiency, do not provide asymptotically efficient estimators. The FM-OLS method of Phillips-Hansen has

Table 6.2 Unit root test for the model variables

Variable	*ADF test statistic*	*Integration order*	*Variable*	*ADF test statistic*	*Integration order*
LPOV	–0.2809	I(1)	LDEVEX	–2.0712	I(1)
GDPR	–1.1608	I(1)	LBANKCD	–0.1095	I(1)
PRICE	–2.0216	I(1)	LPUBCAP	–2.6750	I(1)
ACOR	–3.3230	I(0)	LPCGNP	2.2436	I(1)
LGCEX	–0.8922	I(1)	GIA	0.1395	I(1)
LGCAPEX	–2.2841	I(1)			

Note: The ADF test results presented above indicate that all the variables are integrated of order one, I (1). Critical values: 1%= –3.555 5%= –2.916 10%= –2.595.

been specifically developed to deal with the presence of endogeneity in the regressors. The Phillips-Hansen estimator is asymptotically efficient (i.e. the best for estimation and inference) and does not require the use of instruments. The semi-parametric corrections used in the FM estimator (these are transformations involving the long-run variance and covariance of the residuals) deal with endogeneity of the regressors and potential serial correlation in the residuals. In other words, the Phillips-Hansen method is the best method to use in estimating a single cointegrating relation. Estimation has been carried out using RATS econometric software.

Given different orders of integration, we employ the fully-modified Phillips-Hansen method of estimation to obtain the cointegrating relations by transforming the data using the estimate of the long-run variance, and using OLS to derive the long-run estimates. Table 6.3 presents parameter estimates of the long-run cointegrating regressions. The residuals from these regressions are interpreted as disequilibrium terms measuring the discrepancies between actual values of the variables and their long-run equilibrium values. Such residuals are tested for stationarity or cointegration by employing ADF tests, which are reported in Table 6.3. These test statistics allow us to reject the null hypothesis of no cointegration at 1 per cent levels. These results suggest that the variables under study form a valid cointegrating system. In other words, the FM-OLS cointegration estimates suggest that the final equation (Model 5) is a well-specified long-run model and no other variables are required to capture its long-run stochastic trend. Overall, the coefficient estimates are of correct sign and of plausible magnitude and the tests confirm strongly that the variables are cointegrated (see Figure 6.2). We also carry out tests for stability and homoscedasticity by using recursive least squares, which broadly confirm that the final estimated equation (Model 5 in Table 6.3) do not show any sign of structural breaks (see Figure 6.3). For Model 5, we adopt recursive technique as a misspecification test for the detection of non-constancy of the coefficients (see Figure 6.4). Because recursive least squares cannot detect the exact breakpoint, we undertake the Gregory-Hansen cointegration test, allowing for full structural break (a shift in intercept and slope coefficient),

Table 6.3 Estimates of the equations

Model	*Philips-Hansen fully-modified cointegration*	
1	$LPOV_t = \underset{(1.035)^{**}}{12.92} - \underset{(0.132)^{**}}{0.345}\ YR_t + \underset{(0.194)^{**}}{0.552}\ PR_t - \underset{(0.097)^{**}}{1.017}\ LPY_t$	SEE = 0.089 ADF = –5.17
2	$LPOV_t = \underset{(2.305)^{**}}{14.66} - \underset{(0.241)^{*}}{0.514}\ YR_t + \underset{(0.198)^{*}}{0.477}\ PR_t - \underset{(0.193)^{**}}{1.154}\ LPY_t - \underset{(0.256)}{0.219}\ ACOR_t$	SEE = 0.089 ADF = –4.72
3	$LPOV_t = \underset{(1.959)^{**}}{9.46} - \underset{(0.355)^{*}}{0.857}\ YR_t + \underset{(0.237)}{0.264}\ PR_t - \underset{(0.238)^{*}}{0.455}\ LGC_t$ $+ \underset{(0.186)^{*}}{0.446}\ LDE_t - \underset{(0.094)^{**}}{0.236}\ LBCA_t - \underset{(0.289)^{*}}{0.425}\ LPY_t$	SEE = 0.089 ADF = –5.02
4	$LPOV_t = \underset{(1.899)^{*}}{4.46} - \underset{(0.470)}{0.369}\ YR_t + \underset{(0.316)}{0.598}\ PR_t - \underset{(0.161)^{**}}{0.521}\ LGC_t$ $- \underset{(0.102)}{0.123}\ LGK_t + \underset{(0.140)^{**}}{0.535}\ LDE_t - \underset{(0.081)^{**}}{0.275}\ LBCA_t + \underset{(0.084)}{0.157}\ LPK_t$	SEE = 0.086 ADF = –5.43
5	$LPOV_t = \underset{(2.03)}{2.11} - \underset{(0.452)}{0.09}\ YR_t + \underset{(0.299)^{**}}{0.858}\ PR_t - \underset{(0.005)^{**}}{0.012}\ GIA_t$ $- \underset{(0.151)^{**}}{0.372}\ LGC_t + \underset{(0.127)^{**}}{0.545}\ LDE_t - \underset{(0.077)^{**}}{0.230}\ LBCA_t + \underset{(0.072)}{0.070}\ LPK_t$	SEE = 0.087 ADF = –5.43

Notes: t-statistics in parentheses. * and ** indicate statistical significance at the 5 and 1 percent levels, respectively. SEE is the standard error of estimate. ADF is the augmented Dickey-Fuller test for stationarity; L: Logarithm. The residuals of the five estimated equations have been tested to be stationary. ADF test critical values are: 1% = –3.560 5% = –2.918 10% = –2.596. LPOV – log of HCI, YR – GDP ratio, PR – Price ratio, LPY – log of per capita income, ACOR – Average capital output ratio in agriculture, LGC – log of government current (consumption) expenditure, LGK – log of government capital expenditure, LDE – log of government current (development) expenditure, LPK – log of public capital formation in agriculture (from national accounts), LBCA – log of bank credit to agriculture.

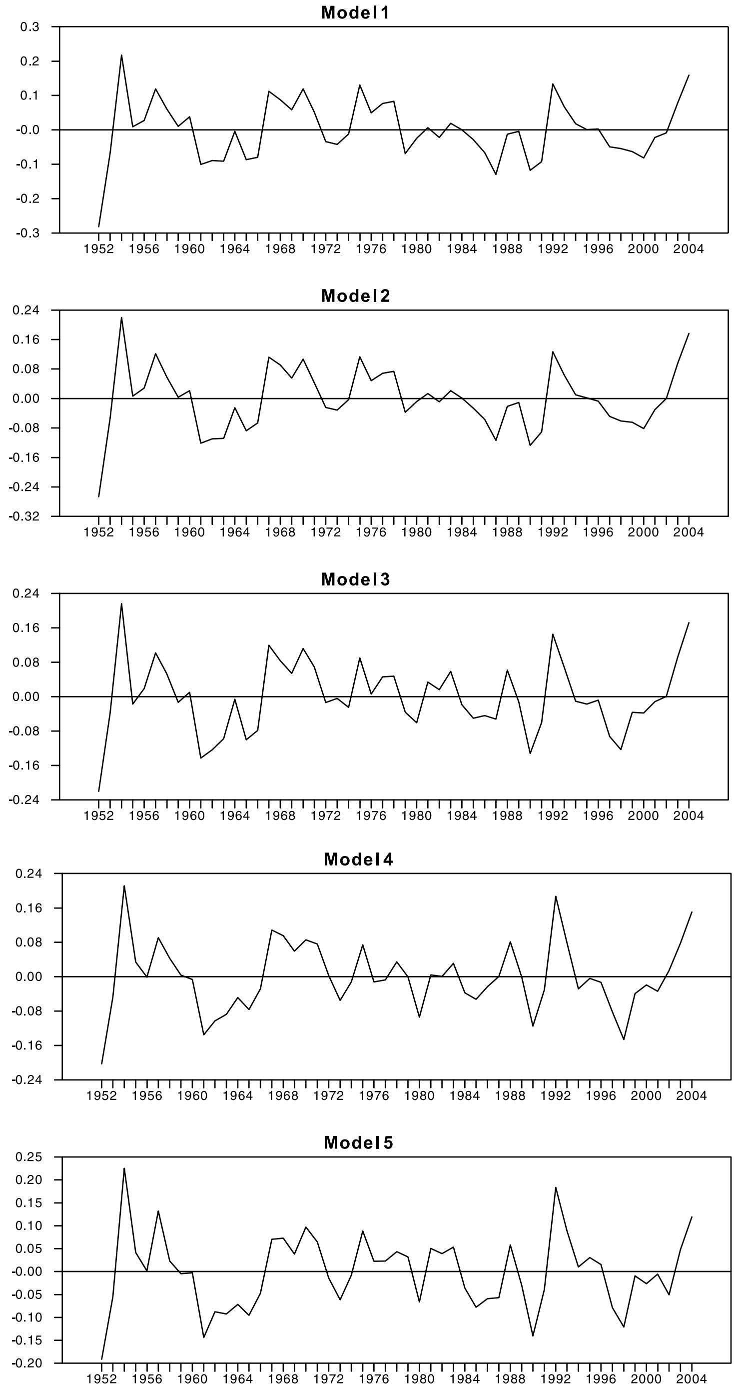

Figure 6.2 Stationarity of cointegration errors.

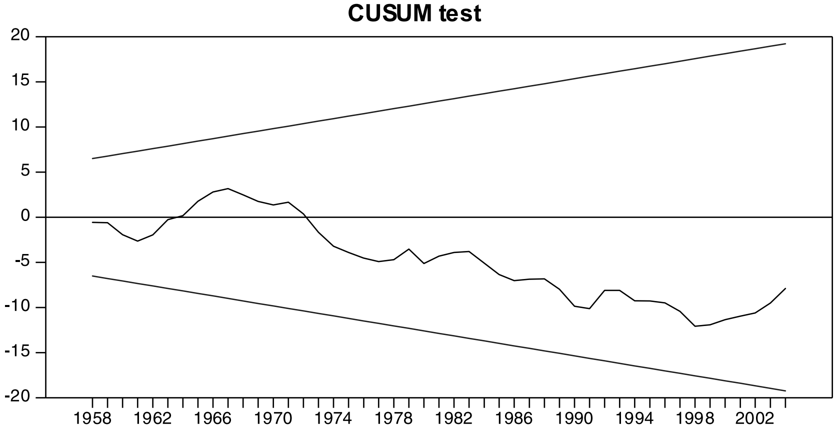

Figure 6.3 Structural break test from recursive least squares.

which also suggests a cointegrated relationship with a break in 1989 (see Figure 6.5). This is the time when India ran into an external payments crisis, giving rise to a shift in economic policy in 1991, mainly contractionary, that led to a rise in poverty. Since then, there has been a steady decline in poverty as reflected in official statistics, although the number of people living below the poverty line still remains around 300 million.

The sectoral GDP ratio and per capita income having significant negative impact on poverty in Models 1 to 3 in Table 6.3 suggests that growth is good for the poor. If agricultural income rises, rural poverty will decline. As we know that the agricultural sector has been decelerating, this will be reflected in a rise in rural poverty. But once we include the policy variables (as in Models 4 and 5 in Table 6.3), the sectoral growth pattern has a neutral impact on poverty on average over the entire sample period, with both per capita income and GDP ratio becoming insignificant, whereas the policy variables have a pro-poor effect. We have carried out a number of robustness checks in support of Model 5 as the best model as discussed earlier. Intuitively, a reduced share of agriculture in the economy can partly explain why the agricultural sector is unable to play an important role in poverty alleviation. So we have looked at the impact of different components of monetary and fiscal policy instruments to uncover the pro-poor policy effect on poverty reduction.

Besides, much empirical evidence suggests that inflation hurts the poor, as is obvious from the coefficient associated with relative price. As agricultural prices increase more relative to non-agricultural prices, poverty tends to be higher. If one takes account of price volatility, it will still have an adverse impact on the people below the poverty line. As poverty is a long-term issue, we only need to derive the long-term relations between poverty and policy variables. Policy decisions cannot be based on short-term movements in welfare indicators (Datt and Ravallion 1997). So there is no economic

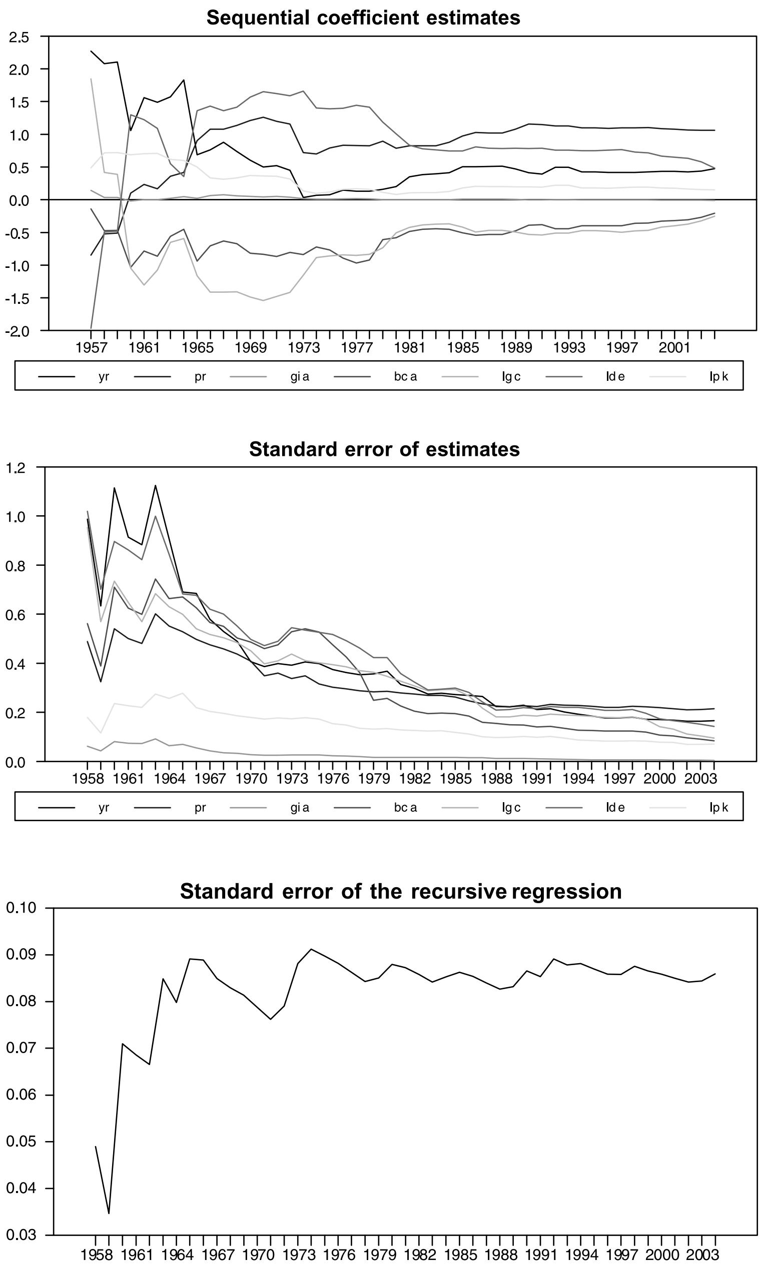

Figure 6.4 Recursive estimates and standard errors of regressors in model 5.

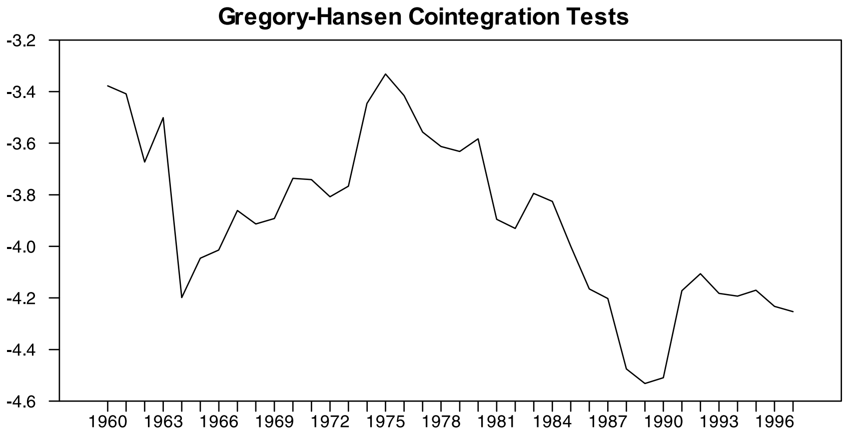

Figure 6.5 Gregory-Hansen cointegration tests.

rationale behind deriving short-run dynamics underlying the long-run poverty relation.

Higher fiscal spending and credit allocation to the rural sector seem to have a direct trickle-down effect on poverty, via higher economic activity and employment. This suggests that the favourable effect of macroeconomic policies on poverty is partly in line with the endogenous growth literature that macroeconomic policies can affect growth and thus poverty in the long run. The per capita GDP and the sectoral ratio in Models 1 to 3 (in the absence of policy variables) with negative effects might capture the effect of trade openness in reducing poverty in India. Trade reforms can help reduce poverty via higher real wages and employment – the so-called static effect, with the dynamic argument that trade promotes growth, and growth in turn reduces poverty (see Bhagwati and Srinivasan 2002). As the vast majority of the poor live in the rural areas where there is excess supply of labour, the static effect does not seem to have occurred, although it is hard to reject the dynamic argument of a possible knock-on effect via growth. We find that the pattern of growth does seem important in the long run. As the sectoral GDP ratio in the final model (Model 5) is not significant, with a continued decline in the GDP ratio, relative prices appear to be moving upwards, leading to a rise in poverty (with a positive coefficient) that can only be addressed via different sets of policies. So in order to make the growth pattern pro-poor, the distributional and allocational channel of macroeconomic policy should be strengthened so as to contribute more in reducing poverty.

4 Concluding remarks

This chapter expands the literature on poverty from a macroeconomic perspective with a sectoral composition of GDP that allows us to disentangle the mechanisms by which agricultural growth with distributional and allocational mechanisms can be poverty-reducing. Designing macroeconomic and financial policies for poverty reduction is a challenging task. We find that development policies in India play a much bigger role in reducing poverty, after having controlled for the sectoral income and terms of trade effects. Although we have used the traditional notion of poverty in this chapter, there is room for replacing the subjective official poverty line with an objective measure in terms of consumption deprivation as suggested in Kumar *et al.* (2009), which can be linked to the key macroeconomic policy variables. Finally, a strategy of investment in infrastructure and in human development can aid private investment and growth, along with improving access to formal credit markets or strengthening the currently emerging link between formal banks and informal microfinance institutions in rural areas to encourage or 'crowd in' private investment, growth and poverty reduction.

As urban poverty is a spillover of rural poverty and about 65 per cent of the labour force is still working in the agricultural sector, Kalirajan (2004) argues that policies directly targeting the agricultural sector, namely promoting investment and technological progress along with efficient use of technology in agriculture, are central to reducing rural poverty. Therefore, the emphasis on pro-poor policies towards generating economic activity in the rural areas will reduce poverty more rapidly than simply relying on the trickle-down effect. Rather than relying on the current trend of service sector expansion, India needs to focus on a greater degree of industrial production than China, in order to create more employment that can help reduce poverty as China has accomplished in reducing its level of poverty. Also social capital formation can help in accumulating human capital, which can contribute to pro-poor growth and thus poverty reduction. Different connections/channels in this context are worth exploring for future research.

Notes

* Thanks are due to Huw Edwards for comments, and N.R. Bhanumurthy, Ramesh Golait and N.C. Pradhan for their help in the process of compiling the necessary data for this chapter.

1 See Datt and Ravallion (1998) and Palmer-Jones and Sen (2006a) for a detailed survey of issues on rural poverty in India, providing strong support for the trickle-down hypothesis.

2 See Agénor (2005) for an exhaustive survey of issues related to the macroeconomic focus on poverty analysis. Also see Granville and Mallick (2005), who incorporate poverty within the Fund-Bank framework.

3 Lanjouw and Lanjouw (2001) summarise the literature in this context, emphasising that the rural non-farm sector can, and often does, contribute to economic growth, rural employment, poverty reduction, and a more spatially balanced population distribution.

4 Basu and Mallick (2007) explore the mechanism of capital-labour substitution that might be contributing to more unemployment and thus preventing economic growth from reducing poverty owing to the possible adoption of labour-saving

technology. All types of capital, however, are not labour-displacing and hence there can be labour-augmenting neutral technical progress.

5 Palmer-Jones and Sen (2006b) examine the spatial patterns of rural poverty in India and find that agricultural growth is the key determinant of rural poverty reduction, and spatial variations in irrigation development at the state level can explain the differences in the decline in poverty.

6 Ghatak and Ghatak (1996) find significant crowding-out effects of government consumption on private consumption.

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Appendix 1

Variables and sources

The dataset used in this study spans the time period 1951 to 2004 from India.

Poverty rate – Historical poverty statistics until 1992 have been taken from the World Bank's India site on poverty. Head count index (HCI) has been used as a proxy for the poverty rate, which is only available for the years in which the survey was conducted. The gap between surveys has been filled by interpolating from the observed values to get a continuous series. The HCI data for three quinquennial surveys since early 1990s (1993–94, 1999–00, 2004–05) have been taken from respective household surveys.

GDP ratio – Data on GDP at factor cost by industry of use at 1999–2000 prices, published by the Central Statistical Organisation (CSO), India, are taken from Reserve Bank of India (RBI) handbook of statistics on the Indian economy, and then the ratios have been calculated.

Price ratio – The price deflators have been calculated for agricultural prices by dividing nominal and real values for agricultural GDP. Similarly the non-agricultural price deflators have been derived and then the price ratio has been calculated.

ACOR – Average net fixed capital to output ratio (ACORs) for agriculture, forestry and fishing at constant prices has been taken from Table 46A in *National Accounts Statistics of India* published by EPW Research Foundation.

Public investment – Gross capital formation in the public sector at new series base 1999–2000 (Table 13) is compiled from *RBI Handbook of Statistics on Indian Economy*, 2007. As this data is for the aggregate public sector, we used the ratio of investment in agriculture and allied activities out of total public investment at 1993–94 base from CSO, and then extracted the agricultural public investment at 1999–00 base from the total public investment. This nominal data was then expressed in real terms with investment deflators being derived from the nominal and real values of total gross domestic capital formation taken from Table 12 of the *RBI Handbook*.

Development expenditure – Developmental expenditure of the central government on the revenue account has been taken from the budget documents of Government of India. From 1980 onwards, the data was taken from the *RBI Handbook*. This has been expressed in real terms using aggregate GDP deflator and then divided by population to get per capita development expenditure.

Government consumption and capital expenditures – Final outlays by the central government and transfer payments to the rest of the economy are added to get total government current and capital expenditures. All the variables are taken from Table 2.3 in *Economic Survey*, 2006–07.

Priority sector lending – Scheduled Commercial Banks (SCBs) credit to agriculture has been used, as loans to agriculture account for around 40 per cent of the total priority sector loans. This has been expressed in real terms using the investment deflator as used in the case of public investment. The investment deflator is more appropriate here compared to the aggregate GDP deflator.

GIA – Gross irrigated area (expressed in terms of area in million hectares) is used as a proxy for irrigation for reasons discussed in section 3. The data are complied from pattern of land use and selected inputs for agricultural production in the RBI database.

Part II

Stabilization, remittances and consumption

7 Estimating the international transmission of shocks using GDP forecasts

India and its trading partners[1]

Kajal Lahiri[2] *and Gultekin Isiklar*

1 Introduction

The knowledge of the patterns of inter-country propagation of economic shocks and the degree of vulnerability of a particular country to shocks originating from other countries is crucial for sound macroeconomic management. The relative robustness of the Indian and the Chinese economies in the recent Asian crisis has been remarkable. The availability of this sort of information is particularly important for Central Banks because they design and implement monetary policy mandates for price stability and GDP growth on a day-to-day basis. Because of these reasons, there is a growing interest in the sources of macroeconomic fluctuations and transmission of shocks in an international perspective. However, most of the research in this area has traditionally focused on industrialized countries, and only a few have studied the dynamics of the transmission of shocks involving developing economies.

As Agenor *et al.* (2000) noted there are two primary reasons for this lack of interest. First, the limitations on the quality and frequency of data are constraining factors. Dependable quarterly data on national accounts are available only for a handful of developing countries and even when they are available, the quality of the data is usually lower than that of annual data. Second, since developing countries usually experience many unanticipated crises, it is hard to extract economic regularities in the data that are usually driven by the crisis environment. Moreover, these crises in developing countries are usually followed by radical reforms, causing significant policy changes and possible structural breaks in the data. This makes it even harder to use macroeconomics data to look for regularities. India is a good case in point. India experienced a severe macroeconomic crisis in 1991, which initiated a series of reforms. These reforms have made drastic changes in the Indian economy, especially in the 1990s. It is likely that these reforms and the relatively long period of adjustment will cause crucial problems in utilizing the Indian data to study the spatial pattern of macroeconomic shocks among its trading partners. Ghatak (1997, 1998) has firmly established the importance of structural breaks in the case of India.

In this chapter, we explore the feasibility of a rather unorthodox methodological approach. We use monthly real GDP forecasts of a developing country, India, and its major trading partners during the period from 1995 to 2002 to study the nature and dynamics of the transmission of shocks. These forecasts are produced by experts from a mix of private consulting firms, public sector agencies and university research bureaus specialized in a particular country. Using the econometric framework developed by Davies and Lahiri (1995, 1999) and Isiklar, Lahiri and Loungani (2006), we use successive differences in fixed-event (rather than fixed-horizon) forecasts to measure the aggregate economic "news" that befell in a particular month. The advantage of this measure is that the estimated news based on forecasts is independent of actual GDP figures and is observed at monthly frequencies in real time. The actual GDP values are known to be sometimes notoriously unreliable due to successive data revisions. Since we have access to simultaneous forecasts for a large number of countries, we can study the persistence, causality, and spatial transmission of such news in a cross-country context.

It is well known that forecasts from estimated time series models often do not have a good track record due to model instability and structural breaks. The forecasts generated by experts tend to respond to the current economic news better. However, the idea of using forecast data to extract information regarding actual economic fundamentals is still subject to several concerns, and the use of survey forecasts necessitates an examination of how good these forecasts are. Thus, we first measure the degree of inefficiency in the Indian real GDP growth forecasts. While it is common to test for the rationality of the forecasts for industrialized countries, it is not so for developing countries. Hence our measurement of forecast inefficiency for India can be considered as another contribution of this study.[3]

Our measure of forecast efficiency is partly motivated by the recent interest in the measures of stickiness in information usage. Mankiw and Reis (2001, 2003), hereafter MR, have proposed a "sticky-information" model as an alternative to the classical sticky-price model. The sticky-information model of MR assumes that economic agents update their expectations only periodically because of the costs of collecting and processing information.[4] One implication of such a model is that the average forecast of individuals should follow a smooth path. While this smoothing behavior is well documented,[5] not much attention has been given to the extent of it. Mankiw *et al.* (2003) have measured the degree of news utilization in professional forecasts by imposing a structure on the true data generating process. In this study, we also measure the promptness in the utilization of information on Indian real GDP growth forecasts. The difference from Mankiw *et al.* (2003) is that their estimate of stickiness is based on particular assumptions about the data generating process of the actual process and the forecasters' behavior (i.e. the sticky-information model). On the other hand, our estimates use only the forecast data without imposing any structure on the true nature of the data generating process or on the behavior of the forecasters.

Using a VAR model of forecast revisions, we measure the degree of forecast inefficiency in Indian real GDP forecasts. Our measure of inefficiency focuses on how quickly agents update their forecasts, and is based on impulse responses and "intertemporal variance decompositions." These variance decompositions are similar to the classical variance decompositions but they are not calculated across variables but calculated over time to measure the variance contribution in forecast revisions as time passes.

After establishing the extent of inefficiency in Indian real GDP forecasts, we compute the "total utilization of news" at successive months after controlling for the stickiness of the forecasters. Under the assumption that the forecasters eventually respond to the news given a sufficient length of time (a concept that we call "long-run efficiency"), we show that the steady-state variance decompositions that are based on cumulative impulse responses give the average variance decompositions of the actual real GDP growth.

We use two different types of VAR models in this chapter. Initially we assume that the transmission of shocks across countries is dominated by foreign country shocks but not by common international shocks. Such a framework implies a classical VAR analysis without any common factors. Second, we study whether common international shocks play an important role in the transmission of shocks across countries using a factor structural VAR (FSVAR) framework.

Our conclusions can be summarized as follows: First, we find that Indian real GDP forecasts are efficient with respect to the use of information available domestically but not so with respect to foreign countries and/or common international information. It takes almost four months for foreign "news" to be incorporated in the forecasts. Nevertheless, the quality of the Indian forecasts compares very favorably with those of the major industrialized countries. Second, we find that there were two global factors that were important to India during 1995 to 2003 – one representing US, UK, EU-3 (Germany, Italy, France), and the other representing selected countries in North East and South East Asia. Further, the Indian real GDP growth was mainly driven by the Asian common factor and to a much lesser extent by the Western common factor. On average more than 30 percent of the Indian real GDP growth variance was accounted for by the common Asian cycle. The domestic shocks accounted for approximately 40 percent of the variance. However, when we excluded the Asian crisis period (1997.7 to 1998.12) from the sample we found that the share of the domestic shocks increased to 60 percent and both Western and the Asian common shocks account for 16 percent each. Thus, we find that the spatial nature of the transmission mechanism can change within short periods of time.

2 Consensus forecasts: data and characteristics

Since October 1989, *Consensus Economics Inc.* [6] has been polling more than 600 private market and other economists each month to obtain their forecasts.

These surveys cover estimates for the principal macroeconomic variables (including GDP growth, inflation, interest rates and exchange rates) of over 70 countries. The forecasts are compiled into a series of publications, *Consensus Forecasts* (includes industrialized countries and published monthly since 1989), *Latin American Consensus Forecasts* (published bi-monthly since 1993), *Asia Pacific Consensus Forecasts* (published monthly since 1995), and *Eastern Europe Consensus Forecasts* (published bi-monthly since 1998). The numbers of panelists ranges from 10 to 30 for most of the countries, and for major countries the panelists are mostly based in countries they forecast. A sample of forecasters that reports for India is provided in Table 7.1. As is seen in the table, while some of the forecasters are located in India, others are multinational firms located in leading industrialized countries. Thus, these forecasts reflect widely diverse information sets held by different stakeholders of India.

Even though the *Consensus Forecasts* data set is a source of rich economic information, there are only a handful of studies that have used this data. These are Artis and Zhang (1997), Batchelor (2007), Gallo, Granger and Joen (2002), Harvey *et al.* (2001), Loungani (2001), Juhn and Loungani (2002), Isiklar *et al.* (2006) and Isiklar and Lahiri (2007). To the best of our knowledge, the *Asia Pacific Consensus Forecasts*, including those for India, remain largely unused.

In this chapter we will concentrate on the consensus forecasts of annual average real GDP growth. A consensus forecast is a simple arithmetical average of all of the individual predictions. Although for most of the countries the forecasts are for calendar years, for some countries including India fiscal year is used (April to March). The rolling forecasts first made 24 months ahead for the target years 1995 through 2003 are plotted in Figure 7.1. The actual real GDP figures are given on the right side of the diagram at horizon 0.[7] These graphs reveal that the monthly forecasts are highly variable and this can only be explained by real-time news that fell during the preceding months. The graphs also reveal that the consensus forecasts made even one month before the end of the year can sometimes be significantly different

Table 7.1 Economic forecasters for India

• ANZ Investment Bank	• Hindustan Lever
• Bank of Tokyo Mitsubishi	• HSBC Securities
• Chase JF	• JP Morgan
• CDE-DSE Research	• Morgan Stanley Asia
• Confed of Indian Industry	• Natl Cncil Apl Eco Rsrch
• Credit Suisse First Bstn	• SG Securities
• Deutsche Bank	• SSB Citibank
• Dresdner Bank	• Tata Services (DES)
• DSP Merrill Lynch	• UBS Warburg
• Global Insight	• UTI Securities
• Goldman Sachs Asia	• WEFA Group

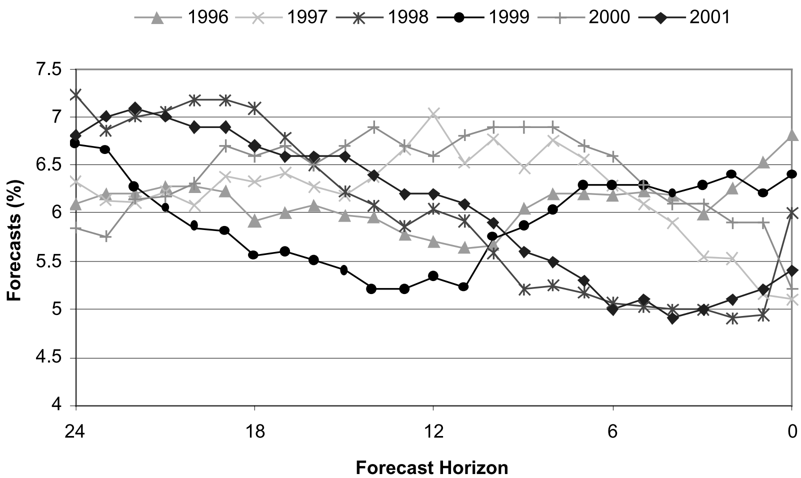


Figure 7.1 Multistep forecasts of Indian real GDP growth (FY1996–FY2001).

from the actual real GDP values (e.g. forecast made in March 1998 for the FY 1998 is almost one percentage point below the actual).[8] Apart from pure unanticipated forecasting error, this discrepancy can also be due to the fact that sometimes the revised GDP figures can be substantially different from the initial announcements. For other years the last forecasts were fairly close. As mentioned before, one advantage of our approach is that it does not depend on the actual GDP values.

The monthly forecast revisions are defined as news as perceived by the forecasters in real time, and since forecasts are made for the current year and the next year, we can define two monthly news components with respect to these two target years. They are plotted in Figure 7.2 and Figure 7.3, and show very similar patterns. It should be emphasized that these series are generated in real time, and are not created at the end of the sample period; see Croushore and Stark (2001). Any student of the Indian economy can easily identify the up and down swings in these graphs. The bullish July 1999 to June 2000 period reflects the optimism surrounding the newly elected BJP government at the Center, its proposed free-market reforms, and the surging stock market. However, the continuing budget deficits, the disappointing Central budget of March 2000, looming inflation fear, etc. were creating variability in the forecasts. During August 2000 to January 2002, the Indian economy experienced a series of bad economic news for real GDP growth. This is a period that can be identified as having a bad balance of payments situation, soaring oil prices, stalled privatization programs, the earthquake of January 2001, an arms bribery scandal, recession in the world economy, the Enron scandal, instability at the Center, the 9/11 attack, and others. However, with the revival of the world economy, and a good monsoon, the Indian

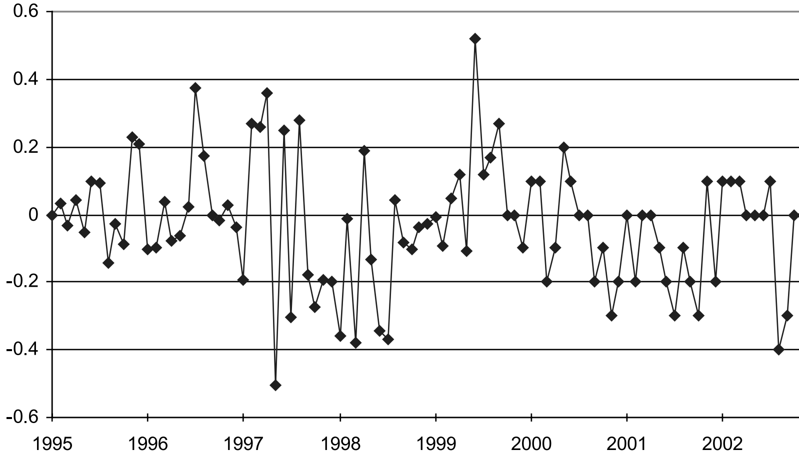


Figure 7.2 Indian real GDP shocks based on current year forecast revisions.

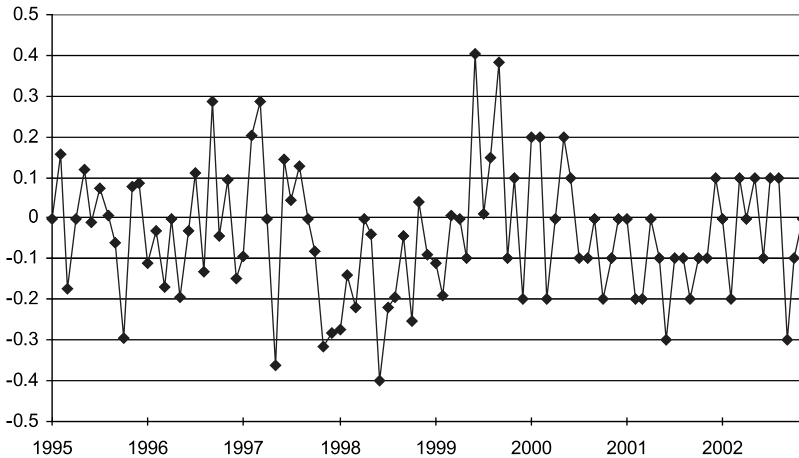


Figure 7.3 Indian real GDP shocks based on next year forecast revisions.

economy seemed to have come out of its slump, beginning in January 2002. The Gujrat riots, attacks on Kashmir, and poor monsoon of 2002 made growth prospects during this period uncertain.

3 Measuring the degree of forecast inefficiency

In this study we propose a measure of forecast inefficiency which is not dependent on any assumed model.[9] The "sticky-information" model of MR assumes that economic agents update their expectations only periodically because of the costs of collecting and processing information, and this causes stickiness in aggregate expectations. They assume that in any given period each individual faces a constant probability λ of updating their information set and therefore only a fraction of the population updates their forecasts on the current state of the economy and computes optimal prices based on that information. The rest of the population continues to set prices on old plans and outdated information. Based on the sticky-information model of MR, several studies have estimated the extent of stickiness. Khan and Zhu (2006) use VAR estimates to mimic the price expectations and find that stickiness for the US and Canada is less than the stickiness for the UK. Carroll (2003) uses the Michigan Survey of Consumers and measures the stickiness in information for households. They treat the forecasts from the Survey of Professional Forecasters (SPF) as those of experts and then measure how quickly the households utilize the information in the expert forecasts. They find that at any point of time, 32 percent of households have inflation expectations that are more than a year out of date.

The model of expectations proposed by MR can be applied to professional forecasters' expectations of other macroeconomic variables too. While the sticky information explanation was not originally developed for professional forecasters who have strong incentives to update their information frequently, there may be other reasons for the professional forecasters to update their forecasts with a lag. For example, Sims (2003) points out that the agents may have information processing constraints, which may cause stickiness in information utilization. Also it has been pointed out by several studies that forecasters may avoid changing their predictions and smooth their forecasts in order to maintain credibility. For example, this is consistent with rational bias and reputation effects as put forward by Ehrbeck and Waldman (1996) and Laster *et al.* (1999).

As we know, the only study that measures the degree of smoothness for the profession forecasters is Mankiw *et al.* (2003), where they measure it in an indirect way. They use a VAR over the whole sample to model how rational agents form their expectations and then compare these rational expectations with those of professional forecasters reported in the Livingston survey, assuming that their sticky-information model is correct. They find that the professional economists surveyed by the Livingston survey update their inflation expectations about every ten months on average. Note that their estimate of stickiness depends on two assumptions. First the data generating process (i.e. VAR model) should be valid over the whole sample to generate rational expectations in real time. Second, the behavioral assumption about the forecasters, i.e. the assumption that forecasters have sticky information, should be valid. In this study we follow a different approach. If the forecasts are smooth for any reason (sticky-information, rational inattention, reputation, rational bias, etc.), then this smoothness can be captured by focusing on the forecast revisions in repeated forecasts for the same target. In the next section we will estimate a VAR model on forecast revisions to capture the degree of inefficiency in a multivariate context without assuming the form of inefficiency.

3.1 VAR model

In order to measure the stickiness in the forecasts we focus on the process of the forecast revisions.[10] Generally speaking, today's forecast revision may be interpreted as accumulation of past news components so that

$$r_{i,t,h} = \beta_0 \varepsilon_{i,t,h} + \beta_1 \varepsilon_{i,t,h+1} + \beta_2 \varepsilon_{i,t,h+2} + \beta_3 \varepsilon_{i,t,h+3} + \ldots \tag{1}$$

where $r_{i,t,h}$ represents the forecast revision in country i real GDP forecasts for year t when the forecast horizon is h, β_s represents the usage of the new information that has been available s periods ago ($\varepsilon_{i,t,h+s}$). If, for example, the forecasters are fully efficient, then $\beta_j = 0$ for all j > 0 should be satisfied. That is, all the information that becomes available should be so immediately and no information components should be left over to be utilized in later revisions.

It is well known that the propagation of shocks from other countries is an important source of GDP shocks to a country. Since forecast revisions indicate the impact of new information on GDP growth, using other countries' forecast revisions in a VAR model provides a way of incorporating the cross-country information for testing and measuring inefficiency. If we use the forecast revisions of other countries in addition to the own-country forecast revisions in a VAR model for J countries, we get

$$r_{t,h} = c + B_1 r_{t,h+1} + B_2 r_{t,h+2} + \ldots + B_p r_{t,h+p} + \varepsilon_{t,h} \tag{2}$$

where $r_{t,h}$ denote a (J × 1) vector containing the forecast revisions of the relevant countries when the forecast horizon is h and target year is t and $E(\varepsilon_{t,h}\varepsilon'_{t,h}) = \Omega = \{\sigma_{ij},\ i,\ j = 1, 2, \ldots, n\}$. B_k denote the (J × J) matrix of coefficients of $r_{t,h+k}$. $VAR\ (p)$ may be rewritten in $VMA\ (\infty)$ form, which is a multivariate version of equation (1) as

$$r_{t,h} = \mu + M_0 \varepsilon_{t,h} + M_1 \varepsilon_{t,h+1} + M_2 \varepsilon_{t,h+2} + \ldots \tag{3}$$

where we usually assume that $M_0 = I$ for normalization.

Notice that if the forecasters are efficient then they will be updating their forecasts exactly in the amount that the new information changes their rational expectations:

$$r_{t,h} = E(y_t \mid \Phi_{t,h}) - E(y_t \mid \Phi_{t,h+1})$$

where $\Phi_{t,h}$ denote the information set when the forecast horizon is h. In this setup $E(y_t \mid \Phi_{t,h}) - E(y_t \mid \Phi_{t,h+1})$ denote the new information on y_t and it can be thought as the $\varepsilon_{t,h}$ in equation (3) where due to perfect efficiency we will have $M_k = 0$ for $k > 0$, $r_{t,h} = \varepsilon_{t,h}$.

Note that since $\varepsilon_{t,h+i}$ is assumed to be the information that arrives between forecast horizons $h + i$ and $h + i + 1$, i.e. $\varepsilon_{t,h+i} = E(y_t \mid \Phi_{t,h+i}) - E(y_t \mid \Phi_{t,h+i+1})$ for $i \geq 0$, the process in equation (3) is the same as:

$$\begin{aligned} r_{t,h} = \mu + M_0\,(E(y_t \mid \Phi_{t,h}) - E(y_t \mid \Phi_{t,h+1})) \\ +M_1\,(E(y_t \mid \Phi_{t,h+1}) - E(y_t \mid \Phi_{t,h+2})) \\ +M_3\,(E(y_t \mid \Phi_{t,h+2}) - E(y_t \mid \Phi_{t,h+3})) \\ + \dots \end{aligned} \tag{4}$$

The estimated VAR system presents us with an important tool to understand the dynamics of the forecasting process in more detail than simple correlations. In its usual interpretation, impulse responses trace the effect of a one standard deviation shock to one of the innovations on the future values of other variables in the system. Our variables are forecast revisions of the sample countries; hence impulse responses show the responses of forecast revisions to innovations over time. But under perfect efficiency, forecast revisions should respond fully to the shocks immediately. If the forecast revisions do not respond to the shocks immediately, i.e. if there are nonzero impulse response values when impulse response horizon is greater than zero, then forecasts are not efficiently using the information immediately, and some of the information is being utilized in the later forecast revisions. In other words, impulse responses of the forecast revisions show the dynamics of how shocks are absorbed in the forecast revisions over time. The longer it takes for the responses to go to zero, the greater is the degree of forecast inefficiency.

Since the shocks of the countries are correlated, we should decompose the correlated shocks into uncorrelated idiosyncratic shocks to find some economically useful representation of the model. The classical way of doing this is by using Cholesky decomposition. The Cholesky decomposition imposes a recursive structure on the contemporaneous interactions among the variables and the resulting impulse response functions become dependent on the ordering of the variables in the VAR. But such a recursive structure is arbitrary and can be very restrictive. To guard against this criticism, we use the ordering-free generalized VAR model that was introduced by Koop, Pesaran and Potter (1996) for nonlinear systems. Pesaran and Shin (1998) proposed the method for an ordering-free solution in the VAR analysis and they show that $n \times 1$ vector of k period ahead generalized impulse response of the effect of a one-standard deviation shock in the j^{th} country forecast revision equation is given by:

$$\psi_j\,(k) = \sigma_{jj}^{-1/2}\,M_k\,\Omega e_j \tag{5}$$

where e_j is the j^{th} column of an identity matrix.

The impulse responses provide one way of judging the speed with which individual country information gets absorbed into forecasts, but it is not an aggregate measure. To look at an aggregate measure of inefficiency we need to focus on the variance decompositions aggregated over all countries. The classical variance decompositions give us estimates of the relative importance of domestic vis-à-vis foreign shocks in explaining forecast revision variance in the long run. But another important issue is the *speed* of forecasters' response to news over time.

In order to do this, we need to see how much of the variation in forecast revisions is accounted for by current innovations and how much of it is accounted for by past innovations. Thus, we decompose the variation in forecast revisions over time into its new and old components using cumulative 'intertemporal variance decompositions.' For country *i*, the cumulative percentage of the variation of the revisions due to information that became available in the last *m- periods* can be calculated from

$$\theta_{i,m} = \frac{\sum_{h=0}^{m} e_i' M_h \Omega M_h e_i}{\sum_{h=0}^{\infty} e_i' M_h \Omega M_h e_i} \tag{6}$$

where e_i is the ith column of an identity matrix; see Isiklar *et al.* (2006).

While the intertemporal variance decompositions in equation (6) give an aggregate measure for the degree of inefficiency, one may also examine the inefficiency specifically towards foreign or common shocks. We will answer this question using a factor structural VAR model. We discuss this model in the next section.

3.2 Factor structural VAR model

In the previous section, we assume that domestic and foreign idiosyncratic country shocks are the most relevant information source for the real GDP figures. In this section we include common international factors in our model using a factor structural VAR (FSVAR) model. FSVAR models have increasingly become popular in studying the international propagation of shocks. Recently Clark and Shin (2000) and Stock and Watson (2005) used these models to shed some light on the sources of economic fluctuations. The FSVAR model can be thought of as a structural VAR model. In a FSVAR model, it is assumed that the contemporaneous interaction among variables stems from the common shocks. In other words, idiosyncratic country shocks are assumed to have no effect on other countries contemporaneously. Then, the reduced form errors follow the structure:

$$\varepsilon_{t,h} = \Lambda f_{t,h} + A u_{t,h} \tag{7}$$

where $f_{t,h}$ is $k \times 1$ vector that denote the common international factors with $E(f_{t,h} f_{t,h}') = I$, Λ is the $J \times k$ matrix of factor loadings, A is a $J \times J$ matrix of the contemporaneous spillovers across countries, and $u_{t,h}$ is a $J \times 1$ vector of the idiosyncratic country shocks with $E(u_{t,h}u'_{t,h}) = diag(\sigma^2_{u1}, \ldots, \sigma^2_{uJ}) = D$. In the special case with $A = I$, contemporaneous interactions across countries through the errors are not permitted. This special case is the model that is also estimated by Stock and Watson (2005) and will be the main workhorse in this study as well. While assuming that the contemporaneous interaction terms across countries are due to the common shocks and none are due to spillovers (i.e. transmission of idiosyncratic country shocks) is quite restrictive, we do not have much choice because of identification problems.[11] So assuming that $A = I$, our aim becomes to estimate Λ and D. Once they are estimated we can rewrite the vector moving average model in the form:

$$r_{t,h} = \mu + (\Lambda f_{t,h} + u_{t,h}) + M_1(\Lambda f_{t,h+1} + u_{t,h+1}) + M_2(\Lambda f_{t,h+2} + u_{t,h+2}) + \ldots \quad (8)$$

This can be used to compute impulse responses and variance decompositions. So with $J = 7$, reduced-form errors will be decomposed into $k + 7$ shocks where k is the number of international common factors.

Once the FSVAR model is estimated, intertemporal variance decompositions can be constructed in a similar way to (6). Also we can construct intertemporal variance decompositions for the utilization of domestic shocks, common shocks or foreign shocks as well. For example, equation (9) gives the cumulative percentage of the variation in the forecast revisions due to total common shock information that becomes available in the last m-periods:

$$\theta_{i,\ common\ factors} = \frac{\sum_{h=0}^{m}\sum_{j=1}^{k} e'_i M_h \Lambda\Lambda' M'_h e_j}{\sum_{h=0}^{\infty}\sum_{j=1}^{k} e'_i M_h \Lambda\Lambda' M'_h e_j} \quad (9)$$

The other intertemporal variance decompositions can be constructed in a similar fashion.

Note that in our context the FSVAR model is useful for two reasons. First, in recent years many studies have emphasized the importance of common factors in international business cycle propagation, and it would be interesting to explore the impact of common shocks on individual country GDP growth rates and their forecasts. This will be discussed in the next section in detail. Second, a common factor model provides a natural way for how forecasters form their expectations based on the rational inattention model of Sims (2003). Following his approach, let us suppose that the forecasters have information-processing limitations. In this case, initially they would allocate their resources to the most relevant information sources and ignore the less relevant ones. Clearly, in such a case domestic news is the first to be utilized since usually it is cheap and relevant. After absorbing the domestic news, it is likely that forecasters will next pay attention to the common international shocks. This is because common international news is more accessible and is easier to observe than the news coming from individual countries separately. For example, a forecaster in India may not pay enough attention to announcements of employment figures for all of its trading countries. But it may be easy to observe global news and common international shocks such as wars, oil price shocks, Asian crises or technological innovations. Hence it is reasonable to assume that the forecasters react to the domestic shocks along with the common international shocks but ignore the idiosyncratic foreign country shocks contemporaneously. Notice that one possible problem with this approach is that we may overestimate the impact of common international shocks because we assume that contemporaneous interaction among the forecast revisions occurs due to the common international shocks. See note 11.

4 International transmission of shocks

4.1 The literature

Interest in international transmission of shocks has been growing in the last few years; see, for example, McAdam (2007), Helbling and Bayoumi (2003), Cardarelli and Kose (2004), Monfort *et al.* (2003), Stock and Watson (2005), Ahmed (2003) and Smets and Wouters (2005). These studies usually utilize quarterly or annual GDP data as a measure of an economy's overall activity and use a sampling period starting from the post-World War II period to the present. For example, Smets and Wouters (2005) use real GDP data along with six other macroeconomic data – consumption, investment, prices, real wages, employment and the nominal interest rate – over a sample period from 1947 to 2002 and over a shorter period from 1983 to 2002. Stock and Watson (2005) use real GDP data from G7 countries and estimate an FSVAR model over 1960 to 1983 and 1984 to 2001. Since the low degrees of freedom in the unrestricted VAR model would create a considerable sampling uncertainty, Stock and Watson (2005) employed a restricted VAR model in the sense that they used only a single lag for the foreign GDP growth but they use four lags for the own country GDP growth. Monfort *et al.* (2003) use quarterly GDP figures in addition to monthly industrial production data for the G7 countries from 1970 to 2002. Industrial production, though available monthly, is less suitable compared to GDP because it covers only a small part of the economy; see note 15.

The GDP, which is the best indicator for the overall economic activity, is available only quarterly with substantial lag and revisions. This implies that the studies on international transmission of shocks, where the GDP interactions are usually measured among several countries in a multivariate model like VAR, do not have enough degrees of freedom. The situation is much worse for the developing countries, where the availability of data constrains the study even more. Because of this limitation only a limited number of papers study the transmission of shocks in developing countries; see Agenor *et al.* (2000), Kim *et al.* (2003), and Selover (1999). In addition to the limited data, developing countries also suffer from frequent crises and structural breaks, which make the study of transmission of shocks even more difficult. Use of dummy variables is a common but not an ultimate solution to control for the impact of frequent crises; the meaning of the dummy variables is not clear in most of the cases and their use decreases the degrees of freedom even more. For example, Selover (1999) studies the transmission of business cycles in the ASEAN region using annual data between 1961 and 1997. Selover (1999) computes bivariate VAR models due to the restrictions on the degrees of freedom, and fails to find a significant transmission of business cycles among the ASEAN countries. Among several other explanations, he notes that the low significance level can be due to: i) small sample size; or ii) large domestic shocks such as wars, coups, natural disasters, insurrections, gross economic policy errors, bad harvests, and commodity price volatility which can add noise to the estimates. In order to correct for these large domestic shocks, he uses a set of level dummies and commodity prices as additional explanatory variables. However, the addition of these explanatory variables decreases the degrees of freedom and increases the uncertainty surrounding the estimates.[12] Moreover, in short samples, the usage of dummy variables can be treacherous and it is possible that the results are highly dependent on the specification and selection of these dummies. If there is uncertainty surrounding the timing and shape of the structural breaks, a better method may be focusing in subsamples.

4.2 India during the 1990s

India's situation is a perfect example to show the extent of the problem of such a structural break. In 1991, severe macroeconomic problems and the balance of payments crisis initiated a set of reforms including devaluation of the rupee and liberalization of international trade and foreign investment in India. While in the pre-1991 period, India was largely insulated from the world, in the post-1991 period she started to connect with the world more than ever following the radical reforms in every aspect of her economic life.[13] These reforms resulted in significant changes in the macroeconomic variables in the early 1990s, especially between 1991 and 1996.[14] These changes suggest that in 1991 India started to experience a structural change and was in a transition period until 1995–1996. This structural break and the long transition period clearly complicate the analysis of international transmission of shocks for India, causing a lack of usable GDP data to study the sources of GDP variations in the long haul.[15]

Because of these restrictions in Indian data, we do not use the actual GDP figures but use the monthly forecasts of it and investigate whether the cross-country forecast data can be used to study the transmission of shocks between India and its major trading partners. Use of forecast data offers several advantages. First of all, the sample size is no longer a problem since the forecasters report two forecasts (for current and next year) every month. Second, the number of lags required in the VAR model on forecast revisions is expected to be much smaller than the number of lags required when we use actual GDP figures. This is because forecasters adjust their forecasts by the amount of the change in their expectations immediately after they observe a shock and they do not wait for the shock's impact to be realized. Under rationality, the lag length is actually zero. Thirdly, due to our data frequency we can study the transmission mechanism over a very short period with relatively large sample size. For example, in section 6 we will work on the post-1995 period without using the Asian crisis period to isolate the impact of the Asian crisis on the transmission of shocks.

Clearly, there is a disadvantage in using forecast data too. Especially if the forecasters are biased and inefficient, the results arrived at by using forecast data may be highly misleading. But note that the most important factor in the reliability of the results is not that the forecasters are biased or inefficient in the short run but rather their ability to correct their mistakes in the long run. Under the assumption that the forecasters can correct their previous misjudgments on the economic activity, we provide a simple method to adjust for the inefficiencies in the forecasts and use the forecast data to study the sources of GDP variations for a country.[16] In the following two subsections we consider the cases when the forecasts are efficient and when they are inefficient.

4.3 Estimating the structure of transmission of shocks using forecast data

4.3.1 Under perfect efficiency

As noted earlier, under perfect efficiency we have:

$$r_{t,h} = E(y_t \mid \Phi_{t,h}) - E(y_t \mid \Phi_{t,h+1}).$$

In this case a factor structure or any other economically meaningful structure can be imposed on the forecast revision series. Suppose we believe that FSVAR structure given in (7) is valid. Then, we have

$$r_{t,h} = \Lambda f_{t,h} + u_{t,h} \tag{10}$$

The estimates of Λ can be obtained using static factor analysis methods. In this case, maximum likelihood estimates would be based on the variance covariance matrix constructed using the forecast revisions. But notice that since we assume perfect efficiency and no contemporaneous response to foreign country shocks (spillovers) at the same time, this would imply that idiosyncratic country shocks do not propagate across countries at all. Then the estimate of Λ from equation (10) would give the average value of the impact of common factors on the real GDP growth rate.

4.3.2 Under long-run efficiency

If the forecasts are inefficient to some degree and they do not include all the available information $\Phi_{t,h}$, then we should correct the inefficiency in the revisions to understand the transmission of shock structure across countries using forecast data. Suppose that the forecast revisions follow the process given in (3) but forecasters eventually utilize all the information within p periods, so that there exists p such that $M_i = 0 \; i > p$. This implies that when there is sufficient number of forecast horizons, i.e. when $h \geq p$, there should be enough time for the forecasters to utilize all the information before they are finished with forecasting for a target. That is, the impact of news $\varepsilon_{t,h}$ will be reflected in the forecasts by the time they report their forecast $f_{t,h-p}$. But, in this case, the total amount of utilized news will be nothing but $M_0 + M_1 + M_2 + \ldots$, which is the accumulated impulse response function. Then accumulated impulse responses give the total utilization of the information not only included in the first forecast just after $\varepsilon_{t,h}$ is observed, i.e. $f_{t,h}$, but also news utilized in the later forecasts too, i.e. $f_{t,h-1}, f_{t,h-2}, \ldots, f_{t,h-p}$. More formally, when forecast horizon is *h-p* the total utilization of news $\varepsilon_{t,h}$ is given by[17]

$$\Gamma_\varepsilon \equiv \text{total utilization of news } \varepsilon_{t,h} = \sum_{r=0}^{p} M_r,$$

where (i,j)th element of Γ_ε gives the total utilization of jth element of $\varepsilon_{t,h}$ on variable i. Another way of looking at this aggregated measure is "inefficiency adjusted utilization of news." While M_r denotes the inefficient response of the forecasters, $\Sigma_{r=0}^{p} M_r$ gives the inefficiency-adjusted response. This suggests that if we assume that forecasters eventually use all the available information, cumulative impulse responses from the FSVAR model will equal the impact of the shocks on the actual real GDP growth averaged over horizons. Moreover, steady-state variance decompositions that are based on these cumulative impulse responses will give the share of shocks accounted for by common factors and idiosyncratic country shocks.

We can also calculate the total utilization of common factors and individual country specific news using equation (8). For example, from equation (8), it is clear that the total utilization of news in the common factors $f_{t,h}$ is represented by $\Sigma_{r=0}^{p} M_r \Lambda$. Hence under the assumption of long-run efficiency, the variation accounted for by the jth common factor in ith country's real GDP variations is

$$\omega_{ij} = \frac{(e_i' \tilde{\Lambda} e_j)^2}{\sum_{s=1}^{k} (e_i' \tilde{\Lambda} e_s)^2 + \sum_{s=1}^{J} (e_i' \tilde{M} e_s)^2} \tag{11}$$

where $\tilde{\Lambda}$ and $\tilde{M}$ denote the inefficiency-adjusted total utilization of news in common factors and individual country shocks respectively, that is,

$$\tilde{\Lambda} = \sum_{r=0}^{p} M_r \Lambda, \text{ and}$$

$$\tilde{M} = \sum_{r=0}^{p} M_r D,$$

where, as defined earlier, D is the diagonal matrix that carries the idiosyncratic country variances, $D = E(u_{t,h}u'_{t,h}) = diag\ (\sigma^2_{u1}, \ldots, \sigma^2_{uJ})$. Notice that in equation (11), $(e_i\tilde{\Lambda}e_j)^2$ is the contribution of jth common factor shocks, and $(e_i\tilde{M}e_s)^2$ is the contribution of sth country shock to the variation in total news utilization in the ith country's real GDP growth forecasts. If our assumption that forecasters are long-run efficient in p periods is valid, then the share in total news utilization should be related to the average variance decompositions that are based on actual real GDP growths.

5 Empirical results on the degree of forecast efficiency

5.1 Descriptive statistics and generalized VAR results

We measure the degree of inefficiency in the forecasts using a VAR model of four countries and three country blocks. Since our analysis also examines the impact of foreign country shocks on India, we should be careful about the calendar year and fiscal year differences. If the forecasts are for the calendar year, then survey respondents make their first forecasts when there are 24 months to the end of the calendar year; that is, in January of the previous year they start forecasting, and their last forecast is reported at the beginning of December of the year they are forecasting. But this is different for India, where survey respondents make their first forecasts when there are 24 months to the end of the fiscal year; that is, in April of the previous year they start forecasting, and their last forecast is reported at the beginning of March of the year they are forecasting. The first official announcement of the fiscal year GDP comes in early July, with an immediate revision in late July and a few revisions thereafter (see Sivasubramonium 1995).

Table 7.2 presents the relation between the calendar year and fiscal year forecasts. In each month forecasters report two forecasts: one for the current year and the other for the next year. For example, on January 2000, a current calendar year forecast predicts the average GDP growth rate for the year 2000. However, for India, the forecast that is reported on January 2000 is still aiming at the current fiscal year, which is year 1999. This difference between the calendar and the fiscal year targets is true for February and

Table 7.2 Relation between the calendar year and fiscal year (April to March) forecasts

			Year = 2000								
			Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	. . . . *Dec*
Calendar year forecast	Current year forecast	Horizon	12	11	10	9	8	7	6	5	,. . . . .,1
		Target year	2000	2000	2000	2000	2000	2000	2000	2000	,. . . . .,2000
	Next year forecast	Horizon	24	23	22	21	20	19	18	17	,. . . . .,13
		Target year	2001	2001	2001	2001	2001	2001	2001	2001	. . . .,2001
Fiscal year forecast	Current year forecast	Horizon	3	2	1	12	11	10	9	8	,. . . . .,4
		Target year	1999	1999	1999	2000	2000	2000	2000	2000	,. . . . .,2000
	Next year forecast	Horizon	15	14	13	24	23	22	21	20	,. . . . .,16
		Target year	2000	2000	2000	2001	2001	2001	2001	2001	,. . . . .,2001

Note: The gray area shows the data that are not used.

March forecasts too. Since we will use these forecasts to analyze the causal relation between India and other countries, the forecasts should be comparable in terms of timing. That is, the forecasts should target the same year and also the forecast horizons should not be very different from each other. Notice that for the calendar year forecasts reported in January, February or March that target the next year, there is no contemporaneous match in the fiscal year forecasts. Similarly, for the fiscal year forecasts in January, February and March that target the current fiscal year, there is no contemporaneous match in the calendar year forecasts. So we had no choice but to drop these observations from our data set in our VAR analysis. So we drop both the next year calendar forecasts when the forecast horizon is more than 21 and the current year fiscal year forecasts when the forecast horizon is less than 4. This means that the forecast horizon for the calendar year forecasts ranges between 1 and 21 and for the fiscal year forecasts, the forecast horizon ranges between 4 and 24. Thus, for each country and for a target year we have 21 forecasts. Our data set ranges from January 1995 (the first forecast for India in the Consensus Economics Inc. database) to November 2002. In a VAR(1) model, the total number of observations per country is 148.

Since our main purpose is to analyze the causality of shocks between India and its major trading partners, we choose countries and regions that have significant relationships with India. These are: USA, UK, the European block, Japan, Southeast Asia block, and Northeast Asia block. As reported by Dua and Banerji (2001), the export-based shares of these countries add up to more than 60 percent of the total. The three largest trade partners of India from Europe, viz. Germany, France and Italy, make up the European block. The UK is treated as separate from the European block because of its historical relationship with India, and because it is well known that the British business cycles are quite distinct from the European cycles led by Germany. The Southeast and Northeast Asian blocks are defined below (Table 7.3).[18]

The Consensus Economics Inc. database reports the aggregate measures of

Table 7.3 Definition of country groups and country weights

Country group	*Countries and GDP shares*[a]
Europe-3	Germany (46%), France (30%) and Italy (24%)
South East Asia	Indonesia (32.5%), Malaysia (14%), Singapore (13.75%), Thailand (26.6%) and Philippines (13.75%)
North East Asia	China (45%), Hong Kong (8.9%), South Korea (29.5%) Taiwan (16.5%).

a The Europe-3 weights are calculated using the 1995 GDP shares from International Financial Statistics – February 2002. The remaining weights are computed by regressing the regional total data provided by the Asia Pacific Consensus reports on the individual country GDP forecasts using survey data from 2001 to 2002. The shares may not add up to 100% due to rounding.

real GDP growth rates for the two regions in Asia, Northeast Asia and Southeast Asia. It uses the 1995 GDP shares for this aggregation. Since the weights are subject to change based on the actual data that is used (i.e. which revision of the actual is used), we calculated the implied GDP shares by regressing the reported regional GDP growth forecasts on the individual countries' GDP forecasts. Our calculations show that the Northeast Asia region weights for China, Hong Kong, South Korea and Taiwan are 45 percent, 9 percent, 29.5 percent and 16.5 percent respectively. Similarly, for Southeast Asia region, weights for Indonesia, Malaysia, Singapore, Thailand and Philippines are 32.5 percent, 14 percent, 13.7 percent, 26.5 percent and 13.7 percent respectively. Note that the shares may not add up to 100 percent due to rounding. The countries and weights are summarized in Table 7.3.

We estimated a seven-country VAR model with monthly data on forecast revisions over January 1995 to November 2002. We use Akaike and Schwarz information criteria to decide on the number of lags. The results for these information criteria along with some fitness statistics for the Indian equation are given in Table 7.4. As it is clear from the table the optimum lag length is one for our model. Note that the number of usable observations decreases quite rapidly with each additional lag. This is because our data is in the form of panel data with nine target years (from 1995 to 2003) and with each additional lag we lose nine observations.[19]

We estimated generalized impulse responses and present them in Figure 7.4. These impulse responses illustrate how quickly new information gets utilized in Indian real GDP forecasts. The top chart in Figure 7.4 shows the utilization of domestic news. As shown in this chart, domestic shocks are being absorbed rather quickly in the forecasts. The rest of the charts in Figure 7.4 show the utilization of foreign country shocks. Notice that the scale of these graphs is different from the first one. Here we see that especially Northeast Asian and Southeast Asian shocks are absorbed at a much slower rate than the domestic shocks. Moreover, one can suggest from these graphs that Asian countries seem to have a greater impact on India than the Western countries. But we will discuss this issue in more detail later.

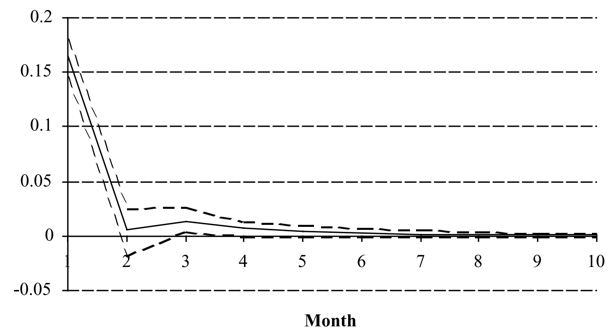
The impulse responses in Figure 7.4 provide inefficiency measures in utilizing cross-country information but they do not provide an aggregate measure for news utilization. As an aggregate measure, we construct the intertemporal

Table 7.4 Definition of country groups and country weights

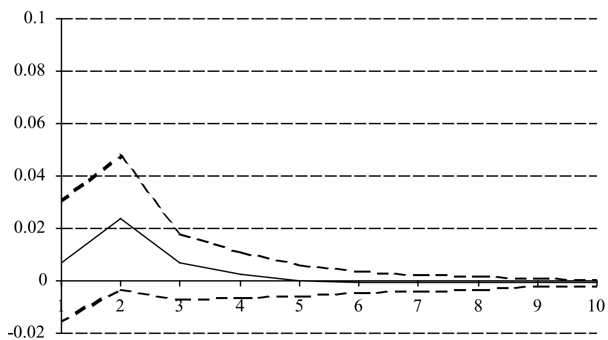
Model	*Akaike-IC*[a]	*Schwarz IC*[a]	$\bar{R}^2$ *(India)*	R^2 *(India)*
VAR(1)	−5.34	−4.20	.10	.14
VAR(2)	−5.14	−2.92	.08	.18
VAR(3)	−4.71	−1.30	.05	.20

a Akaike and Schwarz Information Criteria statistics for the whole VAR system and not only for the equation of India.

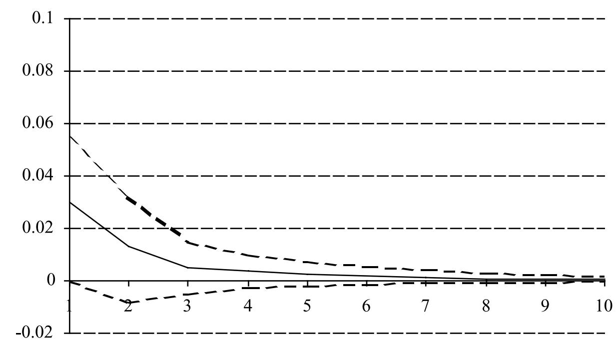
Utilization of Domestic News



Utilization of the USA News



Utilization of Japanese News



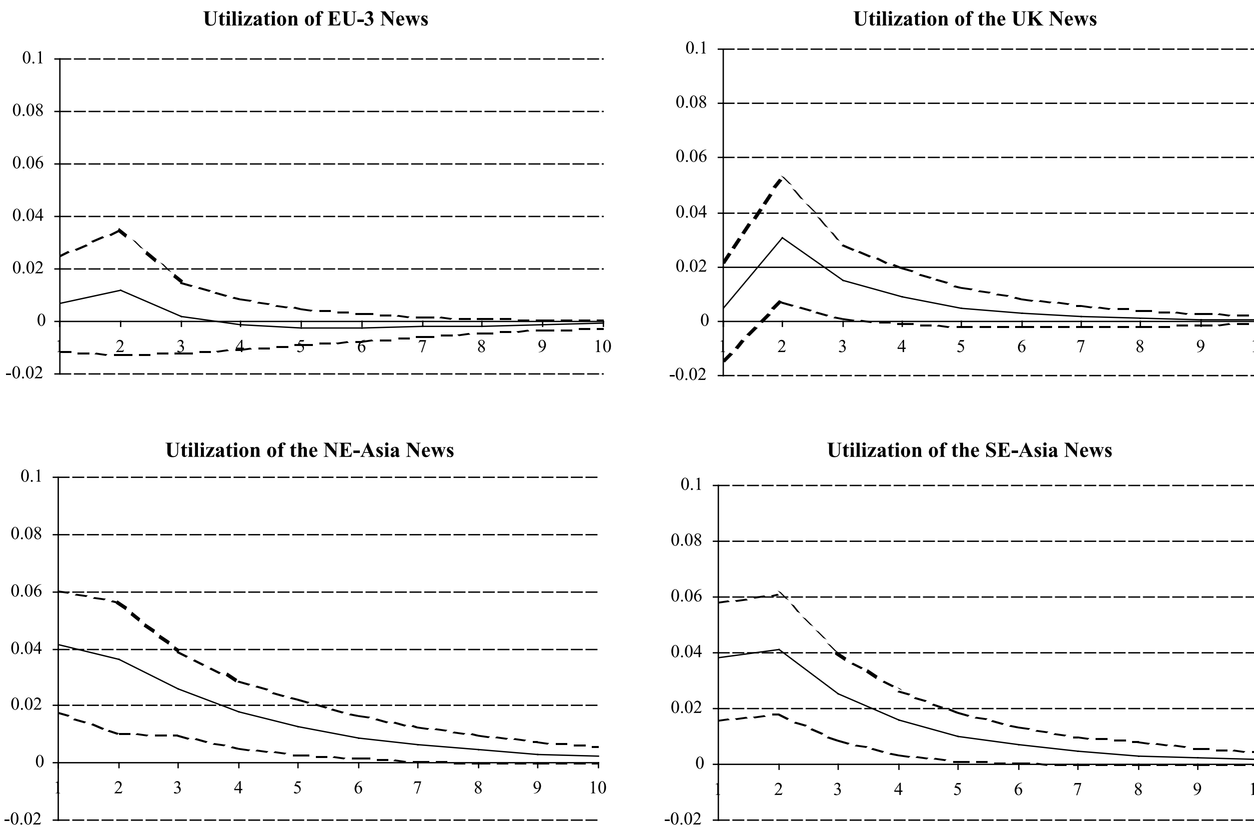


Figure 7.4 Generalized impulse responses of Indian forecast revisions.

variance decompositions for India in Figure 7.5. From this graph it can be seen that 90 percent of revision variance is accounted for by the past two months' shocks. This implies that Indian forecasters are using information quite efficiently on average and, though found inefficient by the Nordhaus test, the Indian forecasts seem to reflect new information quite promptly. Let us note that the aggregate news utilization curve as depicted in Figure 7.5 is robust to alternative identification schemes (i.e. ordering of the variables, contemporaneous restrictions, etc.) because all the countries have been aggregated in these calculations.

5.2 FSVAR results

The estimation of FSVAR is similar to the estimation of any structural VAR with one important difference. Instead of restrictions on the contemporaneous interaction among variables, or long-run restrictions, we assume that contemporaneous interactions among variables are due to common factors. This implies that the estimation is performed in two steps, similar to Clark and Shin (2000). In the first step, VAR is estimated in the usual way. In the second step, we maximize the likelihood function to find the unknowns Λ and σ_{ui}s. The confidence intervals for the impulse responses and variance decompositions are constructed by 500 bootstrap runs.

In order to estimate the FSVAR model, first we have to make sure that identification conditions are satisfied and also we have to decide on the number of common factors in the model. The order condition implies that for exact identification of this structural VAR, we need $7 \times 6/2 = 21$ restrictions and we can estimate $7 \times 8/2 = 28$ parameters (i.e. the number of single elements of the variance covariance matrix Ω). This implies that our FSVAR model is overidentified (in terms of the order condition) when $k \leq 3$. In order to uniquely identify the factor loadings we need to normalize the effect of one

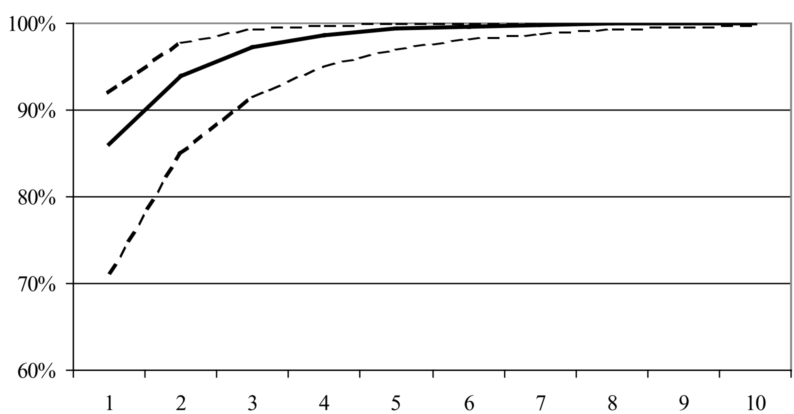


Figure 7.5 Intertemporal variance decompositions from exactly identified VAR(1) and 95% confidence bands – total (cumulative, %).

of the common factors (when k = 2) or two of the common factors (when k = 3). For example, when k = 2, we set the impact of the second factor on the US to zero. Then the total number of parameters to be estimated becomes $(2 \times 7 - 1) + 7 = 20$. Similarly, when k = 3, we set the impact of the second and third factors on the US, and the impact of the third factor on Japan to zero.[20] Then the total number of parameters to be estimated becomes $(3 \times 7 - 3) + 7 = 25$. So the FSVAR structure imposes $28 - (7 \times 3) + 7 = 14$ restrictions when k = 1, $28 - 20 = 8$ restrictions when k = 2 and $28 - 25 = 3$ restrictions when k = 3.

Using these restrictions, we tested the overidentifying restrictions and present the results in Table 7.5. The hypothesis of one common factor is strongly rejected while the hypothesis of two and three common factors are not rejected at the conventional significance levels. So we use an FSVAR model with two common factors.

The estimated impulse response functions to the domestic shocks and two common factors are given in Figure 7.6. The first chart of Figure 7.6 shows the utilization of the domestic information and 95 percent confidence intervals. Similar to the findings with generalized impulse responses, we observe that impulse responses to domestic shocks go to zero almost immediately. The second and the third charts in Figure 7.6 show the utilization of the international common factors. As opposed to the quick utilization of the domestic information, we observe some stickiness in utilization of information in the common factor. Especially, the information related with the second common factor is very slowly absorbed in the forecasts. As we will discuss later, this second common factor can be considered as the Asian common shock, which implies that Indian forecasters may increase their forecast efficiency by utilizing the Asia-related shocks more promptly.

To construct an aggregate measure of inefficiency we calculated the intertemporal variance decompositions for Indian forecast revisions. Figure 7.7 presents the intertemporal variance decompositions calculated from the FSVAR (1) model. The figure clearly shows that more than 90 percent of the forecast revision variation is captured within two months of the information becoming available. Also notice the similarity between Figure 7.7 and Figure 7.5. If the model were exactly identified then the aggregate measure of

Table 7.5 Tests for overidentifying restrictions from FSVAR(1) model (k-factor versus unrestricted error covariance matrix)

Number of factors	*d.f.*	*LR statistic*	*p-value*
1	14	81.58	.00
2	8	8.69	.37
3	3	2.38	.50

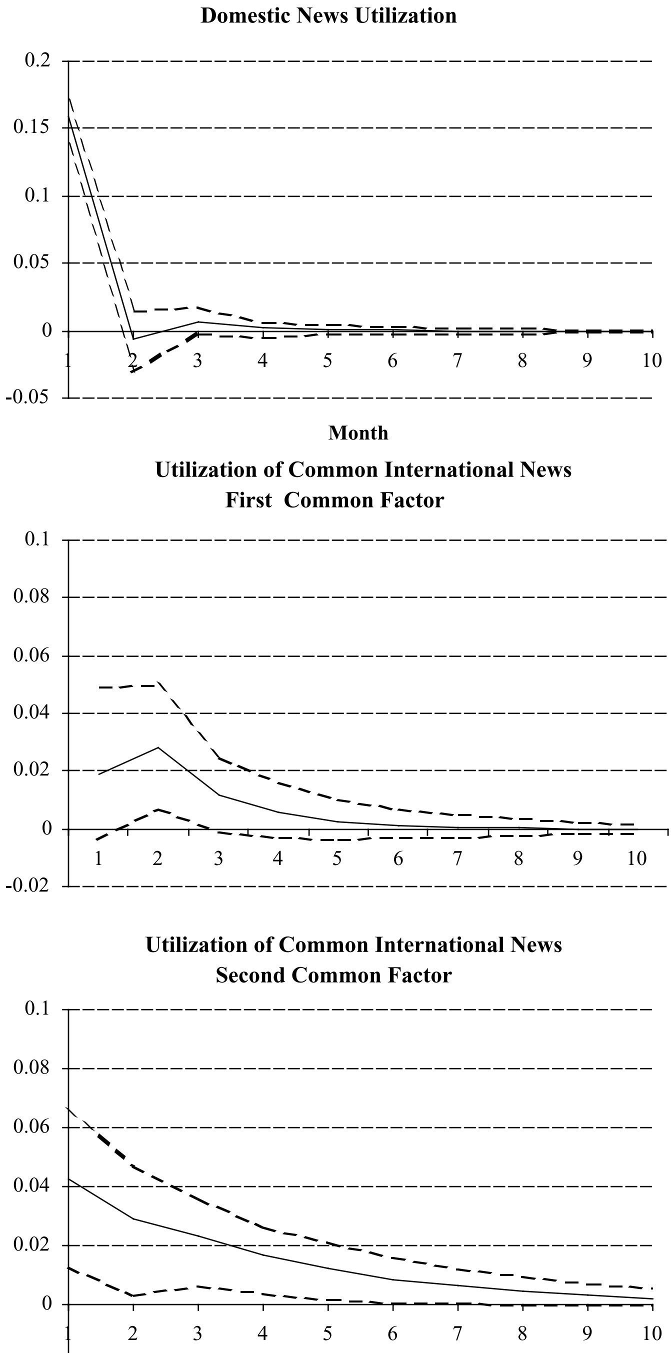


Figure 7.6 Impulse responses of India from FSVAR(1) model – domestic news and common international news.

inefficiency calculated in the previous section would be exactly the same as the aggregate measure of the model calculated here. This is because $(1/TH)\Sigma\hat{\varepsilon}\hat{\varepsilon}' = \hat{\Omega}$ would be exactly satisfied for exactly identified systems. But since the model is over-identified, our constructed errors do not satisfy $(1/TH)\Sigma\hat{\varepsilon}\hat{\varepsilon}' = \hat{\Omega}$ exactly, and hence this aggregate measure of inefficiency could be different from the previous estimate. This implies that the better the restriction imposed by equation (7) fits the model, the closer the two estimates of aggregate measure of inefficiency would be. So the similarity between Figure 7.7 and Figure 7.5 implies that the FSVAR model fits the data well and this can be taken as additional support for the FSVAR specification.

We compute the individual intertemporal variance decompositions, i.e. domestic, foreign countries and common factors. In order to be brief, we only present the most interesting results, which are the utilization of information in the common factors. The intertemporal variance decomposition for the combined common factors which is based on equation (9) is given in Figure 7.8. Similar to the findings in the impulse responses presented in Figure 7.6, we find that forecasters tend to underutilize news from common international factors initially. It takes up to four months to reach the 90 percent threshold in terms of explaining the revision variance accounted for by the two international common factors.

To be brief, we find that Indian forecasts are not efficient in the sense that forecast revisions are serially correlated (e.g. Nordhaus 1987) but the degree of inefficiency is quite low. As we have mentioned earlier, several models may explain this observed inefficiency. The evidence of inefficiency may be due to sticky information, rational inattention, credibility issues or rational bias. Another explanation may come from the inefficiency of the statistical agency processing the available information. Faust *et al.* (2005) found that the actual data revisions that are produced by the statistical agencies of the UK, Italy

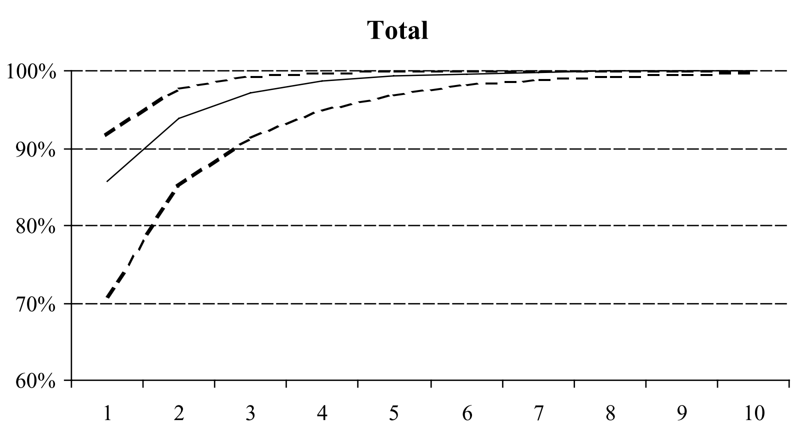


Figure 7.7 Intertemporal variance decompositions of India from FSVAR(1) ±2SE – total (cumulative, %).

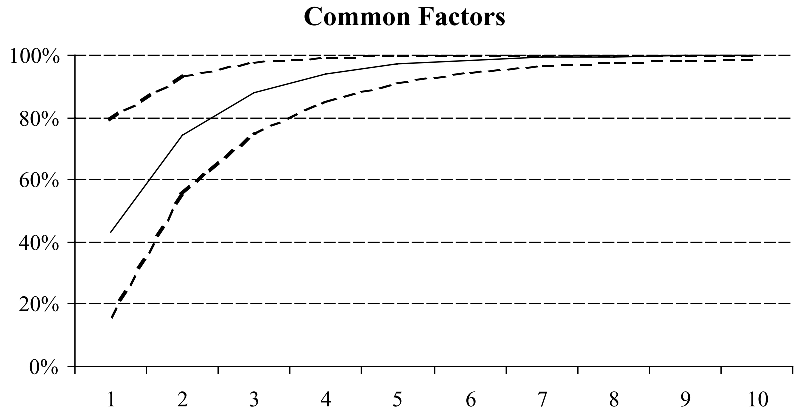


Figure 7.8 Intertemporal variance decompositions of India ±2SE – international common factors (cumulative, %).

and Japan are highly predictable, but they are much less so for the US. This implies that some part of the observed forecast inefficiency can be due to the inefficiency of the statistical agencies rather than that of the forecasters.[21]

We should again point out that our methodology for testing for forecast efficiency and studying the causality of international shocks are independent of the actual values that are only subsequently observed. That is, we do not need the actual forecast errors in our analysis. Apart from the fact that forecast errors are observed much later than when forecasts are made, any analysis based on forecast errors (i.e. actual minus predicted) has very little value in real time. In addition, the forecast errors depend on data revisions, which are sometimes substantial. Not surprisingly, the Indian GDP figures go through substantial data revisions. For instance, the initial June value of the year-over-year growth rate in real GDP for FY 2000 was revised from 6.0 percent in June 2001 to 4 percent in February 2002. Since 1995 such revisions have been nearly 0.5 percent on average.

6 Empirical results on transmission of shocks as implied by forecast data

6.1 Under perfect efficiency – static factor analysis

Under the assumption that forecast data is efficient the cross-country correlations of forecast revisions show the importance of cross-country linkages in monthly shocks. We provide these correlations in forecast revisions across seven selected countries and country groups in Table 7.6. As seen in this table, the correlations for India with the USA, EU-3 and UK are only around 0.12; the corresponding values for the Southeast Asian region (0.39), Japan (0.31),

Table 7.6 Correlations of forecast revisions

	EU-3	*India*	*Japan*	*NE-Asia*	*SE-Asia*	*UK*	*USA*
EU-3	1.00						
India	0.12	1.00					
Japan	0.49	0.31	1.00				
NE-Asia	0.14	0.38	0.33	1.00			
SE-Asia	0.16	0.39	0.40	0.75	1.00		
UK	0.75	0.14	0.43	0.24	0.30	1.00	
USA	0.59	0.11	0.38	0.31	0.21	0.47	1.00

and the Northeast Asian region (0.38) are much higher. By contrast, the correlations between the Northeast Asia region and the Southeast Asia region, and between EU-3 and the USA, EU-3 and the UK are in excess of 0.50. Note that these contemporaneous correlations can be due to production, consumption and FDI interdependencies, or common exogenous shocks without such interdependencies; see Canova and Marriman (1998) and Ghatak and Halicioglu (2007).

To observe how these correlations change over our sample we constructed the correlations of the forecast revisions of the three countries and three country groups with respect to Indian forecast revisions over a rolling window of 36 observations. The results are presented in Figure 7.9. The first figure presents the correlations for Japan, Southeast Asia and Northeast Asia and the second figure presents the correlations for the US, the three countries of the European Union and the UK. On the horizontal axis we give the periods over which the correlations are calculated. Notice that 36 observations represent a 21-month period; this is because the forecasters report two forecasts each month, and also we drop three observations to match the fiscal year and calendar years. The correlations show that typically forecast revisions of the Asian countries have larger correlations with Indian forecast revisions than those of the US, the EU or the UK. Especially from 1997 to 1998, a period that covers the Asian crisis, the correlations with Northeast Asia and Southeast Asia increase to over 0.60. Another interesting observation from the first figure is that the correlations of the Asian countries seem to be moving together, which may suggest the existence of a common Asian business cycle. Later, when we present our results of the FSVAR model, we will address this issue again and show that there really is a strong common factor that affects the Asian countries.

As discussed earlier, if we assume that the forecasts are efficient then static factor analysis methods provide evidence about how common factors impact individual countries' real GDP growth. We use factor analysis to shed light on how the economies naturally group together in terms of the reaction to the common factors. Table 7.7 presents such factor loadings for the selected countries and country blocks estimated based on equation (10). Identification

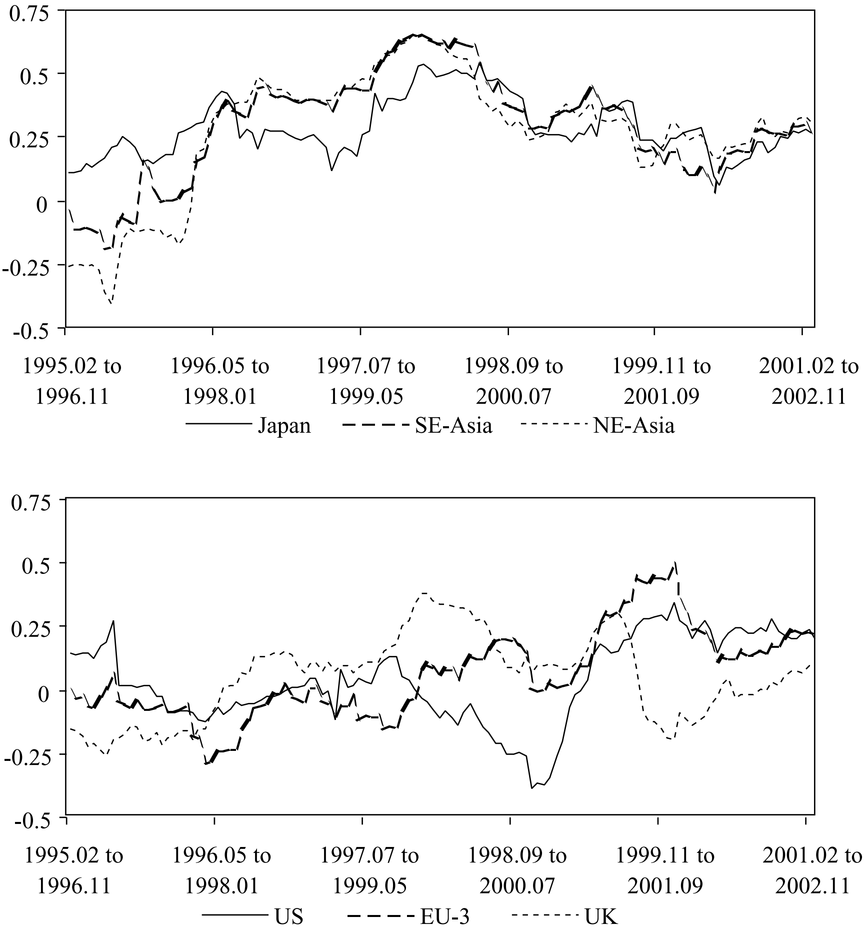


Figure 7.9 Rolling correlations with Indian forecast revisions using a window of 36 observations.

problems can be solved in two different ways in the static factor analysis. One way is to impose a normalization pattern on the estimated factor loadings as we discussed earlier. A second approach is applying an orthogonal transformation on the estimated factor loadings. In Table 7.7, we used Varimax transformation to get meaningful estimates for the factor loadings. We report the results for two and three common factors. The null hypothesis that the number of factors is sufficient is not rejected for both the models with p-values of 0.61 and 0.57 for the two and three common factor models respectively. When we consider two factors, we see that the first common factor contributes highly to the forecast revisions of Southeast Asian and Northeast Asian country groups. It also contributes to the Indian and Japanese forecast revisions but to a lesser extent. The second common factor

Table 7.7 Static factor analysis

	2 factors		*3 factors*		
	Factor 1	*Factor 2*	*Factor 1*	*Factor 2*	*Factor 3*
EU-3	0.05	**0.91**	0.03	**0.88**	0.07
India	0.42	0.11	0.25	0.06	**0.97**
Japan	0.40	0.28	0.35	0.29	0.21
NE-Asia	**0.81**	0.29	**0.75**	0.31	0.18
SE-Asia	**0.94**	0.04	**0.97**	0.05	0.16
UK	0.28	**0.50**	0.26	**0.51**	0.05
USA	0.18	**0.64**	0.16	**0.66**	0.03

Note: Table presents the factor patterns estimated by Maximum Likelihood estimation and that are transformed using an orthogonal transformation (Varimax). The test statistics for the null hypothesis on the sufficiency of the number of factors have p-values 0.61 and 0.57 for the two and three factor models respectively, not rejecting the null hypothesis. Entries greater than 0.5 are shown in bold.

contributes highly on EU-3 group and also to the USA and the UK. These results imply that when we assume two common factors we observe two distinct business cycles. The first one affects mainly the East Asian countries and India, and the second common factor affects the Western countries, i.e. EU-3, USA and UK.

With three common factors, the first common factor contributes to Northeast and Southeast Asian countries as before and the second common factor contributes to EU-3, USA and UK as before. The last common factor now contributes mainly to the Indian forecast revisions, implying that the Indian business cycles may have some distinct movements that are not captured by either the East Asian or Western business cycles. Also let us note that the Western common factor (factor 2) does not contribute any significant amount to the Indian real GDP forecast revisions. These results imply that India is affected more by the East Asian common factor than the Western common factors, and it is also largely affected by domestic shocks. So far we have assumed that the forecasts are efficient. In the next section we assume that the forecasts are not efficient in the short run but are efficient in the long run.

6.2 Under long-run efficiency – FSVAR model results

The estimated variance decompositions are given in Table 7.8. The first international common factor seems to be the common factor among US, UK and EU-3 (Western common factor). The second factor, on the other hand, can be interpreted as the common factor across the Asian countries. Especially for Southeast Asia the importance of this second factor is very large. It accounts for 76 percent of the Southeast Asian real GDP growth shocks. Since our sample period covers the Asian financial crisis, it is very likely that this second

Table 7.8 Steady-state variance decompositions for all countries from FSVAR(1) model with two common factors (full sample results)

Two common factors
(Over identification test p-value = 0.37)

	Source of the shock:								
Impact on:	*Factor 1*	*Factor 2*	*US*	*Japan*	*EU-3*	*UK*	*SE-Asia*	*NE-Asia*	*India*
US	**52%**	0%	**40%**	2%	0%	1%	1%	2%	2%
Japan	13%	**34%**	1%	**36%**	2%	3%	1%	9%	1%
EU-3	**65%**	3%	1%	0%	**14%**	9%	1%	1%	5%
UK	**25%**	6%	1%	1%	0%	**65%**	1%	0%	2%
SE-Asia	5%	**76%**	1%	1%	2%	3%	**9%**	4%	0%
NE-Asia	14%	**56%**	0%	0%	2%	3%	2%	**22%**	0%
India	8%	**38%**	0%	1%	2%	5%	1%	3%	**42%**

Note: Steady-state variance decompositions are calculated from 31-period ahead forecast error variance shares (from squares of the aggregated impulse responses) of the FSVAR (1) model with two common factors. The largest two contributions for each country are shown in bold.

common factor is mainly capturing the common behavior of the GDP growth rates of the region countries during the Asian crisis. The Asian crisis started in Thailand in July 1997 and quickly spread to the other Southeast Asian countries. The Northeast Asian region is affected less by this common shock partly because China is a member of this group, and was much less affected compared to other Asian countries. India is another country that was not affected much by the Asian crisis but the variance decompositions show that while the Asian common factor accounts for 38 percent of the Indian GDP growth variance, the share of domestic shocks in Indian GDP growth is around 42 percent.

In mid 1997 and 1998 we saw that current and next year forecasts had very large common movements due to the Asian crisis, which may have caused increased comovement of the GDP variations over a short period of time. In order to test for the impact of the Asian crisis on our estimates, we estimate the model after excluding the survey data from the period 1997.7 to 1998.12. The results with two common factors are reported in the first panel of Table 7.9. As expected the share of the Asian common factor decreases to 16 percent and the share of domestic shocks becomes 61 percent. In addition to the decreasing effect of the second common factor, we also see that the first common factor's importance increases for all of the countries including India.[22] After the Asian crisis period is excluded, what we labeled as the "Western" cycle becomes more like a "world shock" that is affecting all the countries significantly. Moreover, results for the Southeast Asia region suggest that we may not need the second common factor at all. When we exclude the Asian crisis, the share of domestic shocks in the Southeast Asia region becomes zero and factor 1 and factor 2 together explain

Table 7.9 Steady-state variance decompositions for all countries from FSVAR(1) model (excluding the Asian Crisis 1997.7–1998.12 survey data)

Two common factors
(Over identification test p-value = 0.45)

	Source of shock:								
Impact on	*Factor 1*	*Factor 2*	*US*	*Japan*	*EU-3*	*UK*	*SE-Asia*	*NE-Asia*	*India*
US	**61%**	0%	**26%**	2%	0%	1%	0%	8%	2%
Japan	**34%**	**22%**	0%	**31%**	0%	1%	0%	7%	4%
EU-3	**72%**	0%	0%	0%	**8%**	6%	0%	6%	7%
UK	**36%**	13%	2%	0%	1%	**43%**	0%	2%	3%
SE-Asia	**37%**	**48%**	0%	0%	1%	1%	0%	10%	2%
NE-Asia	**41%**	**24%**	1%	1%	1%	1%	0%	**30%**	2%
India	**16%**	**16%**	0%	0%	1%	2%	0%	3%	**61%**

One common factor
(Over identification test p-value = 0.02)

	Source of shock							
Impact on	*Factor 1*	*US*	*Japan*	*EU-3*	*UK*	*SE-Asia*	*NE-Asia*	*India*
US	**63%**	**25%**	2%	0%	1%	0%	7%	2%
Japan	**48%**	0%	**34%**	1%	1%	5%	7%	4%
EU-3	**68%**	0%	0%	**13%**	7%	0%	6%	7%
UK	**42%**	2%	0%	1%	**46%**	4%	1%	4%
SE-Asia	**51%**	0%	1%	2%	1%	**33%**	10%	2%
NE-Asia	**54%**	1%	1%	1%	1%	11%	**29%**	2%
India	**23%**	0%	0%	1%	2%	5%	3%	**65%**

Note: Steady-state variance decompositions are calculated from 31-period ahead forecast error variance shares (from squares of the aggregated impulse responses) of the FSVAR (1) model with one and two common factors. The surveys that are reported between July 1997 and December 1998 are excluded from the analysis. The largest two contributions for each country are shown in bold.

85 percent of the total GDP variation in the region, which suggests that the use of only one common factor may be preferable. So we estimate the model assuming a single common factor and the results are reported in the second panel of the table. The p-value from the LR test for the null hypothesis of a single common factor is now 0.02 and not rejecting the null hypothesis at 1 percent significance level. The single common factor now accounts for a significant share of the GDP variation in all of the countries. Since the impact of the common factor is widespread, we can now think of this common factor as a world shock. For India, it accounts for 23 percent of the variation while India's domestic shocks account for 65 percent of the total variation.

As mentioned earlier, our estimates are biased in favor of finding a large share for the common factors and underestimating the impact of individual country shocks. This means that the large shares of common factors given in Table 7.8 and Table 7.9 in the US and EU-3 GDP variations may be actually driven by idiosyncratic shocks of the US and/or Europe. But our current model does not let us identify this since so far we assume that $A = I$ in equation (7). Remember that the A matrix shows the contemporaneous utilization of news from the transmission of idiosyncratic shocks across countries (i.e. spillovers).

The suspiciously high contribution of the common factor to US and EU-3 real GDP variations prompts for a robustness check. To test this we make slight modifications to the A matrix in equation (7). We let A have nonzero elements in the column that corresponds to the US data, so that we let US shocks be utilized contemporaneously in other countries' GDP growth forecasts. But if we let US shocks have an effect on the other countries in the model then the impact of common factors and the US will not be individually identified.[23] In order to identify the model, we need to impose additional restrictions on A. Based on our previous findings, we assume that the first common factor does not have contemporaneous impact on Japanese GDP growth and the second common factor does not have contemporaneous impact on EU-3.[24] In this way, the degree of freedom becomes 9 for the single factor model and 4 for the two-common-factor model. The results of the estimations along with the corresponding LR test results are presented in Table 7.10.

The first part of Table 7.10 presents the results with two common factors. As expected, the share of the US shocks on other countries increases. For example, US shocks account for 90 percent of the US GDP growth variations and 58 percent of the EU-3 GDP growth variations. But still we see that the US shocks do not account for more than 5 percent of the real GDP variations in Asian countries. Also note that the results with two common factors are not very reasonable in the sense that idiosyncratic EU-3 shocks account for less than 1 percent of the EU-3 GDP growth variations. Also the first common factor looks irrelevant because, except EU-3, no other country is affected by this common shock significantly. Because of these reasons, we also give the results of the model with a single common factor in the second part of the table. The results in this table imply that the first common factor is a common factor across the Asian countries and the US factor is the first or the second largest contributor of the GDP variations in most of the countries. But even in this model India seems not to be affected by US shocks. In addition, the overidentifying test statistics have a p-value less than 1 percent and the null of a single common factor is strongly rejected.

The finding that India's GDP shocks are driven mainly by the Asian common factor and not by the Western countries is reasonable when India's "Look East Policy", which has been in effect since the early 1990s, is considered. It is very possible that with the signing of new trade agreements between India and the other Asian countries, the importance of the Asian factors will increase in the future even more.[25]

Table 7.10 Steady-state variance decompositions for all countries from FSVAR-US (1) model when forecast horizon for India ≥ 6

Two common factors
(Over identification test p-value = 0.28)

Impact on:	*Source of shock* Factor 1	*Factor 2*	*US*	*Japan*	*EU-3*	*UK*	*SE-Asia*	*NE-Asia*	*India*
US	2%	0%	**90%**	2%	0%	1%	1%	2%	2%
Japan	1%	**42%**	4%	**37%**	0%	3%	1%	9%	1%
EU-3	**24%**	0%	**58%**	0%	0%	10%	1%	1%	5%
UK	2%	13%	10%	1%	0%	**71%**	1%	0%	2%
SE-Asia	3%	**77%**	0%	1%	0%	3%	**12%**	4%	0%
NE-Asia	1%	**68%**	3%	0%	0%	4%	2%	**21%**	0%
India	1%	**45%**	2%	1%	0%	5%	2%	3%	**42%**

One common factor
(Over identification test p-value = 0.00)

Impact on:	*Source of shock* Factor 1	*US*	*Japan*	*EU-3*	*UK*	*SE-Asia*	*NE-Asia*	*India*
US	1%	**90%**	2%	1%	1%	2%	1%	2%
Japan	**33%**	14%	**37%**	4%	4%	3%	5%	1%
EU-3	0%	**43%**	0%	**35%**	12%	3%	1%	6%
UK	8%	11%	1%	1%	**77%**	2%	0%	2%
SE-Asia	**56%**	7%	1%	5%	3%	**26%**	2%	0%
NE-Asia	**61%**	**15%**	0%	4%	4%	4%	10%	0%
India	**35%**	8%	1%	3%	5%	3%	2%	**42%**

Note: Steady-state variance decompositions are calculated from 31-period ahead forecast error variance shares (from squares of the aggregated impulse responses) of the FSVAR-US (1) model with one and two common factors. The largest two contributions for each country are shown in bold.

So far we have identified the existence of an Asian common factor, but we did not discuss what constitutes this "Asian common factor." Since we only analyze the post-1995 period we can think of these common factors as regional shocks that affected the Asian countries exclusively. The change in the demand for semiconductors, Japanese stagnation, appreciation and depreciation of the US dollar against the Japanese yen and European currencies since 1994, which affected most of the Asian countries since their currencies are pegged against the US dollar, can be given as examples.

7 Concluding remarks

In this chapter we have studied the sources of Indian real GDP variations using monthly forecast data. Since 1989, the Consensus Economics Service

Inc. has been providing such data on a number of macroeconomic variables for a large number of countries. Because these forecasts come on a monthly basis, the usefulness of such information for real-time macroeconomic management (e.g. inflation and GDP growth targeting) can not be overemphasized. The track record of automated forecasts based on macro models has been disappointing due to structural breaks and specification instability. As a result, there has been a renewed interest in survey forecasts. Even though these forecasts tend to respond to current news well, they are found to be somewhat sluggish in their adjustments. Many behavioral and institutional explanations have justified the apparent irrationality of these forecasts.

In order to use the forecast data to extract important information on the economic fundamentals, we started our analysis by providing forecast evaluation tests for fixed-event forecasts. We proposed an econometric framework to analyze the monthly fixed-target real GDP forecasts of India where forecasts for its major trading partners are also considered simultaneously. Our framework is useful not only for testing the forecast efficiency but also to estimate the degree of efficiency. Using monthly data over the period from January 1995 to November 2002, we found that the real GDP forecasts are not fully rational. In addition to India, we also considered forecasts for the US, UK, European block, Japan, Southeast Asia and Northeast Asia to examine whether Indian forecasters incorporate news coming from these country blocks correctly. Indeed, our evidence suggests, whereas the domestic information is incorporated in forecast revisions in a rational manner, foreign news takes a little longer to be fully reflected in forecast updating. Thus, the observed inefficiency in Indian real GDP forecasts is due to forecasters' sluggishness in reacting to foreign news. It takes nearly four months for foreign news to be fully reflected in Indian forecast revisions. Nevertheless, the quality of these forecasts compares very favorably to those of the US and Canada.

After detecting the degree of inefficiency in the forecasts, we provided an "efficiency adjusted" utilization of cross-country news components and then studied the transmission of shocks across countries, including common international shocks in our model. By assuming that the forecasters are long-run efficient we constructed average variance decompositions for Indian real GDP shocks and found that almost 60 percent of the real GDP shocks for India come from foreign countries, and the rest is explained by domestic shocks. We saw that the Asian common factor is the second largest contributor after the domestic shocks, accounting for 38 percent of the Indian real GDP growth variations. However, when we excluded the surveys reported during the Asian crisis (1997.7 to 1998.12), we saw that the contribution of domestic shocks increased to 61 percent and the Asian common factor contributed only 16 percent of the variations, which is also the same as the contribution of the Western common factor. The relatively large contribution of domestic shocks is consistent with a basic distinguishing characteristic of developing countries where much of the forecast revisions can be attributed to volatile domestic shocks due to political uncertainty, vagaries of monsoon, natural disasters, monetary policies, budget announcements, data revisions, and the like.

One advantage of our approach is that the analysis of transmission of shocks is studied in real time, and does not depend on the actual values of the variable that are observed much later than the forecasts. Apart from the uncertainty due to data revisions, any analysis based on forecast errors has very little value in real time.

Much remains to be done in utilizing this multi-country forecast data. In addition to real GDP, one can also use forecast information on inflation, interest rates and exchange rates available in the data set to build multivariate models that can discriminate between demand shocks and supply shocks. The forecasts for real GDP, inflation and exchange rates will move in the same or opposite directions depending on the nature of the shocks. The type of shocks in turn determines the type of monetary, fiscal and exchange rate policies the government should undertake. Since these shocks can potentially be identified on a monthly basis in real time, appropriate stabilization policies can conveniently be fine-tuned for sound macroeconomic management. Given all this potential, as years pass, the value of this forecast data is sure to grow like old wine.

Notes

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3 As it will be clear later, for our purpose, we do not need the forecasts to be rational in the sense of Muth (1961); instead, we require a much less stringent condition that the forecasters eventually use all available information. More specifically, the agents may be inefficient (and biased) in absorbing the impact of shocks in their forecasts immediately, but under the condition that they adjust eventually, we show that the forecast data can be fruitfully used for extracting information about the underlying economic structure.

4 Sims (2003) has proposed an alternative model of inefficiency that is based on the assumption of limited processing power of agents.

5 Studies that point out the smoothness are Nordhaus (1987), Clements (1995, 1997) and Harvey *et al.* (2001).

6 Available HTTP: <http://www.consensuseconomics.com> (accessed 30 September 2008).

7 These are the latest revisions released in June by Central Statistical Organizations for each year.

8 This point has been documented by Gallo *et al.* (2002) for GDP forecasts of three developed countries.

9 In recent years, a number of authors have given alternative behavioral and institutional explanations for the observed lack of rationality in survey forecasts. See, for instance, Ehrbeck and Waldman (1996), Laster *et al.* (1999), Mankiw and Reis (2001) and Sims (2003).

10 Before measuring the degree of inefficiency in the forecasts we first tested for the forecast efficiency following Nordhaus (1987). Using a GMM framework similar to Davies and Lahiri (1995), we found that the Indian real GDP growth forecasts are inefficient. Note that the validity of rational expectations has an important bearing on tests for Ricardian equivalence, permanent income/consumption hypothesis, etc. See Ghatak and Ghatak (1996) for a serious attempt to grapple with this issue using Indian data.

11 Later, we will experiment with some alternative specifications for the *A* matrix by allowing some off-diagonal elements to be non-zeros. Note that spillovers in this model take place via the lagged terms of the VAR model. With monthly data, this assumption is less restrictive than with quarterly data, cf. Stock and Watson (2005).

12 For example, in his VAR(2) model of Thailand, the number of right-hand-side variables is 14 due to the presence of lagged terms, dummy variables and commodity prices. Since Selover (1999) has 35 usable observations (1963–97), the degree of freedom becomes only 21.

13 For example, the rupee was devalued by 22.8 percent relative to a basket of currencies in 1991 and was made convertible in 1993. The import-weighted average tariff for the whole economy was brought down to 33 percent in 1994–95 from 87 percent in 1990–91 and has remained relatively stable since then. In 1991, many restrictions on the inflow of foreign direct investment (FDI) were removed although FDI is still prohibited in certain sectors of the economy such as retail trade. See Srinivasan (2001) for a detailed analysis of the reforms that took place in India during the post-1991 period, and Ghatak and Halicioglu (2007) for the role of FDI in the transmission mechanism.

14 For example, both the exports and imports started to grow as large as 20 percent in the early 1990s until 1995–96. Since 1996, the growth rates of exports and imports have been mostly less than 10 percent. Similarly, the share of exports plus imports as a percentage of GDP increased from 14.4 percent in 1991–2 to 21.6 percent in 1995–6 and has remained stable since then. Liberalization of FDI policy and reforms boosted the FDI inflows in India in the early 1990s until 1996. In 1991 FDI inflows to India were only US$155 million. During the period from 1991 to 1995 inflows approximately doubled in every year, reaching US$2.1 billion in 1995. Based on the World Investment Reports of UNCTAD, since 1995 FDI inflows have grown relatively slow, reaching US$3.4 billion in 2001 and staying the same in 2002.

15 An alternative approach would be to use some monthly data such as industrial production. However, the differences in the growth rates of the industry, service and agriculture sectors and the increasing share of the service sector in the economy causes a problem in using industrial production data. For example, as is analyzed in detail by Gordon and Gupta (2003), over the period from 1991 to 2000, the service sector grew by 7.5 percent, while the industry sector grew by 5.8 percent and the agriculture sector by only 3.1 percent, resulting in an average GDP growth of 5.8 percent.

16 Our cross-country forecast data can be used to understand how expectations are changing and are affected by changes in the expectations of other countries. Such information may be important, for example, to understand the reasons behind the Asian financial crisis. One argument as to why the Asian crisis occurred is that the agents had overly optimistic GDP growth expectations before the crisis, which caused them to save less but consume and invest more than optimum, and financed

by large capital inflows. But when an external shock led to a sudden change in the expectations, a rapid reversal of capital flows triggered a currency crash. Corsetti *et al.* (1999) offers a number of explanations for the Asian crisis. So in order to understand the importance of the role of expectations in the crisis, it would be interesting to study how expectations reacted to shocks and how they propagated among the countries.

17 Note that when there is not enough time, i.e. when $h \leq p$, the full amount of the information will not be utilized in the forecasts; instead the total utilization of the news will be the sum of the moving average coefficients over the forecast horizon, i.e. $\Sigma_{r=0}^{h} M_r$.

18 We also estimate the VAR model using six individual countries that have the largest trade with India. These are USA, UK, Japan, Germany (representative for the European block), Singapore (representative for the Southeast Asian block), and Hong Kong (representative for the Northeast Asian block). The results with the seven individual countries as defined above were very similar to the main conclusions of this chapter.

19 Consider a VAR(3) model. After taking the first difference to calculate the forecast revisions, we are left with 20 observations per country per year. Due to the use of third lag, we have 17 observations per country per year. So from 1996 to 2001 we have 17 observations, for 1995 we have eight observations (the first available forecast is January 1995), for 2002 we have 16 observations (since the latest available forecast is November 2002) and for 2003 we have 4 observations. So in total we have $17 \times 6 + 8 + 16 + 4 = 130$ observations for each country. Similarly the VAR(1) model will have 148 observations.

20 Note that while the interpretation of common factors changes depending on which countries are used for normalization, the intertemporal variance decompositions and so the results of this study are not affected by the normalization scheme.

21 It will be interesting to examine whether the real GDP revisions produced by CSO of India have any predictable component; see Faust *et al.* (2005) and Mankiw and Shapiro (1986).

22 We also estimated models after discarding three obvious outliers during the Asian crisis. These outliers are the current and next year forecasts reported in 1998.6 and next year forecasts reported in 1998.5. The results are similar to the ones reported in the sense that the Asian common factor's contribution decreases substantially but it does not decrease as much as when we exclude the Asian crisis period altogether.

23 More specifically, in the variance decompositions the sum of shares of the variances accounted for by the common factors and the US will be fixed. So the other countries' shares in the variance decompositions will be identified but not between the US and the common factors.

24 Remember that we have already one restriction on the impact of the second common factor on the US.

25 India signed bilateral free trade agreements with Nepal, Sri Lanka and, in August 2004, with Thailand. Such agreements with other Asian countries including China and Singapore are also under way.

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8 Money demand in China

Evidence from a bounds testing cointegration approach[1]

Anita Ghatak and Qing Zhang

1 Introduction

Demand for money plays an important role in macroeconomic analysis. The stability issue in money demand functions becomes an interesting area for researchers to test the effectiveness of monetary programmes. A number of studies on the relationship of money, financial development and economic growth in China have been well demonstrated by economists in the past (Chow 1987; Chen 1989; Yi 1993; Qin 1994; Huang 1994; Tseng *et al.* 1994; Girardin1996; Arize 2000; Gu 2004). Finding a stable money demand function is generally considered essential for the formulation and conduct of efficient monetary policies. In recent years, the Chinese economy has undergone profound changes. China's economic reforms, rapid growth, structural changes and dramatic monetary expansion have been of major interest to economists and provide a useful explanation of money demand in China. Many of these studies demonstrate that a long-run relationship exists between money demand and its determinants. Some of the studies showed that the demand for money in China has changed significantly in response to economic reform (Yi 1993; Qin 1994). The conventional study of money demand in China is based on a framework which suggests that money demand is generally determined by some scale variables such as income and opportunity cost like domestic interest rate. With the rapid liberalization of the financial markets of recent years in China, some special features since reform have become apparent: the monetization process accompanied by rapid income increase of both individuals and enterprises has boosted money demand; wages as part of income has changed significantly during the reform; household savings have been sensitive to changes in price levels and interest rates. These features are of increasing importance to the determinants of money demand. The objectives of this study, therefore, are twofold: first, we try to find a more appropriate and satisfactory money demand function in China. Second, we try to explore a few more other influences regarding the nature of money demand behaviour and intend to establish the empirical suitability of the extended demand for money function for the Chinese economy. The influences of economic reforms will be highlighted.

This chapter is divided into six parts. Part 2 provides a summary of the relevant literature so as to provide a better understanding of the Chinese monetary system and its institutional changes. Part 3 summarizes the influences of other variables on money demand functions in the specific context. Part 4 outlines the equations and time series methodologies to be utilized. Part 5 demonstrates the empirical results and the last part draws conclusions.

2 Literature review

Money is defined as a medium of exchange, a store of value, a unit of accounting and a source of deferred payment. Numerous studies have empirically examined the money demand functions in both developed and developing countries in the past. The econometric advances in the last two decades, especially in the case of cointegration techniques, have enabled researchers to test more vigorously the stability issue of money demand functions. More empirical investigations of the demand for money functions for the long run and short run have been provided by many economists. Sriram (2001) has provided a comprehensive survey of the empirical literature on demand for money in various countries and presented relevant information in a comparable framework to promote easy understanding of the approaches used. Sriram indicates that the extensive literature underscores two major points relevant to modelling and estimating the demand for money: variable selection and representation and framework chosen (Sriram 2001). The studies relating to Less Developed Countries (LDCs) have yielded additional evidence on the role of money demand and its determinants and provided useful framework for the research in China.

The empirical work on money demand in China was started by Chow (1987). Chow's work on money and price level determination in China attracted theoretical interest all over the world. Chen (1989) investigated causal relationships between three alternative monetary aggregates and four indicators of macroeconomic performances – economic development, budget deficit, trade deficit and price stability in mainland China. It was found that a causal relationship existed among currency and nominal income, budget deficit, trade deficit and total inflation. Hence, around the 1980s, currency was the best target for monetary policy (Chen 1989). The measure of the opportunity cost of holding money in some of the previous studies was omitted. This was because during the period from 1952 to 1988 in China, interest rates had been strictly controlled and virtually fixed at a level far below the equilibrium level (Yi 1993). It would be natural to include the inflation expectation in the money demand model as an explanatory variable. However, some of the previous studies in China omitted it, and the reason was quite obvious. The official retail price level was virtually frozen during the period 1952 to 1978 and the market price level was also relatively stable before the economic reform, so it is fair to say that the inflation rate was extremely low during that period (Yi 1993). Yi's work also demonstrated that the growth rate of money supply accommodated both GDP growth and the monetization process. Both Yi (1993) and Qin (1994) were concerned with the effects of economic reform on the money demand function in China. Girardin (1996) discussed the question, 'Is there a long-run demand for currency in China?' The record of Chinese monetary authorities at targeting m_0 in the late eighties and early nineties was rather poor. Girardin's (1996) research aims at determining whether the instability of currency demand is responsible for this. The empirical results show that, using adequate economic econometric techniques, a long-run demand for currency did exist over the period of 1988 to 1993 with quarterly data. Another objective of Girardin's research was to test for the robustness of the result. Most previous studies concluded that the income elasticity of currency demand was very high. Girardin's work showed that the income elasticity is unity when proper account is taken of institutional variables representative of the transition process. Yu and Tsui (2000) constructed a Monetary Services Index (MSI) for China. Compared to the traditional simple money aggregates, this index has solid microeconomic foundations and has consistent variables. A more recent study from Gu (2004) revealed that a stable long-run money demand function for both narrow and broad money exists in China over the period 1952 to 2000. Gu (2004) found a couple of weaknesses in the structural break test. To arrive at a better understanding about the money demand in China, Table 8.1 and 8.2 summarize the results of some of these previous studies of demand for money in China. Table 8.1 presents details relevant to modelling and estimating the demand for money in China. Table 8.2 summarizes the long-run coefficients from those studies listed in Table 8.1.

The studies in the summary from Tables 8.1 and 8.2 cover the sample period from 1952 to 2000 and monetary aggregates considered are narrow money m_0 and broad money m_2, though Tseng's work also considered narrow money m_1. The long-term interest rates are considered widely by the researchers as an opportunity cost of holding money. Some of the studies also present evidences on the effect of the inflation variability on the demand for real money balances in China. The findings of the above studies demonstrate that a long-run stable relationship exists between real balances and their determinants. In terms of methodologies, some studies construct an error correction model (ECM) to evaluate the dynamic adjustment process of money demand in China in the reform period and a few of them employed Johansen (1988) and Johansen and Juselius (1990) cointegrating techniques to examine the long-run relation between demand for money and its determinants. There is no previous empirical evidence on studies of money demand in China by using the Pesaran *et al.* (2001) method.

3 Factors affecting money demand in China

This section aims to formulate some alternative money demand equations in the case of China. The independent variables in the demand for money

Table 8.1 Summary of demand for money studies in China

Authors	*Sample period/ frequency*	*Monetary aggregate*	*Determinants*				*Unit root test*	*Cointegration techniques*	*Stability tests*	*ECM*	*Findings*
			Scales variables	*Interest rates*	*Price index*	*Others*					
Chow (1987)	1952–1983 (Annual)	Real m_0	Real GNP	–	RPI	–	–	–	–	–	The quantity theory provides a useful point to explain price levels in China.
Burton and Ha (1990)	1983–1988 (Quarterly)	Household Money balances	Real GNP	–	RPI	Inflation RPI based.		EGC	–	–	Inflation is included as explanation variables
Yi (1993)	1952–1989 (Annual) 1983–1989 (Quarterly)	Real m_2 Real m_2	Real GNP	–	OPI & MPI	UP Dummy	DF	–	–	–	Economic reform and monetization process influence money demand significantly
Tseng *et al.* (1994)	1983–1988 1989–1993 1983–1993 (Quarterly)	Real m_1 Real m_2	Real national income	–	RPI	Inflation RPI based	ADF	EGC J (1988) JJ (1990)	Chow	Yes	All monetary aggregates are sensitive to inflation. Interest rate has significant influence on m_1 and m_2.
Qin (1994)	1952–1991 (Annual) 1978–1991 (Quarterly)	m_0 deflated by NID	GDP GNP	Real	–	IM&RSL	DF ADF	J (1988)	–	Yes	Monetization index and economic reform are considered as significant influence. A constant relation of money demand can be found.
Huang (1994)	1979–1990 (Annual)	Real m_2	Real GNP	Real	CPI	–	ADF	EGC JJ (1990)	Chow	Yes	Long-run relationship exists between money demand and its determinants.

Hafer and Kutan (1994)	1952–1983 (Annual)	Real m_0 Real m_2	Real GNP	Real	RPI DEF	–	DF	J (1988) JJ (1990)	–	Yes	Cointegration relation exists only when national income deflator is used as a price variable
Girardin (1996)	1988–1994 (Quarterly)	Real m_0	Nominal GNP	–	RPI	ρ	ADF	J (1988)	–	–	A long-run demand for currency did exist over 1988–1994.
Arize (2000)	1952–1994 (Annual)	Real m_0 Real m_2 Real m_3	Real income	Nominal	RPI	σ	ADF	JJ (1990) Phillips & Hansen	–	Yes	Inflation exerts a significant effect upon money demand in short run and long run.
Gu (2004)	1952–2000 (Annual) 1982–200 (Quarterly)	Real m_0 Real m_2	RGDP	Real	RPI DEF	–	ADF	J (1991) DOLS Gregory and Hansen (1996)	–	Yes	There exist long-run money demand functions in China over 1952–2000.

Notes: RPI – Retail price index, CPI – Consumer price index, OPI – Official price index, MPI – Free market price index, NID – National income deflator, IM –0.5RP+0.RO (RP: ratio of agricultural output deflator to industrial output deflator, RO: ratio of non-state-owned industrial output to total industrial output. RSL – annual rates of the ratio of total bank savings to total loans. UP – Urban population to total population. See Qin (1994). DEF – National income deflator. ρ is the difference of the logarithms of industrial production in the non-stat sector and in the state sector. σ is the logarithms of the inflation. DF – Dickey-Fuller tests, ADF – Augmented Dickey-Fuller tests, EGC – Engle-Granger Cointegration tests, J (1988) – Johansen (1988), JJ (1990) – Johansen and Juselius (1990), ECM – Error correction Model. DOLS – Dynamic OLS.

Table 8.2 Summary of coefficients of long-run demand for money studies in China

Authors	*Sample period/frequency*	*Money*	*Elasticity* *Real income*		*Interest rate*	*Inflation*	*others*
Chow (1987)	1952–1983 (Annual)	Real m_0	1.162		–	–	–
Burton and Ha (1990)	1983–1988 (Quarterly)	Household Money balances	1.66		–	–1.0	–
Yi (1993)	1952–1989 (Annual)	Real m_2	1.25		–	–	–
	1983–1989 (Quarterly)	Real m_2	0.719				0.949 (UP)
			1.152				0.530 (UP)
Tseng *et al.* (1994)	1983–1988	Real m_1	1.53		–	–1.51	–
	1989–1993	Real m_2	1.81			–2.21	
	1983–1993 (Quarterly)						
Huang (1994)	1979–1990 (Annual)	Real m_2	2.12		–0.29	–	–
Hafer and Kutan (1994)	1952–1983 (Annual)	Real m_0	1.13		0.13	2.48(DEF)	–
		Real m_2	1.33		0.15	1.52 (DEF)	
Girardin (1996)	1988–1994 (Quarterly)	Real m_0	1.391		–	–0.826	
Arize (2000)	1952–1994 (Annual)	Real m_0	1.326		–0.169	0.721	–
		Real m_2	1.510		–	0.334	
		Real m_3	1.134		–0.319	0.306	
Gu (2004)	1952–2000 (Annual)	Real m_0	By Johansen model	AN	0.4426	–	–
	1982–2000 (Quarterly)	Real m_2	1.3165 (RM0)	AB	0.4082		
			1.5354 (RM2)	QN	0.1155		
			1.5369 (RM0)	QB	–0.1503		
			1.5094 (RM2)	AN	0.219		
			By DOLS	AB	–0.002		
			1.336 (RM0)	QN	0.002		
			1.556 (RM2)	QB	–0.016		
			1.335 (RM0)				
			1.485 (RM2)				

Notes: UP is the urban population ratio account for monetization process. Where there are two annual models: AN is the model with narrow money, AB is the model with broad money; where two quarterly models, QN is the model with narrow money, QB is the model with broad money; see Gu (2004).

function could normally fall into three groups – the scale variables, the opportunity cost variables and other variables. Some previous studies have considered those 'other variables', for example the real wage rate and the riskiness of bonds. Some studies have tried to investigate the effects of long-run institutional changes on the demand for money through such variables as the proportion of the labour force employed outside of agriculture, the ratio of population to bank offices, the ratio of currency to the total money stock and the ratio of non-bank financial assets to total financial assets to measure the degree of the monetization and financial development of the economies (Laidler 1993). Yi (1993) introduced the ratio of urban population to total population as a proxy for monetization in China; another closer proxy for the monetization process is composed by Qin (1994), who used the average of two ratios: the price ratio of agricultural to industrial output deflators and the output ratio of the non-state-owned industry to the whole industry. Moreover, the ratio of the total savings and loans to capture the special features of a centrally planned economy is employed by Qin (1994).

3.1 The influences of real wages

A number of empirical analyses in the western countries used real wage rates to investigate the relationship between wages and money demand (Laidler 1993). The evidence showed that it is unwise to neglect the role of real wage influence, as it plays an important role in both transactions and precautionary theories of the demand for money. The wage rate has been proved to have a positive effect on the demand for money regardless of precisely which other variables are included in the function. This idea was first suggested by Dutton and Gramm (1973). It was found that the predictions of wage rate influences on money demand models were important. The argument behind the wage rate hypothesis is that an increase in the wage rate leads to an increase not only in income and consumption, but also in turn tends to increase money demand.

In the economic reforms of the early 1980s, the price reform was one of the very successful schemes. The price reform also included 'wage reform' (Yi 1990). The incomes of staff members and workers after reform were related to their job performance and entailed the application of the 'responsibility system' to the enterprise concerned. The percentage increase of real wages was very much in line with the productivity increase (Yi 1990). In most societies, the ultimate purpose of economic growth is to raise the consumption and welfare of the people. Chinese economy reform and economic growth led to a dramatic rise in the standard of living of Chinese people. Figure 8.1 illustrates how the total wages bill from 1952 to 2005 has changed significantly after economic reform. This growth increased money costs and consequently the price level. The rapid growth of nominal wages also played a significant role in inflation. This raises the question of whether the wage rate influences the money demand in China. The evidence suggested that it is

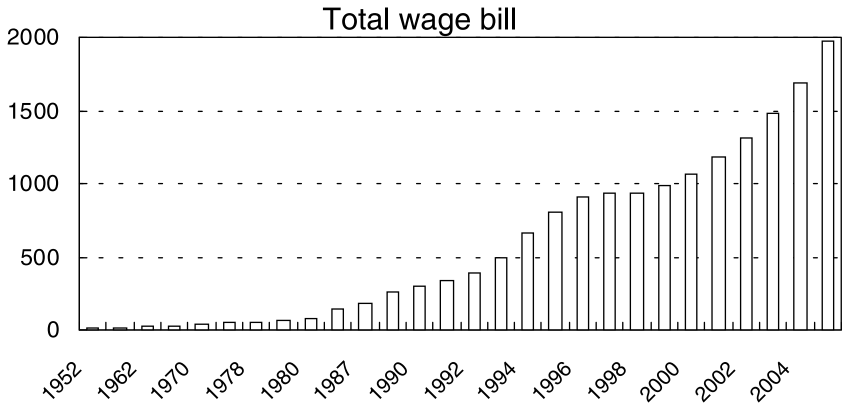


Figure 8.1 Total wage bill in China 1952–2005 (in billions of yuan).

Source: Data comes (1978–2005) from *China Statistical Yearbook* (2006) and (1952–77) from *China Statistical Yearbook* early issues.

unwise to neglect explicit analysis of transactions and precautionary motives for money holding.

3.2 Monetization process

The Chinese economic reforms caused greater monetization after 1978. The reason behind the monetization process was the increase of transaction demands of households and firms. There are two important macro indicators related to the monetization process. First, the ratio of broad money to GDP has been increasing sharply during the reform period. Second, the total stock of financial assets has increased rapidly. In the economy, there are normally three types of financial assets: money, bank deposits and bonds. In China, financial assets are composed of currency in circulation, deposits taken by financial institutions, loans provided by financial institutions and securities issued by different sources. Since the beginning of economic and financial reform until recent years, there have been remarkable changes in China's financial structure. The evidence from Table 8.3 shows that the remarkable changes and development of financial structure in China are because of the development of financial institutions; financial instruments and financial markets which provided various savings and financial possibilities for economic factors. This implies that financial reforms have had positive effects on the economy. It can be seen that after economic reforms, the powers of control by the government of the financial assets have been decentralized. The proportions of financial assets owned by households, enterprises, financial institutions and local governments have increased.

In recent years, after economic reforms, the Chinese people are now aspiring to own property, notably houses, durable consumer commodities and automobiles. The markets for most commodities have turned from sellers'

Table 8.3 Financial assets structure in China 1978–2005 (in billions of yuan)

	1978		*1986*		*1995*		*2005*	
	Amount	*% GNP*	*Amount*	*% GNP*	*amount*	*% GNP*	*amount*	*% GNP*
Currency	21.2	6	121.8	12	788.5	14	2403.17	13
Deposit of financial institutions	130.0	36	581.4	57	5400.0	94	30,204.28	164
Loans of financial institutions	189.0	52	811.6	80	5100.0	88	19,469.04	106
Budget borrowing			37.0	4	158.2	3	692.29	4
Government bonds			29.3	3	350.0	6	704.2	4
Enterprise bonds			8.4	1	170.0	3	204.65	1
Financial bonds			3.0		110.0	2	567.28	3
Shares					450.0	8	–	–

Source: Data of 1978–1995 come from Yi (1996: 27); data of 2005 come from *China Statistical Yearbook* 2006.

markets to buyers' markets. Banks and non-bank financial institutions have introduced various instruments since the reform, such as stock and bonds. The youngest would like to hold bonds or enterprise securities, expecting higher returns. The government created lending opportunities for the banks by announcing housing reforms, including privatization of the housing stock (PBC 2000). Table 8.4 shows real estate investment status from 1991 to 2005. The banks then expanded mortgage lending on the basis that the household debt will be fully backed by a marketable asset and hence boost aggregate demand. Yi (1994) predicted early that the reforms in the housing sector and increasing the size of the stock and bond markets will certainly have monetization consequences. As a result of the market-oriented reforms in recent years, the monetization process has been playing an important role in determining the money demand in China.

3.3 *Saving effects*

Theoretically, savings behaviour is a crucial element to explain the process of economic growth. Savings are a part of disposable income, which is not expended for present consumption but 'stored' for future expenditure (Fry 1995). Prior to 1979, the Chinese system did not view private savings as being

Table 8.4 Real estate investment in China 1991–2005 (in billions of yuan)

Year	*Total fixed assets investment*	*Real-estate investment*	*% of total investment*
1991	559.45	33.62	6
1992	808.01	73.12	9
1993	1307.23	193.75	14.8
1994	1704.21	255.41	15
1995	2001.93	314.90	15.7
1996	2291.35	321.64	14
1997	2494.11	317.84	12.7
1998	2840.62	361.42	12.7
1990	2985.47	410.32	13.7
2000	3291.77	498.41	15.1
2001	3721.35	634.41	17
2002	4399.99	779.09	17.9
2003	5511.8	1010.6	18.3
2004	7047.74	1315.83	18.7
2005	8877.36	1590.92	17.9

Source: PBC Research 2004: 191 and *China Statistical Yearbook* 2006.

a source of investment funds. However, there have been remarkable changes in China's savings level and savings structure since reform. During the period from 1985 to 2004, the average GDP growth in China was the result of capital accumulation, supported by an extraordinarily high savings rate that has come to depend increasingly on China's households. Savings are normally composed of household savings, business savings and the budgetary surpluses of the government. Table 8.5 shows that there have been remarkable changes in China's savings level and savings structure. The private household savings level increased from 5.81 per cent in 1978 to 77.04 per cent in 2005. Private household savings have become the main source of savings (PBC Research 2004). A previous study by Klovland (1983) investigated the relationship of the ratio of the savings deposit to currency on money demand function in Norway. The study of the short-run demand for money indicates that the ratio of deposit to currency may pick up the effect on the demand for money of the increased riskiness of bank deposit. In China, the ratio of total deposits to currency in circulation was usually used to indicate whether there was too much cash in circulation. This ratio was pretty stable before economic reform. In this study, the ratio of total deposits to currency and the ratio of total deposits to national income is to be considered in the money demand function. The ratio of total deposits to currency is correlated with cash income, and, therefore, the task of planners would be to control money incomes and the money supply. The ratio of total deposit to national income could also be used as a measure of savings level to check its influence on demand for money. The prediction of the hypothesis is that the increase of savings level will lead to an increase in money demand.

Table 8.5 Savings level and structure in China (in billions of yuan)

Year	*Household saving*	*Time deposit*	*Demand deposit*	*Urban*	*Rural*	*Household saving/GDP*
1978	21.06	12.89	8.17	15.49	5.57	5.81%
1980	39.95	30.49	9.46	28.25	11.7	8.84%
1985	162.26	122.52	39.74	105.78	56.48	18.10%
1990	711.98	591.12	120.86	519.12	184.16	38.39%
1991	924.16	769.17	154.99	692.49	231.67	42.75%
1992	1175.94	942.52	233.42	889.21	286.73	44.15%
1993	1520.35	1197.1	323.25	1162.73	357.62	43.90%
1994	2151.88	1683.87	468.01	1670.28	481.6	46.02%
1995	2966.23	2377.82	588.41	2346.67	619.56	50.72%
1996	3852.08	3087.34	764.74	3085.02	767.06	56.74%
1997	4627.98	3622.67	1005.31	3714.76	913.22	62.15%
1998	5340.75	4179.16	1161.59	4296.64	1044.1	68.17%
1999	5962.18	4495.51	1466.67	4840.46	1121.73	72.65%
2000	6433.24	4614.17	1819.07	5197.71	1235.53	71.96%
2001	7376.24	5143.49	2232.75	5994.11	1382.14	75.80%
2002	8691.06	5878.89	2812.17	7150.48	1540.58	82.64%
2003	10,361.73	6849.86	3511.89	8543.96	1817.77	88.37%
2004	11,955.54	7813.89	4141.65	9878.92	2076.62	87.58%
2005	14,105.1	9226.39	4878.75	–	–	77.04%

Source: China Statistical Yearbook (2006)

4 Money demand functions

4.1 Model specification

4.1.1 Traditional money demand functions

First, we will estimate both real/nominal money demand functions and compare the results from testing m_0, m_1 and m_2 separately to find a more appropriate money demand function in China. The classical demand function for money is estimated in their natural logarithms of the form:

$$(m/p)_t = a + by_t + cr_t + u_t \tag{1}$$

Where (m/p) is the real money supply, y is the real income, r is the long-term interest rate, p is the price level.

The money demand function also is estimated in their logarithms of the form:

$$m_t = a + by_t + cr_t + dp_t + u_t \tag{2}$$

Where m is the nominal money supply, y is a real income, r is the interest rate, price index p is taken as a proxy for inflation rate.

The dummy variable D will be added in each above equation to highlight the influences of the economic reform. Chinese economic development can be separated into two periods: prior to and after economic reform (Yi 1993). Under the old monetary system, the functions of the financial sector were to support the central planned production and investment targets and to conduct microeconomic and macroeconomic performance. From late 1978, China began to reform its economic system and opened the door to the rest of the world. China attempted various reforms which involved monetary banking system reforms and the use of monetary policy at different levels. After reform, China's financial sector has undergone great institutional changes. The monetary authorities had much greater responsibility for keeping macroeconomic balance. Therefore, it is necessary to separate the estimated period into two: $D = 0$ for the period 1952 to 1978, $D = 1$ for the period 1979 to 2004.

4.1.2 Money demand models with other influences

The estimations of money demand in China will now be considered with other influences. The money demand function could be estimated by adding both total wage index and percentage of urbanization as follows:

$$(m/p)_t = a + by_t + cr_t + dw_t + eROP_t + u_t \tag{3}$$

Where m/p is the real money demand, y is the real income, r is the long-term interest rate, w is the real wage index. As the official data on real wage rate are not available, we use the total wage index deflated by inflation as an additional variable. ROP is the ratio of urban population to total population to approximate the monetization process. We will drop a variable each time from equation (3) in searching for the equilibrium relationship.

$$(m/p)_t = a + by_t + cr_t + dw_t + u_t \tag{4}$$

$$(m/p)_t = a + by_t + cr_t + dROP_t + u_t \tag{5}$$

Considering the influences of saving effects, we get the following:

$$(m/p)_t = a + by_t + cr_t + dDCR_t + u_t \tag{6}$$

Where DCR is the ratio of total deposits to currency.

The ratio of total deposit to GDP will be used as a measure of savings level to check its influence on demand for money as following:

$$(m/p)_t = a + by_t + cr_t + dRDG_t + u_t \tag{7}$$

Where RDG is the ratio of total deposit to GDP.

The dummy variable D will be added in each equation.

4.2 Pesaran cointegration procedure

For investigating the long-run equilibrium among time-series variables, there are several econometric methodologies for both single and multivariate cointegration proposed in the last decades. Univariate cointegration examples include Engle and Granger (1987) and the fully modified OLS procedures of Philips and Hansen's (1990) and Johansen and Juselius's (1990) procedures and Johansen's (1996) full information maximum likelihood procedures are widely used in empirical research. However, a recent single cointegration method proposed by Pesaran *et al.* (2001) appears to emerge more in empirical studies of money demand functions since the former has a number of econometric application advantages over the previous cointegration techniques. The Pesaran cointegration technique extended the original autoregressive distributed lag (ARDL) approach (Pesaran and Shin 1995) and this method avoids some problems of other previous methods, such as the endogeneity problem; the long-run and short-run parameters of the model are estimated simultaneously, etc. Unlike the previous techniques, this method can be applied with variables regardless of whether they are $I(0)$, $I(1)$ or fractionally integrated.

The Pesaran *et al.* (2001) ARDL has certain econometric advantages in comparison to the other procedures and has been increasingly popular amongst the researchers in recent empirical investigations of the demand for money functions (see the examples of Tang 2002; Bahmani-Okskooe and Ng 2002; Halicioglu and Ugur 2005). To our knowledge, there is no previous empirical evidence on the studies of money demand in China from the Pesaran method, therefore in this chapter we will estimate and report on the stability of various money demand functions by employing the Pesaran *et al.* (2001) method along with the CUSUM and CUSUMSQ stability tests.

The ARDL representation of equation (1) and (2) are formulated as follows:

$$\Delta(m/p)_t = a_0 + \sum_{i=1}^{k} a_{1i}\,\Delta(m/p)_{t-i} + \sum_{i=0}^{k} a_{2i}\,\Delta y_{t-i} + \sum_{i=0}^{k} a_{3i}\,\Delta r_{t-i} + a_4\,(m/p)_{t-1} + a_5\,y_{t-1} + a_6\,r_{t-1} + u_t \tag{8}$$

$$\Delta m_t = a_0 + \sum_{i=1}^{k} a_{1i}\,\Delta m_{t-i} + \sum_{i=0}^{k} a_{2i}\,\Delta y_{t-i} + \sum_{i=0}^{k} a_{3i}\,\Delta r_{t-i} + \sum_{i=0}^{k} a_{4i}\,\Delta p_{t-i} + a_5\,m_{t-1} + a_6\,y_{t-1} + a_7\,r_{t-1} + a_8\,p_{t-1} + u_t \tag{9}$$

In the test, accordingly, the null hypothesis of no cointegration is defined by $H_0 : a_5 = a_6 = a_7 = a_8 = 0$. The F-statistic has a non-standard distribution. Pesaran *et al.* (2001) provide two sets of asymptotic critical values. One set assumes that all variables are $I(0)$, and the other assumes they are $I(1)$. If the computed F-statistic falls above the upper bound critical value, then the null of no cointegration is rejected. If it falls below the lower bound, then the null cannot be rejected. Finally, if it falls inside the critical value band, the result would be inconclusive. Once cointegration is confirmed, we move to the second stage and estimate the long-run coefficients of the money demand function and the associated ARDL error correction models:

$$\Delta(m/p)_t = a_0 + \sum_{i=1}^{k} a_{1i}\,\Delta(m/p)_{t-i} + \sum_{i=0}^{k} a_{2i}\,\Delta y_{t-i} + \sum_{i=0}^{k} a_{3i}\,\Delta r_{t-i} + \lambda e_{t-1} + u_t \tag{10}$$

$$\Delta m_t = a_0 + \sum_{i=1}^{k} a_{1i}\,\Delta m_{t-i} + \sum_{i=0}^{k} a_{2i}\,\Delta y_{t-i} + \sum_{i=0}^{k} a_{3i}\,\Delta r_{t-i} + \sum_{i=0}^{k} a_{4i}\,\Delta p_{t-i} + \lambda e_{t-1} + u_t \tag{11}$$

5 Empirical explanation

Equations (8) and (9) with additional dummy variable are estimated using annual data over the period 1952 to 2004. The source of data and variable descriptions are presented in the appendix to this chapter. A two-step ARDL cointegration procedure is implemented. In the first stage of the ARDL procedure, the order of lags on the first differenced variables is obtained from unrestricted vector autoregression (VAR) by means of Akaike's information criterion (AIC) and the Schwarz Bayesian Criterion (SBC). Table 8.6 displays the F-statistics for testing the existence of a long-run money demand.

In the second stage, we used the ARDL cointegration method to estimate the parameters of the equations with maximum order of lag set to 2 to minimize the loss of degrees of freedom. We used four lag selection criteria, namely adjusted R^2, AIC, SBC and Hannan-Quinn Criterion (HQC) to identify the true dynamics of the models. The ARDL estimation of long-run results and the diagnostic test for the short-run estimation are presented in Table 8.7. The estimation results of ARDL error-correction representations are displayed in Table 8.8.

We performed the CUSUM and CUSUMSQ stability tests for all error correction models. The test results are indicated in Table 8.8, which shows that the CUSUM and CUSUMSQ graph of m_2 cross over the upper band marginally during 1990 to 1995 and all other tests are well within the critical bounds, implying that the coefficients in the error correction models are stable. The above tables enable us to select the most appropriate model of implementing the stability test for the money demand equation. It is found that real money demand with a dummy of m_1 performs better than the others.

Table 8.6 F-statistics for testing the existence of a long-run money demand

Order of lag	*F-statistics (with dummy)*		
	m_0/p	m_1/p	m_2/p
1	3.9439*	1.7674	2.1280
2	3.6231	2.1466	2.4560
3	0.65767	1.8833	3.0610
Order of lag	*F-statistics (with dummy)*		
	m_0	m_1	m_2
1	3.1948	2.7085	2.9057
2	4.9178**	4.3499**	2.9808
3	2.1897	2.7403	4.4294*

Notes: The relevant critical value bounds are obtained from Table C1.iii (with an unrestricted intercept and no trend, with three regressors) in Pesaran *et al.* (2001). They are 2.72–3.77 at 90%, and 3.23–4.35 at 95%. * denotes that the F-statistic falls above 90% upper bound and ** denotes above the 95% upper bound.

Figure 8.2 presents the CUSUM and CUSUMSQ graph of SBC-based error correction model for real m_1.

It is found that the real money demand functions with additional dummy perform better than the nominal money demand functions and real money demand for m_1 has a better explanation than the other two definitions of money. Therefore, in this section, we will concentrate the estimation on the real money demand for m_1 only with additional other variables using annual data over the period 1952 to 2004. We use the same methodology employed above in equations (3) to (7). First, the order of lags on the first differenced variables is obtained from VAR by means of AIC and SBC. We performed F-tests and found there is no strong evidence of cointegration and we considered the results preliminary since the choice of lag length was arbitrary. In the next step, we used the ARDL cointegration method to estimate various equations with maximum order of lag set to 2 to minimize the loss of degrees of freedom. The estimation results are reported in Table 8.9. The ARDL error-correction estimation results and respective appropriate optimal lag length selection criteria are displayed in Table 8.10.

We also performed CUSUM and CUSUMSQ stability tests for all error correction models. The CUSUM and CUSUMSQ stability tests are all well within the critical bounds and indicate that there exists a stable money demand function with additional variables. The estimations reveal that the other additional variables of real wage index w, the ratio of urban population *ROP* to account for the monetization process, and the ratio of total deposit to income *RDG* to account for the savings level all have significant effects on demand for money.

Table 8.7 ARDL estimations

Panel A: the long-run results(real money demand with dummy)

	m_0/p			m_1/p			m_2/p
Regressors	$\bar{R}^2$	AIC	SBC, HQC	HQC	$\bar{R}^2$, AIC	SBC	$\bar{R}^2$, AIC, SBC, HQC
	(1,2,2,0)	(1,1,0,0)	(1,0,0,0)	(1,1,1,0)	(2,2,1,0)	(1,0,1,0)	(1,1,1,0)
y	1.1361	1.0934	0.98870	1.0908	1.1153	1.1268	1.3987
	(7.3008)	(6.4185)	(4.4237)	(13.1715)	(15.2263)	(17.3060)	(8.5843)
r	0.013258	−0.085041	−0.15903	−0.28526	−0.26295	−0.26839	0.056472
	(0.097780)	(−0.50871)	(−0.74039)	(−3.5579)	(−3.7175)	(−4.0091)	(0.35663)
D	0.79666	0.89659	1.1136	0.48341	0.41572	0.41672	0.79736
	(2.0503)	(2.1496)	(1.9852)	(2.6394)	(2.6206)	(2.8794)	(1.8471)
Constant	−2.5956	−2.3859	−2.2308	−0.75975	−0.85190	−0.80134	−1.1334
	(−8.3478)	(−6.0346)	(−4.2666)	(−4.5534)	(−5.9023)	(−5.8847)	(−3.8620)

Panel B: the short-run diagnostic tests

R^2	0.99672	0.99632	0.99613	0.99803	0.99822	0.99790	0.99883
DWh	−0.62849	−0.34133	−0.12174	1.9118	DW = 1.9146	2.1405	0.72417
$\chi^2_{SC}(1)$	0.45871	0.14324	0.025332	3.4388	0.3.422	3.9274	0.50514
$\chi^2_{FC}(1)$	0.027022	0.094903	0.27140	0.96027	0.20870	0.33527	1.9448
$\chi^2_{N}(2)$	1.8733	6.3244	3.1794	4.0750	2.7229	7.9244	5.3128
$\chi^2_{H}(1)$	2.2145	2.5650	4.9129	0.39616	0.82609	0.12092	0.49300

Panel A: the long-run results (nominal money demand with dummy)

	m_0			m_1			m_2
Regressors	$\bar{R}^2$ (2,2,2,2,0)	AIC (1,1,0,1,0)	SBC,HQC (1,0,0,1,0)	$\bar{R}^2$ (2,2,1,2,0)	AIC (1,2,1,2,0)	SBC,HQC (1,0,0,0,0)	$\bar{R}^2$, AIC, SBC, HQC (1,0,1,0,0)
y	1.2563	1.0595	0.82613	1.1176	1.1315	1.1074	1.5630
	(2.9498)	(3.1768)	(2.9200)	(5.7157)	(5.4810)	(7.7205)	(3.7695)
r	0.23574	–0.045966	–0.21937	–0.16061	–0.13404	–0.17719	0.38231
	(0.66299)	(–0.20085)	(–1.1166)	(–0.92463)	(–0.71593)	(–1.8233)	(0.86122)
p	0.77376	1.0841	1.3715	1.0288	1.0068	1.1028	0.94568
	(0.93754)	(2.1326)	(3.3144)	(3.5195)	(3.2504)	(5.4734)	(1.3534)
D	1.0355	0.93319	0.99591	0.50139	0.53842	0.45544	0.81412
	(1.5402)	(2.1618)	(2.2221)	(2.4317)	(2.4308)	(2.8476)	(1.9064)
Constant	–1.7067	–2.8253	–3.9207	–1.0753	–0.96569	–1.3795	–1.3325
	(–0.46765)	(2.1618)	(–2.1091)	(–0.89433)	(–0.75695)	(–1.6123)	(–0.47600)

Panel B: the short-run diagnostic tests

R^2	0.99831	0.99798	0.99789	0.99911	0.99907	0.99873	0.99936
DWh	DW = 2.2499	–0.36034	0.0065562	DW = 1.9488	1.3704	2.2907	1.5769
$\chi^2_{SC}(1)$	3.1384	0.15940	0.0010370	0.082325	1.4322	4.1724	1.9064
$\chi^2_{FC}(1)$	0.96935	0.42693	0.29251	0.20088	0.5747E-3	0.20344	0.025566
$\chi^2_{N}(2)$	0.97729	5.8312	2.6124	1.7606	1.7828	22.2344	13.5801
$\chi^2_{H}(1)$	3.8607	1.4824	1.9457	1.0795	0.77602	1.3901	0.45584

Notes: χ^2_{SC}, χ^2_{FC}, χ^2_{N}, χ^2_{H} are Lagrange multiplier statistics for, respectively, tests of residual correlation, functional form misspecification, non-normal errors and heteroscedastcity. The statistics are distributed as Chi-squared variates with degrees of freedom in parenthesis.

Table 8.8 Error correction representation of the ARDL model

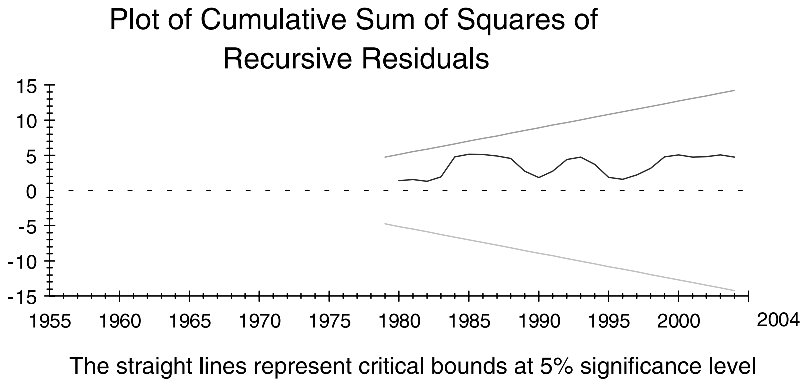
	m_0/p			m_1/p			m_2/p
Regressors	$\bar{R}^2$ (1,2,2,0)	AIC (1,1,0,0)	SBC, HQC (1,0,0,0)	HQC (1,1,1,0)	$\bar{R}^2$, AIC (2,2,1,0)	SBC (1,0,1,0)	$\bar{R}^2$, AIC, SBC, HQC (1,1,1,0)
Δm_t					0.22471		
					(2.0305)		
Δy_t	0.078265	−0.059193	0.15979	0.52030	0.59658	0.35769	0.47571
	(0.39487)	(−0.34919)	(1.7312)	(4.3799)	(4.6038)	(4.9315)	(4.1953)
Δy_{t-1}	−0.26782				−0.23859		
	(−1.2727)				(−1.5739)		
Δr_t	0.093815	−0.016800	−0.025701	−0.21721	−0.19374	−0.21763	−0.17743
	(1.0021)	(−0.54264)	(−0.83308)	(−3.6632)	(−3.3064)	(−3.5946)	(−3.1648)
Δr_{t-1}	−0.16846						
	(−1.9315)						
ΔD_t	0.18953	0.17713	0.17998	0.12703	0.12129	0.13228	0.10743
	(3.1468)	(3.0434)	(3.0497)	(2.9688)	(2.9039)	(3.03531)	(2.6762)
Constant	−0.60577	−0.47135	−0.36053	−0.19965	−0.24855	−0.25436	−0.15270
	(−2.2524)	(−2.0896)	(−1.6634)	(−2.5385)	(−2.9646)	(−3.4681)	(−2.0201)
e_{t-1}	−0.23339	−0.19756	−0.16161	−0.26279	−0.29175	−0.31742	−0.13473
	(−2.7803)	(−2.8549)	(−2.4473)	(−4.0002)	(−4.1046)	(−5.4181)	(−2.7793)
$\bar{R}^2$	0.25248	0.21690	0.19402	0.52613	0.55338	0.50594	0.52044
F-Statistics	4.1480	4.7121	4.0090	15.3783	11.6586	14.0506	15.0656
DW	2.1409	2.0831	2.0301	1.5272	1.9146	1.4555	1.8097

	Δm_0			Δm_1			Δm_2
Regressors	$\bar{R}^2$ (2,2,2,2,0)	AIC (1,1,0,1,0)	SBC, HQC (1,0,0,1,0)	$\bar{R}^2$ (2,2,1,2,0)	AIC (1,2,1,2,0)	SBC, HQC (1,0,0,0,0)	$\bar{R}^2$, AIC, SBC, HQC (1,0,1,0,0)
Δm_t	−0.15844			0.14528			
	(−1.0122)			(1.2022)			

Δy_t	−0.0078114	−0.10920	0.16857	0.54918	0.52824	0.33950	0.22823
	(−0.027500)	(−0.49609)	(1.7595)	(3.0428)	(2.9242)	(4.4588)	(2.7848)
Δy_{t-1}	−0.45880			−0.32807	−0.28780		
	(−1.7651)			(−2.7014)	(−1.7011)		
Δr_t	0.13177	−0.0093058	−0.044762	−0.18010	−0.19208	−0.054325	−0.079630
	(1.2191)	(−0.19825)	(−1.1212)	(−2.7014)	(−2.8978)	(−1.4398)	(−1.4840)
Δr_{t-1}	−0.19164						
	(−1.8518)						
Δp_t	1.2638	0.82384	1.2288	1.1698	1.2441	0.33812	0.13809
	(2.4358)	(1.7375)	(3.2385)	(3.0073)	(3.2217)	(2.9872)	(−.81270)
Δp_{t-1}	−0.61124			−0.74504	−0.76825		
	(−1.3254)			(−2.3039)	(−2.3668)		
ΔD_t	0.19921	0.18892	0.20321	0.13136	0.13544	0.13963	0.11888
	(2.8783)	(2.7149)	(2.9207)	(2.6933)	(2.7681)	(2.6553)	(2.7025)
Constant	−0.32831	−0.57198	−0.80001	−0.28173	−0.24291	−0.42293	−0.19456
	(−0.37370)	(−0.91885)	(−1.3174)	(−0.75383)	(−0.64880)	(−1.3761)	(−0.38935)
e_{t-1}	−0.19237	−0.20245	−0.20405	−0.26200	−0.25154	−0.30659	−0.14602
	(−1.5783)	(−2.4039)	(−2.3972)	(−2.7794)	(−2.6651)	(−4.3901)	(−1.8646)
$\bar{R}^2$	0.25125	0.37816	0.36466	0.54575	0.54069	0.44260	−0.61956
F-Statistics	4.2884	7.4812	6.9397	8.8838	9.8370	8.9405	17.4857
DW	1.6063	2.0806	1.9985	1.9488	1.7165	1.4440	1.6339

CUSUM and CUSUMSQ stability tests

Dependent variables	m_0/p	m_1/p	m_2/p	m_0	m_1	m_2
CUSUM	Yes	Yes	No.	Yes	Yes	Slightly cross upper band margin during 1990–1995
CUSUMSQ	Yes	Yes	Cross upper band during 1990–1995	Yes	Yes	Slightly cross upper band margin during 1990–1995



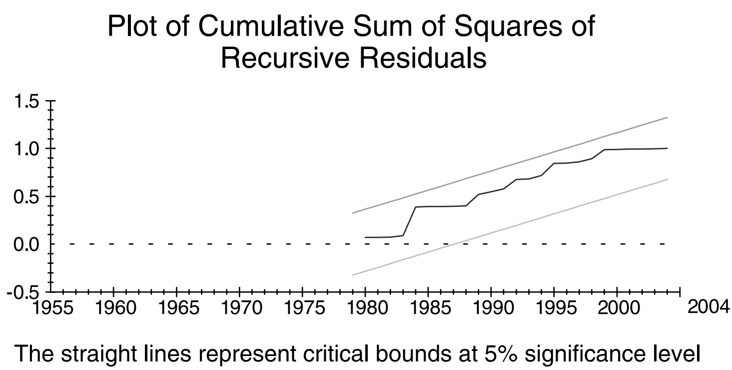


Figure 8.2 CUSUM and CUSUMSQ plots for stability test – (m_1/p) with dummy.

6 Conclusions

In this study, we have described the different patterns of the money demand functions and their structural dynamics in China. We have estimated a number of money demand functions with the annual data for China from 1952 to 2004. The impact of various economic fluctuations and scale variables in Chinese economy have been incorporated into the traditional money demand equations. The appropriate dummy variable has been added into the functions to assess and evaluate the effects of economic reform in China. In recent years, the actions of Chinese authorities accelerated the reforms of the banking and the financial sector. From a centrally planned economy, it moved to a system of monetary control through indirect, market-based instruments. The central bank, PBC, now has more ability to forecast the quantity of money which consumers demand while maintaining a certain level of national income and the rate of inflation. This study concludes that a long-run stable money demand function exists in China. The estimated coefficients over different time periods do not alter significantly and indicate that that the

Table 8.9 ARDL estimations

Panel A – the long-run results

	Eq.(3)		*Eq.(4)*		*Eq.(5)*
	AIC (2,0,2,2,2,0)	SBC/HQC (2,0,0,1,2,0)	AIC (2,2,0,2,0)	SBC (1,0,0,1,0)	AIC/SBC/HQC (2,0,0,2,0)
Constant	1.7487 (6.9735)	1.5287 (5.1509)	1.0418 (2.3743)	0.85346 (1.9200)	0.83450 (2.3868)
y	0.62983 (10.0769)	0.67929 (9.4105)	0.65896 (5.6629)	0.72102 (6.1317)	0.92146 (16.4342)
r	–0.22856 (–11.0893)	–0.22944 (–9.5183)	–0.22822 (–6.5514)	–0.24885 (–6.4862)	–0.23530 (–6.8117)
w	0.42194 (5.1697)	0.34542 (3.8947)	0.54872 (4.5408)	0.48049 (3.9103)	
ROP	0.64095 (4.7827)	0.66746 (4.3035)			0.95824 (5.0811)
D	0.23201 (5.4790)	0.27811 (5.9329)	0.27719 (4.1589)	0.29554 (3.9438)	0.28546 (4.2315)

Panel B: the short-run diagnostic test statistics

R^2	0.99898	0.99880	0.99850	0.99804	0.99848
DWh	2.0669	1.9152	1.8910	1.4663	1.7876
$\chi^2_{SC}(1)$	0.25355	0.17340	.5921	4.6057	1.0032
$\chi^2_{FC}(1)$	0.045192	0.33231	4.3482	3.0827	4.5174
$\chi^2_{N}(2)$	2.3261	4.0695	0.51377	3.0920	10.1700
$\chi^2_{H}(1)$	1.0138	1.3317	2.3786	1.0744	0.40393

Panel A – the long-run results

	Eq.(6)		*Eq.(7)*		
Regressors	AIC (2,2,1,0,0)	SBC (1,0,1,0,0)	Regressors	AIC/$\bar{R}^2$ (2,2,2,0,2)	SBC (1,1,0,0,0)
Constant	–0.66107 (–1.3043)	–0.59431 (–1.2679)	Constant	–0.40766 (–2.7349)	–0.36273 (–2.1987)
y	1.1368 (12.6463)	1.1519 (13.7547)	y	0.91630 (12.5450)	0.90283 (11.1410)
r	–0.29394 (–2.7657)	–0.30159 (–3.0857)	r	–0.19358 (–3.7300)	–0.17266 (–3.1464)
DCR	–0.10062 (–0.39660)	–0.11085 (–0.46537)	*RDG*	0.42830 (3.7264)	0.45180 (3.7469)
D	0.39721 (2.4158)	0.39320 (2.5950)	*D*	0.31877 (3.1906)	0.33705 (3.5245)

(*Continued Overleaf*)

Panel B: the short-run diagnostic test statistics

R^2	0.99823	0.99791	R^2	0.99870	0.99825
DWh	1.8942	1.4355	DWh	2.1055	1.4802
$\chi^2_{SC}(1)$	0.4912	4.2699	$\chi^2_{SC}(1)$	1.1615	3.3793
$\chi^2_{FC}(1)$	0.66005	0.80150	$\chi^2_{FC}(1)$	7.3496	0.98506
$\chi^2_{N}(2)$	2.3241	7.3157	$\chi^2_{N}(2)$	0.9218	4.6924
$\chi^2_{H}(1)$	0.7619	0.099674	$\chi^2_{H}(1)$	0.058904	0.29249

Notes: χ^2_{SC}, χ^2_{FC}, χ^2_{N}, χ^2_{H} are Lagrange multiplier statistics for, respectively, tests of residual correlation, functional form misspecification, non-normal errors and heteroscedastcity. The statistics are distributed as chi-squared variates with degrees of freedom in parenthesis.
Eq.(3) $(m/p)_t = a + by_t + cr_t + dw_t + eROP_t + u_t$
Eq.(4) $(m/p)_t = a + by_t + cr_t + dw_t + u_t$
Eq.(5) $(m/p)_t = a + by_t + cr_t + dROP_t + u_t$
Eq.(6) $(m/p)_t = a + by_t + cr_t + dDCR_t + u_t$
Eq.(7) $(m/p)_t = a + by_t + cr_t + dRDG_t + u_t$

Table 8.10 Error correction representations of the ARDL model

	Eq.(3)		*Eq.(4)*		*Eq.(5)*
Regressors	AIC/$\bar{R}^2$ (2,0,2,2,2,0)	SBC/HQC (2,0,0,1,2,0)	AIC (2,2,0,2,0)	SBC (1,0,0,1,0)	AIC/SBC/HQC (2,0,0,2,0)
Δm_{t-1}	0.42124	0.30716	0.28695		0.27185
	(3.8159)	(2.9688)	(2.6328)		(2.4808)
Δy_t	0.53143	0.48772	0.64829	0.39377	0.50602
	(7.3279)	(7.6877)	(5.3630)	(5.9988)	(7.3329)
Δy_{t-1}			–0.26440	–0.13591	
			(–1.8615)	(–4.8320)	
Δr_t	–0.17110	–0.16473	–0.13072		–0.12921
	(–3.2322)	(–6.4172)	(–4.8039)		(–5.0821)
Δr_{t-1}					
Δw_t	0.10074	0.10108	0.080559	0.12693	
	(1.7415)	(1.8151)	(1.2879)	(1.9336)	
Δw_{t-1}	–0.076632		–0.073830		
	(–1.5138)		(–1.3341)		
ΔROP_t	–0.201123	–0.16174			–0.017059
	(–0.095800)	(–0.75493)			(–0.073948)
ΔROP_{t-1}	–0.78402	–0.75063			–0.71838
	(–3.9746)	(–3.8675)			(–3.3674)
ΔD_t	0.19576	0.19967	0.15877	0.16140	0.15676
	(5.0613)	(5.1141)	(3.7788)	(3.6153)	(3.8870)
Constant	1.4755	1.0976	0.59674	0.46611	0.45827
	(4.3566)	(3.9210)	(2.0213)	(1.6756)	
e_{t-1}	–0.84378	–0.71797	–0.57729	–0.54614	–0.54915
	(–7.2752)	(–8.5224)	(–6.1921)	(–6.7263)	(–7.5098)
$\bar{R}^2$	0.70795	0.68392	0.60371	0.5314	0.61713
F-Statistics	13.4206	14.7732	10.7713	12.4830	12.6563
DW	2.0669	1.9152	1.8910	1.4663	1.7876

	Eq.(6)			*Eq.(7)*	
Regressors	AIC/ (2,2,1,0,0)	SBC/HQC (1,0,1,0,0)	Regressors	AIC/$\bar{R}^2$ (2,2,2,0,2)	SBC (1,1,0,0,0)
Δm_{t-1}	0.22039 (1.9622)		Δm_{t-1}	0.38150 (3.2139)	
Δy_t	0.60756 (4.45411)	0.36968 (4.7612)	Δy_t	0.67996 (5.6695)	0.63497 (5.6976)
Δy_{t-1}	–0.23227 (–1.5087)		Δy_{t-1}	–0.27642 (–2.0034)	
Δr_t	–0.21253 (–2.8049)	–0.23973 (–3.0901)	Δr_t	–0.14905 (–2.3892)	–0.070909 (–2.8506)
Δr_{t-1}			Δr_{t-1}	0.14693 (2.1508)	
ΔDCR_t	–0.029443 (–0.39732)	–0.035575 (–0.46198)	ΔRDG_t	0.19298 (3.2300)	0.18555 (3.4571)
ΔDCR_{t-1}			ΔRDG_{t-1}		
ΔD_t	0.11623 (2.6372)	0.12619 (2.7496)	ΔD_t	0.17291 (2.6552)	0.13842 (3.4119)
ΔD_{t-1}			ΔD_{t-1}	–0.12118 (–2.2901)	
Constant	–0.19344 (–1.1903)	–0.19073 (–1.2199)	Constant	–0.18368 (–2.901)	–0.14897 (–1.9331)
e_{t-1}	–0.29261 (–4.0734)	–0.32094 (–5.3856)	e_{t-1}	–0.45056 (–5.4595)	–0.41069 (–6.6077)
$\bar{R}^2$	0.54424	0.49715	$\bar{R}^2$	0.6398	0.57993
F-Statistics	9.8153	11.0867	F-Statistics	11.1961	15.0056
DW	1.8942	1.4355	DW	2.1055	1.4802

CUSUM and CUSUMSQ Stability Tests

	Eq.(3)	*Eq.(4)*	*Eq.(5)*	*Eq.(6)*	*Eq.(7)*
CUSUM	Yes	Yes	Yes	Yes	Yes
CUSUMSQ	Yes	Yes	Yes	Yes	Yes

demand for money in China is stable. From various estimations reported above, it is found that the stabilization policy should primarily aim at the narrow money m_1. The analysis of other additional variables provides significant information on policymaking. The impact of wage index on money demand models is important. Increases in the monetization process have made money play a more vital role in the Chinese economy. The prediction of the hypothesis of the effect of ratio of total deposit to income is meaningful. For future studies, the demand for money is likely to depend upon the exchange rate. In the macroeconomic environment of the world economy, China has made great efforts to absorb foreign capital in order to speed up economic development. This study ignored the influence of exchange rate fluctuations on money demand functions in China, mainly because the Chinese RMB was not freely convertible with other important currencies in the world until recent years. Another suggestion for future research on money demand in China might be studies which include a factor based on the riskiness of bonds, as in recent years they are becoming an important asset in the financial portfolio of Chinese households.

Appendix: definitions of the variables and data sources

Annual data (1952–2004) is collected from various issues of the *Statistical Yearbook of China* and the website <www.stats.gov.cn>.

m_0 is currency in circulation in billion yuan.

m_1 is narrow money. m_1 contains m_0 plus demand deposits of households, firms and institutions in billion yuan.

m_2 is broad money. m_2 contains m_1 plus time and saving deposits of households, firms and institutions in billion yuan.

y is GDP in billion yuan. Real income is deflated by official price index.

p is general price index, 1951=100.

r is one year savings deposit rate %.

w is total wage index, 1952=100. Real wage index is deflated by official price index.

ROP is the ratio of urban population to total population.

DCR is the ratio of the total deposit to currency.

RDG is the ratio of total deposit to GDP.

Note

1 This chapter is dedicated to Professor Anita Ghatak. The study is drawn from a PhD thesis. Many thanks to Professor Subrata Ghatak, Professor Ferda Halicioglu and Professor Philip Arestis for their great help and valuable comments.

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9 Monetary policy rules and the impact of ambiguity in transition economies [1]

Subrata Ghatak and Willy Spanjers

1 Introduction

The use of monetary policy rules to evaluate and describe central bank policy actions has been growing rapidly. Much of the research on policy rules has focused on economies with highly developed asset markets, especially markets for debt and foreign exchange.

The main type of monetary policy rule suggested in the early 1990s was the Taylor rule, which was originally designed for the USA, but also worked well in other developed economies. The main research tool used to design that rule was a model of seven large economies. Each economy was assumed to have both a fully developed long-term bond market and a foreign exchange market with a high degree of capital mobility.

The Taylor rule is defined by

$$r = r^* + \beta(\pi - \pi^*) + \gamma(Y - Y^*)$$

where

- r denotes the actual nominal short-term interest rate
- r^* denotes the equilibrium nominal short-term interest rate
- π denotes the actual rate of inflation
- π^* denotes the equilibrium rate of inflation
- Y denotes the actual output and
- Y^* denotes the capacity output.

A question that arises is whether the Taylor rule is also a useful guide for monetary policy in transition economies. It should be noted that the Taylor rule does not take direct account of shocks, which one would expect to occur more prominently in transition economies than in developed economies. Still, Taylor rules have many of the same advantages in transition economies as they have in developed countries. In particular, for transition economies that do not choose a policy of a "permanently" fixed exchange rate (perhaps through a currency board or through a common currency, i.e. dollarization), a sound monetary policy should be based on the trinity of a flexible exchange rate, an inflation target, and a monetary policy rule. But it will be necessary to change some of the features of the typical kind of policy rule that is recommended for countries with more developed financial markets.

In particular, when considering monetary policy rules for transition economies, the following major issues arise:

1 Which instruments should be included in the monetary policy rule?
2 What specific rule should be followed?
3 What is the role of the exchange rate in a monetary policy rule?
4 What is the role of uncertainty and ambiguity?

2 Monetary policy rules

Before addressing these issues in more detail, we state what precisely we mean by a monetary policy rule. In the context of our analysis, a monetary policy rule is understood to be a contingency plan that specifies clearly the cases under which a central bank should change the instruments of monetary policy. For example, the Taylor rule describes the change in the instruments that would accompany an increase in inflation or in real GDP relative to potential GDP. To be credible, a policy rule should be used for many periods in the future.

In research on policy rules, the instrument has been a short-term overnight interest rate. But other instruments in a policy rule could be the money base, or some other monetary aggregate. In his seminal paper Taylor (1979), for instance, uses the money supply as the instrument. McCallum (1988) sees advantages in policy rules with a monetary aggregate as the instrument and the famous Friedman growth rate rule also has a monetary aggregate as the instrument. Since the mid 1980s, however, it has been found that the interest rate is a more practical instrument in policy rules.

Thus, one may want to consider a modified Taylor rule to take these considerations into account. A central bank may want to implement a general interest rate rule in order to achieve specific policy objectives. Such a rule may take the following form:

$$r_t = r^* + \alpha r_{t-1} + \beta(\pi_t - \pi^*) + \gamma(Y_t - Y^*) + \delta(e_t - e_{t-1}) + \varepsilon_{mt}$$

where t is the time index, e_t denotes the exchange rate and ε_{mt} denotes a domestic monetary policy shock.

More generally, one may want to consider three special cases of monetary policy rules. They are rules that operate at the moment of monetary policy shocks and, therefore, are feedback rules for monetary policy. In particular, we mention the inflation targeting rule, the Taylor rule and the managed exchange rate rule. These rules are considered in the context of a central bank that is engaged in interest rate smoothing, but, of course, a similar approach can be applied for the smoothing of other instruments, such as, for example, the exchange rate.

The inflation targeting rule is

$$r_t = \rho_r r_{t-1} + (1 - \rho_r)\,\beta\,(\pi_t - \pi^*) + \varepsilon_{mt}$$

where ρ_r is the interest rate smoothing parameter.

The Taylor rule extends the inflation targeting rule by adding the deviation of output from its capacity:

$$r_t = \rho_r r_{t-1} + (1 - \rho_r)\,\beta\,(\pi_t - \pi^*) + (1 - \rho_r)\,\gamma\,(Y_t - Y^*) + \varepsilon_{mt}$$

The managed exchange rate rule, finally, is obtained by adding a reaction to the devaluation of the exchange rate, as exchange rate volatility is a cause for worry to many countries. The rule is

$$r_t = \rho_r r_{t-1} + (1 - \rho_r)\,\beta\,(\pi_t - \pi^*) + (1 - \rho_r)\,\gamma\,(Y_t - Y^*)$$
$$+ (1 - \rho_r)\,\delta\,(e_t - e_{t-1}) + \varepsilon_{mt}$$

The actual short-term interest rate as set by the central bank may, however, at times deviate from the one indicated by the appropriate policy rule, as some special factors of the policy environment cannot be included in the rule. Liquidity crises in financial markets will usually require such discretion. The 1987 stock market crash in the USA is one such example. Before this crash, the Fed was increasing the short-term interest rate, apparently because inflation and the output gap were increasing. But when liquidity became a concern after the crash, the Fed lowered the interest rate and thereby provided more liquidity. Such discretionary actions are, of course, relative to the benchmark rule, which in this example is the Taylor rule.

The size of the interest rate responses in policy rules matter greatly for economic performance. Changing the interest rate by more than one for one with inflation is a crucial property of a good monetary policy rule. A response that is smaller than one-to-one can result in very poor performance. An example of this is the USA's response of the interest rate to inflation in the late 1960s and the 1970s in comparison with the 1980s and 1990s.

Another important advantage of having a monetary policy rule is that it increases the transparency of monetary policy. Financial market analysts frequently use monetary policy rules to figure out what central banks are going to do. Whether the rule is good or bad, they use monetary policy rules to help predict the short term-interest rate. Such a prediction is also useful for analyzing exchange rates, bond prices, or stock prices.

The following consideration determines the choice between a policy rule with the interest rate as the instrument and a policy rule with the money base (or some other monetary aggregate) as the instrument. If there is too much uncertainty in measuring the real interest rate or if there are relatively big shocks to investment or net exports, then a monetary aggregate is the preferred instrument. The same is true if it is difficult to measure the equilibrium real interest rate. But if velocity shocks are big, then the interest rate is the more suitable instrument.

The preference for the interest rate instrument in recent works on policy rules primarily reflects velocity uncertainty. But there are circumstances where real interest rate measurement is difficult and where the overnight nominal interest rate is not the best guide. Such cases may very well be present in transition economies. In a situation of a high growth rate and/or a high inflation rate, the real interest rate is hard to measure and the risk premia can be high and variable, for instance due to the presence of political uncertainty. With an interest rate rule, uncertainty about the equilibrium real interest rate translates into policy errors. Policymakers in transition economies might want to give greater consideration to policy rules with monetary aggregates, even if rules with the interest rate become the preferred choice.

Just because monetary policy rules can be written down as a mechanical-looking equation, this does not imply that central banks should follow them mechanically. To the contrary, most proposals for monetary policy rules suggest that the rules are best used as guidelines, or general policy frameworks. Discretion is needed to implement the policy rule.

The Taylor rule (Taylor 1993) suggests a very specific policy for the central bank. It calls for the quarterly average US interest rate to rise by 1.5 times any increase in the four-quarter average inflation rate plus 0.5 times any increase in the output gap. Even so, the Taylor rule is a guideline for assessing interest rate decisions. Discretion is needed to assess monthly data on commodity prices, employment, industrial output and other variables, in order to estimate or predict the current quarterly inflation rate and the output gap.

3 Inflation targeting

Having an inflation target is essential for good monetary policymaking in cases where a country decides on a flexible exchange rate regime. The inflation target places the nominal anchor on domestic prices. In this it contrasts with a fixed exchange rate regime, a currency board, or dollarization. The increased focus on the inflation target in transition economies is a welcome development. By the target rate of inflation we mean the value level of inflation that one would like to be the one that the actual inflation rate fluctuates around. The table opposite provides an impression of the inflation targets of some countries that operate an inflation targeting regime.

Having a target for the inflation rate is not enough. There are many different policies and instruments that will achieve an inflation target over the long run. Some policies will involve much larger fluctuations in other variables of concern to policymakers, such as the exchange rate or the real output. Thus,

Table 9.1 Inflation targeting in different countries

Country	*Inflation target*	*Target's horizon*
Australia	2% to 3% (since 1993)	Medium term
Brazil	5.1% (for 2005)	1 year
Canada	1% to 3% (since 1998)	Medium term
Chile	2% to 4% (since 2001)	Medium term
Colombia	3.5% to 4.5% (for 2007)	Medium term
Czech Republic	2% to 4% (since 2005)	1 year
Mexico	2% to 4% (since 2004)	Medium term
Norway	1.5% to 3.5% (since 2001)	Medium term
Peru	1.5% to 3.5% (since 2002)	Medium term
Philippines	4% to 5% (for 2006)	1 year
Poland	1.5% to 3.5% (since 2004)	Medium term
Sweden	1% to 3% (since 1995)	Medium term
United Kingdom	2% (since 2004)	Medium term

Source: various sources

choosing an inflation target still leaves open most of the important questions about monetary policy decisions. That is where a monetary policy rule comes in. It provides the details about how the inflation target is to be met.

A good monetary policy rule is one in which the fluctuations of actual inflation around the inflation target rate are small. There can also be targets of other variables, as long as they are not inconsistent with the inflation target in the long run. For output, the target must be the natural rate of output. For the exchange rate, the target for appreciation or depreciation must be the difference between the domestic target inflation rate and the average inflation rate of other countries. Once such consistent long-run targets are set, then there is a variance trade-off between keeping small the fluctuations around the inflation target and the fluctuations around other targets (Taylor 1979). The variance trade-off replaces the old Phillips curve trade-off.

> But alas, inflation targeting does not guarantee that a central bank practising it will be able to deliver consistently low inflation. All the debates about how to formulate monetary policy in order to deliver the best outcomes are still relevant. Should we use monetary aggregates? Should we use Taylor rules? Should we simply adjust interest rates so that the direct price effects of the change in the exchange rate produce the desired effect on the domestic price level?
>
> (Brash 1999: 43–4)

There is no inconsistency between using inflation targeting as the objective and using a monetary aggregate as the instrument in the policy rule. In fact, because of the difficulties with the interest rate as an instrument in some transition economies, the money base may be a better instrument for achieving the inflation target. In earlier work on policy rule evaluation with an inflation target the money supply is the instrument (Taylor 1979). Inflation targeting is an alternative to fixed or managed exchange rates, not to policies that focus on the monetary aggregates.

Inflation forecast targeting means that the central bank chooses the instruments of policy so as to bring a forecast of inflation into equality with the inflation target at some future date. An example of inflation forecast targeting is the Monetary Policy Committee of the Bank of England, which describes its policy operations this way. Inflation forecast targeting, however, does not necessarily perform well in obtaining an inflation target.

Inflation forecast targeting as defined here may be difficult in transition economies. The alternative to inflation targeting is simply to use a monetary policy rule. But inflation forecasts can be used in monetary policy rules in place of actual observed inflation values; such rules are called inflation forecast based policy rules (Batini and Haldane 1999; Rudebusch and Svensson 1999).

In reality, any policy rule will involve some forecasts of inflation. The rule states policy should react to the current quarter, but data on the current quarter are not tabulated until after the quarter, so at least one-quarter forecasts are needed. Batini and Haldane (1999) showed that the optimal horizon – if one does not include output in the rule – is about three or four quarters.

Reifschneider and Williams (2000) have shown how the expectations effects of policy rules can greatly reduce the likelihood of getting into deep recessions. Such expectations effects are present in any monetary policy in which changes in the instruments depend on future events.

Woodford (1999, 2004) shows that these expectations effects indicate that the response of the interest variables has a lot of inertia. Inertia is created by slowly adjusting interest rate instruments to changes in the economy. The inertia actually increases the size of the response of variables that are forward-looking such as long-term bonds.

How should transition economies without highly liquid longer maturity markets view these results? They must not think that they can have a less clearly stated policy that will work better. Even if financial markets are not fully developed and there are few long-term securities, movements in the exchange rate, the price of land, and even wages are affected by expectations of the future. It will be easier for the private sector to form expectations if the central bank is clear in its intentions through some kind of policy rule.

However, without long-term markets, it may be wise to react more quickly and by a larger amount because the shorter term interest rates will have to do more of the work. This suggests that "optimal" monetary policy rules in transition economies should be more responsive than optimal policy rules in more developed economies.

The exchange rate is part of the transmission mechanism in many of the models used for policy evaluation. The exchange rate enters both in the determination of net exports and in equations describing how the prices of foreign goods are passed through to domestic prices. And there is a link between the exchange rate and the interest rate through capital markets. It should be noted, however, that the models that have been used for policy evaluation assume perfect capital mobility.

The policy evaluation research that helped design the Taylor rule considered the role of the exchange rate. Simulations of multi-country models led to the belief that if the central bank reacted too strongly to the exchange rate, then inflation-output performance would deteriorate. However, the same conclusion would not necessarily be reached for small open transition economies. A country's size, openness, capital mobility, and degree of exchange market development would matter as well (Ball 1999; Svensson 2000; Batini, Harrison and Millard 2001).

Evidence suggests that simple policy rules that focus on a smoothed inflation measure and real output and do not try to react too much to the exchange rate might actually work well in transition economies. However, the current models may understate the exchange rate effects in small open economies and therefore tend to underestimate the costs of exchange rate fluctuations which may be very high in transition economies where there is a mismatch of assets by currency or duration. The forward-looking nature of the exchange rate suggests that there may be significant gains from policies that utilize rational expectations in the same way that inertial rules for the interest rate do in closed economy models (Woodford 1999, 2004).

4 Political risk and ambiguity

As opposed to ordinary risks, some of the risks faced by financial markets fail to be calculable. Such non-calculable risks are referred to as instances of ambiguity. This distinction between calculable risk and non-calculable ambiguity was first made by Knight (1921) and ambiguity, therefore, is sometimes referred to as Knightian uncertainty.

Regarding the impact of the amount of ambiguity – and its counterpart: the level of confidence – on interest rates, Keynes observes:

> . . . partly on reasonable grounds and partly on instinctive grounds, our desire to hold money as a store of wealth is a barometer of the degree of our distrust of our own calculations and conventions concerning the future. [. . .] the quantity of hoards can [. . .] be altered [. . .] if the total quantity of current money income [. . .] is changed; whereas fluctuations in the degree of confidence are capable of having quite a different effect,

> namely, in modifying [. . .] the amount of premium which has to be offered to induce people not to hoard.
>
> (Keynes 1937: 116)

Political risk is a prominent form of ambiguity in the context of monetary policy and has a significant impact on investor confidence. Non-calculable political risk is much more prominent in transition economies than in developed economies. Its presence leads to an ambiguity premium on the real interest rate. When investors are pessimistic, i.e. ambiguity averse, this premium is positive as in the case of the normal risk premium. In the case investors are optimistic, i.e. ambiguity loving, the ambiguity premium will be negative. Thus, the ambiguity premium supplements the usual risk premium (Spanjers 1999).

The ambiguity premium is likely to be more volatile than the risk premium, as the level of non-calculable political risk is subject to rapid and violent fluctuations, even if the fundamentals of the economy remain unchanged. The added presence of the ambiguity premium makes the nominal interest rate even less suited as a policy instrument for transition economies than the discussion in Section 2 indicates.

The impact of ambiguity on the instruments of monetary policy is not restricted to the interest rate. The ambiguity premium incorporated in the exchange rate of transition economies is even more sensitive to unexpected political events and loss of confidence. As is argued in Spanjers (2008b) two different types of loss of confidence – and therefore two different sources of changes in the ambiguity premium – can be identified. The first is an exogenous loss of confidence as can be observed after an unexpected political event, such as the fall of a government or the events in the wake of the "Orange Revolution" in the Ukraine. The second is an endogenous loss of confidence as it may be observed after a plausible political event occurs, the likelihood of which was at best vaguely known.

Keynes (1937: 114–15) highlights that decisions which are made in the presence of ambiguity are vulnerable to sudden violent changes:

> Now a practical theory of the future [. . .] has certain marked characteristics. In particular, being based on so flimsy a foundation, it is subject to sudden and violent changes. The practice of calmness and immobility, of certainty and security, suddenly breaks down. New fears and hopes will, without warning, take charge of human conduct. The forces of disillusion may suddenly impose a new conventional basis of valuation. All these pretty, polite techniques, made for a well-panelled board room and a nicely regulated market, are liable to collapse. At all times vague panic fears and equally vague and unreasoned hopes are not really lulled, and lie but a little way below the surface.

In our opinion, both ambiguity and sudden violent changes in investor behavior are leading characteristics in many currency crises and in the 1997 East Asian crisis in particular. Therefore, we take a closer look at Keynes's intuition regarding the consequences of ambiguity before discussing its potential impact on monetary policy rules.

Economists in his days, Keynes (1937: 112–13) notes, were reluctant to consider uncertainty. If they considered uncertainty at all – be it in the form of expectations or otherwise – they only focused on calculable risk. The use of this approach of subjective expected utility and rational expectations is, in Keynes's view, based on an inappropriate model of decision making. He considers this model particularly inappropriate where decisions regarding "wealth" and "wealth accumulation" are concerned. Such decisions are particularly prone to the impact of non-calculable risks and, therefore, cannot be adequately justified by the use of subjective expected utility.

From here, he proceeds to the next natural question: how are appropriately founded decisions made in an environment that displays a certain amount of non-calculable risk? His answer is that what decision makers do in the presence of ambiguity is to ignore it as best they can, hoping that the current state of opinion in the market is a more or less fair summary of the future perspectives:

> Nevertheless, the necessity for action and for decision compels us as practical men to do our best to overlook this awkward fact and to behave exactly as we should if we had behind us a good Benthamite calculation of a series of prospective advantages and disadvantages, each multiplied by the appropriate probability, waiting to be summed.
>
> (Keynes 1937: 114)

It is only when "something new and relevant comes into the picture" that the existing state of opinion is no longer accepted as a fair and useful summary of future perspectives:

> How do we manage in such circumstances to behave in a manner which saves our faces as rational, economic men? We have devised for the purpose a variety of techniques, of which much the most important are the three following:
>
> 1 We assume that the present is a much more serviceable guide to the future than a candid examination of past experience would show it to have been hitherto. In other words *we largely ignore the prospect of future changes about the actual character of which we know nothing*.
> 2 We assume that the existing state of opinion as expressed in prices and the character of existing output is based on a correct summing up of future prospects, so that *we* can *accept it as such unless and until something new and relevant comes into the picture*.

> 3 Knowing that our own individual judgement is worthless, we endeavour to fall back on the judgement of the rest of the world which is perhaps better informed. That is, we endeavour to conform with the behaviour of the majority or the average. The psychology of a society of individuals each of whom is endeavouring to *copy the others* leads to what we may strictly term a conventional judgement.
>
> (Keynes 1937: 114)[2]

In Keynes's view this leads to severe consequences of relatively small changes in what would be considered only marginally relevant areas. This applies when considering the ambiguity premium in interest rates or in the case of currency crises.

Next, Keynes shifts his focus on to economic theory and economic theorists who, in his view (in 1937), were slow to duly recognize the relevance of ambiguity and to incorporate it in their thinking accordingly:

> Perhaps the reader feels that this general, philosophical disquisition on the behaviour of mankind is somewhat remote from the economic theory under discussion. But I think not. [. . .] I accuse the classical economic theory of being itself one of those pretty, polite techniques which tries to deal with the present by abstracting from the fact that we know very little about the future.
>
> I daresay that a classical economist would readily admit this. But, even so, I think he has overlooked the precise nature of the difference which his abstraction makes between theory and practice, and the character of the fallacies into which he is likely to be led.
>
> (Keynes 1937: 115)

Various kinds of adverse changes in the premium for ambiguity of assets in transition economies may cause currency crises, loss of confidence being the most prominent among them. Both the interest rate and the exchange rate are vulnerable to changes in non-calculable political risk, leading to increased volatility and to difficulties in measuring their equilibrium levels. This reinforces the conclusion in Section 3 above, that the optimal targets for transition economies may be inflation and output, with a monetary aggregate – e.g. the money base – as the optimal policy instrument.

5 Monetary policy and ambiguity

The above discussion of political risk and ambiguity raises the broader question of how ambiguity affects the outcomes of monetary policy. Here the focus is on the effects of ambiguity regarding either the specific reactions triggered by the monetary policy or the predictability of central bank behavior. Wagner (2005) observes that in the modern literature three different sources of uncertainty are analyzed:

1. Uncertainty regarding the current state of the economy, caused by the lags with which data become available (Data uncertainty).
2. Uncertainty regarding the structure and the functioning of the economy (Model uncertainty and parameter uncertainty).
3. Uncertainty regarding the interaction between the central bank and the public (Strategic uncertainty).

The analysis of these forms of uncertainty typically takes place in Bayesian models, where the risks are perfectly calculable. If, however, the uncertainty is considered to have a significant non-calculable component, specific methods for modeling ambiguity are required. But even if model-builders are willing to include ambiguity in their models, they face a seemingly impossible task: how to make the non-calculable calculable?

This problem was solved by Schmeidler (1989) and Gilboa (1987), who extended the axiomatic approach of the subjective expected utility theory. It is based on the assumption that decision makers, even if they face non-calculable risks, can still express a clear preference when facing two alternatives. That is, they can state either which alternative they prefer or that they are indifferent between the two. If such preferences satisfy certain properties similar to – but slightly weaker than – those of the subjective expected utility theory, then these preferences can be represented by the generalized expected utility of the outcomes that follow a non-additive probability measure as obtained by applying the Choquet integral. In situations in which no preferences as required in this approach are given, there is no obvious way to make the non-calculable calculable.

Therefore, in the setting where a central bank faces data uncertainty, model uncertainty or parameter uncertainty, more or less sophisticated versions of sensitivity analysis are the only options available. This is the approach which is effectively taken in the literature on robust control in monetary policy (Svensson 2007). Even if some of the formulations are similar to those of models that deal with ambiguity, the parallel is misleading. In the end, questions regarding the appropriate trade-off of the consequences of ambiguity against other relevant aspects cannot be solved within the model. The trade-off remains fully at the discretion of the policymaker.

The situation is different when the public faces strategic uncertainty. Strategic uncertainty affects the functioning of the economy through the expectations of the decision makers, for example the central bank and the public. These expectations are formed much in line with Keynes's observations as cited above. In principle, it is possible to extract this information regarding the perceived amount of ambiguity and the prevailing attitudes towards it and to include them in the model. If now, for one reason or another, the amount of ambiguity and/or the attitudes towards it change, it would be possible to predict the effects on the monetary policy outcomes. As opposed to the literature on robust control, the latter strand of literature is still in its infancy (see Caglianrini and Heath 2000, Chprits and Schipper 2003 and Spanjers 2008a).

In Spanjers (2008a) the interaction between a central bank and the public is analyzed in a standard setting where both the central bank and the public face ambiguity. The public faces strategic ambiguity regarding the trustworthiness of the central bank, whereas the central bank faces parameter ambiguity regarding the effectiveness of surprise inflation. Within the context of a standard model, the public and the central bank are both assumed to be pessimistic, i.e. ambiguity averse. When the public faces a level s of strategic ambiguity regarding the central bank, with s between zero and one, the resulting level of inflation is:

$$\pi = \pi^* + \alpha \mathrm{s}$$

where π^* denotes the optimal rate of inflation and α is a constant. The presence of strategic ambiguity regarding the monetary policy of the central bank leads to an ambiguity premium on inflation, αs, causing inflation to be above its optimal level.

If, in addition, the central banks face a level p of parameter ambiguity regarding the effectiveness of surprise inflation, with p between zero and one, the ambiguity premium on inflation becomes even larger, the actual level of inflation being:

$$\pi = \pi^* + \alpha \mathrm{s}(1 - \mathrm{p}) + \beta \mathrm{sp}$$

where β is a parameter that exceeds α and that is determined by the maximal plausible effectiveness of surprise inflation. Here the ambiguity premium on inflation equals

$$\mathrm{s}[\alpha\,(1 - \mathrm{p}) + \beta \mathrm{p}].$$

In the absence of strategic ambiguity regarding the monetary policy of the central bank, i.e. the case where s=0, actual inflation obtains its optimal value irrespective of the level of ambiguity the central bank is facing.

This shows that under inflation targeting strategic ambiguity regarding the monetary policy of the central bank raises inflation above the level that would have been obtained in its absence. It re-enforces the empirical result referred to in Section 3 that simple monetary policy rules that focus on a smoothed inflation measure and real output work well in transition economies. By committing to a predictable and easily observable monetary policy rule based on non-ambiguous variables, central banks can reduce the level of strategic ambiguity perceived by the public and thus reduce the equilibrium level of inflation in the economy.

Future research on monetary policy rules in transition economies faces the challenging and interesting question of which monetary policy rules are most suited when the economy faces specific kinds of ambiguity. How will the source of ambiguity influence the optimal monetary policy rule? How are the results affected when the ambiguity affects different decision makers: the central bank, the domestic public and foreign investors?

6 Concluding Remarks

The most certain thing in the world is uncertainty. In the presence of random shocks, liquidity crises and the loss of confidence or reputation, uncertainty matters. But how should it be modeled and understood? Should we use Bayesian methods for estimating demand/supply general equilibrium models? Should we use flexible priors or perhaps even modern methods for modeling ambiguity? For transition economies, a further question that arises is: how do we model the role of uncertainty and ambiguity in formulating expectations in the context of monetary policy rules? And regarding the issue of commitment in a timeless perspective: can we be confident that the time inconsistency problem can be solved in a satisfactory way?

At the moment, the trinity of a flexible exchange rate, an inflation target and a monetary policy rule still stands tall in transition economies and a modified Taylor rule could be an important pillar. It would seem a sensible idea to perform a welfare analysis using a linear quadratic approach to derive optimal monetary policy rules. Another idea would be to use a foreign currency premium to minimize risk. Or one could devise models to analyze the impact of foreign interest shocks. In each of these cases, though, a Bayesian method could be used for the estimation of uncertainty.

Notes

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2 Italics added.

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10 Public sector debt in developing countries[1]

Peter M. Jackson[2]

The past thirty years have been punctuated by debt crises across the world. Developing countries have been particularly prone and vulnerable to debt crises. The oil price shock of 1981 resulted in a hike in global interest rates which promoted developed economies to cut back on imports from developing countries, causing an increase in deficits for non-oil-exporting developing nations. During the 1980s the breakdown of the Bretton-Woods agreement, which had established an international system of fixed exchange rates in 1946, resulted in floating exchange rates for the major currencies whilst other currencies pegged themselves mainly to the US dollar but also to Sterling. The exchange rates of developing countries depreciated under this new regime and caused them problems of servicing debt denominated in foreign currencies. Interest costs on public sector debt are higher in developing compared to industrialized economies: an average of 17 per cent compared to 10 per cent. These interest charges also tend to be more volatile for developing nations.

Taking all of these changes together they posed challenging problems for the management of public sector debt in developing countries. The increase in the burden of the nominal debt resulted in a number of industrialized economies cancelling some of the debt whilst others rescheduled the repayment of debts. In the 1990s the Brady Plan restructured the debt of developing countries in the hope that this would stave off future debt problems. What the Brady Plan did was to roll up the short-term bank loans which were financing the deficits and restructure them as long-term bonds. The US government purchased a large volume of these Brady bonds.

Thin domestic financial markets had promoted the governments of developing countries to borrow overseas. This increased their exposure to exchange rate risks. While this was true for many emergent economies it was not true for all. The economies of the Far East, especially Singapore, had high levels of savings. They could, therefore, invest domestically without resorting to raising finance from overseas. The political stability of Singapore actually attracted foreign direct investment.

A central feature of debt management is the management of many financial risks, especially interest rate and exchange rate risks. One of the major problems facing most developing economies has been the mismatch of public sector debt structures both in terms of the maturity of the debt and the currency it is denominated in. If debt is short term then it is likely that it will be rolled over frequently. This implies continuous borrowing and interest rates are more likely to rise in order to make the debt rollover attractive to investors but the increase in interest rates feeds into the budget deficit through debt servicing costs. Examples of these problems are to be found in the 1994 Mexican debt crisis and the 1999 Brazilian crisis. Fixed interest bonds were replaced by variable rate debt denominated in US dollars.

The public debt to GDP ratios in 2002 averaged about 70 per cent for developing countries. There is, however, a wide variation around this mean, just as there is a wide range of experiences over time. The debt ratio for Bulgaria fell from 160 per cent in 1990 to 60 per cent in 2002 while the same ratios for Argentina and the Lebanon increased respectively from 30 per cent (1990) to 150 per cent (2002) and from 50 per cent (1990) to 180 per cent (2002). Much of the increase was due to changes in interest rates and exchange rates and not simply because of increases in the primary fiscal balance.

Public sector deficits arise because while public expenditures are relatively smooth and easier to predict as cash flows over the medium term, tax revenues are not. The cash flow of tax revenues depends upon the state of the economy and upon the efficiency of collection. Deficits also arise if governments attempt to live beyond their means using deficit finance to fund current public sector consumption. A distinction is drawn between borrowing to finance current public spending rather than public sector capital spending.

What then is the impact of public sector debt upon economic behaviour and who bears the burden of the debt? How large are the debts of developing countries? How have they been managed? What has caused them to change and what impact do they have on economic growth? These are some of the questions examined in the sections which follow.

The impact of public sector deficits

Is the impact of a budget deficit positive, negative or neutral? The answer to this question depends upon the precise perspective adopted. There are three dominant and contestable perspectives. First, deficits have negative impacts on inflation rates and, therefore, on investment. Interest payments on the debt accumulate over time, thereby increasing the burden of taxation, which in turn will cause a reduction in consumption and/or savings. Non lump sum taxes have distortionary effects upon "prices" which affect resource allocation and efficiency. The tax burden can also have distributional impacts if it becomes increasingly regressive. If the tax burden is kept constant then interest payments on servicing the debt will displace other elements of public spending – again with distributional effects.

The Keynesian perspective on the other hand regards deficits as beneficial in promoting growth, employment and prosperity (even with a balanced budget).

The third perspective is referred to as the Barro-Ricardo theorem, which argues that deficits and public debt have no long-run impacts upon economic activity. That is, public sector deficits are neutral.

The desirability of public debt has been the subject of much debate and controversy for hundreds of years. The mercantilist view was that, provided borrowing was used to fund successful wars of the sovereign, then borrowing was beneficial. David Hume, however, identified a number of negative aspects of public debt. The rentier class who held the debt and who received interest as income could increase their power over the sovereign or government and expect favours or patronage, such as a reduction in their personal taxation. Hume also recognized that taxes would probably need to be increased to service the debt, i.e. interest payments and eventually the repayment of the principal. Adam Smith in his *Wealth of Nations* also held views about the negative impact of public debt. In particular he argued that public debt crowded out private consumption and/or investment, i.e. it absorbed a greater proportion of private savings with consequential adverse effects on industry and commerce and hence on productive capacity and growth. Smith also had a more subtle argument about public debt. He suggested that, if wars were financed out of taxation in the current year rather than from borrowing, then wars would be "speedily concluded". Debt enabled governments (or sovereigns) to allow wars to linger on. In Smith's view there was also a solvency issue attached to public debt. A government could simply write off its debt by declaring itself bankrupt. On other occasions it could just debase the currency (seniorage). For all of these reasons public sector debt was not regarded as desirable.

These issues raised by the classical economists have been more explicitly formalized recently by economic theorists but remain at the heart of the debate today. As will be demonstrated, the political economy dimension is as relevant today for developing countries as it was in the time of Hume and Smith.

The Keynesian perspective

The revolution in Keynes's thinking was to challenge the laissez-faire view of the classical economists, who assumed that markets cleared with infinite velocity against a backdrop of the gold standard and a balanced public sector budget.

One of the early disciples of Keynes was Abba P. Lerner of the London School of Economics. Lerner was interested in designing systems of functional finance which were aimed at allowing governments to use their imbalanced budget to spend their way out of a recession (Lerner 1943 and 1948). Lerner used the Keynesian notion of functional finance along with the mercantilist idea that the burden of the national debt was neutral with respect to future generations because we simply owe the debt to ourselves.

> A variant of the false analogy is the declaration that the national debt puts an unfair burden on our children, who are thereby made to pay for our extravagances. Very few economists need to be reminded that if our children or grandchildren repay some of the national debt those debts will be paid to our children or grandchildren and to nobody else. Taking them together they will be no more impoverished by making the repayments than they will be enriched by receiving them.
>
> (Lerner 1948: 300)

Writing in 1948, Lerner was confident that "very few economists needed reminding" of the mercantilist argument that internal debt did not impose a burden on future generations and yet this lesson did need to be restated in the Thatcher and Reagan era of the 1980s and needs to be reiterated today. Lerner did acknowledge that the repayment of debt could have distributional effects just as any broad-based public policy does. He believed that these distributional consequences could be alleviated through progressive taxes.

Lerner's argument for the intergenerational neutrality of internal debt did not, by his own argument, apply to external debt.

> A nation owing money to other nations (or to the citizens of other nations) is impoverished and is burdened in the same kind of way as a man who owes money to other men [. . .] The borrower is enabled to consume more than he is producing. And when he repays the external debt he has to consume less than he is producing.
>
> (Lerner 1948: 300)

The problem of the intergenerational burden of the debt will be explained later.

The classical liberal perspective

This view of public debt emphasizes the negative impacts of the debt on economic performance. If the debt is monetized then it can cause the money supply to rise faster than the demand for money. This creates excess real money balances in the short run, which are then spent on a variety of transactions. The result is a rise in the rate of inflation. Monetization of the debt, therefore, generates an inflation tax which is paid by those holding money balances and is paid to those who issue the money, i.e. the government. It has been estimated (Iqbal 2007) that modest inflation of 2½ per cent per annum reduces the purchasing power of money by 50 per cent every 28 years (i.e. within a generation). The inflation tax is arbitrary in its incidence.

Another negative aspect of public sector debt is that it promotes an increase in interest rates, which in turn reduces the level of private investment. Public sector investment "crowds out" private investment, as Smith argued. The increase in interest rates, it is argued, is necessary to make public debt attractive to financial investors. If the increase in the absolute level of interest rates also causes relative interest rates to rise on international capital markets then hot money will flow into the economy in the short run and the exchange rate will appreciate. It will be difficult to sell exports in competitive international markets while imports will be sucked in. This combined effect results in a current account deficit (i.e. national dis-saving). The international aspects of public sector deficits will be returned to when the "twin deficits" are discussed.

Whether or not monetization of the debt causes inflation clearly depends upon what is happening to the demand for money. The increased public spending or reduction in taxation which lie behind the deficit will result in an increase in the transactions demand for money. It does not, therefore, automatically follow that monetization of the debt will spill over into an increase in the rate of inflation.

Whether or not a public sector deficit will result in the crowding out of private investment depends upon the prevailing conditions at the time. While at a simplistic level investment is a function of the real rate of interest naïve crowding out arguments assume a high *interest elasticity of investment*. The generally accepted view is that the interest elasticity of investment is close to zero, though it depends on the type of investment (Auerbach and Slemrod 1997). Also, savings are used to finance investment. The interest elasticity of savings is close to zero. Moreover, as Keynes suggested, expectations and risk perceptions play a more important role. If the deficit arises because of a recession then private investment will be depressed because of the excess capacity faced by firms. In the case of a small open economy, interest rates are exogenously determined and will, therefore, not be affected by fiscal policy.

There have been many studies carried out to establish whether or not public sector deficits result in an increase in interest rates. Orr *et al.* (1995) used pooled cross-section time series for 17 countries between 1981 (second quarter) and 1984 (second quarter). Their hypothesis was that the equilibrium long-run rate of interest is a function of the cost of capital; a measure of the domestic bond portfolio risk; the deficit to GDP ratio and the current account balance. Using an error correction model they find that adjustment to the equilibrium interest rate is very slow, which implies that very little of the actual interest rate is explained by variation in the equilibrium interest rate. In other words actual interest rates are not (in the short or long run) readily explained by the public sector deficit. If this is coupled with a low value for the interest elasticity of investment then the crowding out of private investment by public sector deficits is an unlikely event. Ball and Mankiw (1995) calculated that in the long run US national income is about 6 per cent lower than it would have been in the absence of public debt. This is a small but negative effect. Finally, Laubach (2003) could not find any empirical support for the hypothesis that budget deficits raise long-term interest rates. He could only find limited support for effects on the yield spread, but acknowledges that there are significant problems of omitted variables and measuring expectations.

The Barro-Ricardo equivalence theorem

The essence of the Barro-Ricardo equivalence theorem is that the form of government finance is irrelevant. It does not matter whether taxation or debt are used to finance public expenditures: they are equivalent in their long-run impact on the economy. This proposition was first advocated by the nineteenth-century British economist David Ricardo and formalized much later by Barro (1974). In this model another irrelevancy theorem is introduced, similar to that of Modigliani/Miller for private sector debt vs equity finance. That debt finance is equivalent to taxation depends upon strict assumptions just as the conclusions of the Modigliani/Miller theorem do.

Suppose a government reduces taxes whilst keeping government spending constant. This will imbalance the budget, creating a deficit which will then be financed by borrowing. Assuming a life-cycle model, either of the Samuelson/Diamond overlapping generations version or the Barro/Ramsey infinitely lived individual approach, an individual who has rational expectations and a strong intergenerational altruistic motive will foresee in the current period that this borrowing has to be repaid in the future. Current period individuals will, therefore, increase their savings so that future generations (through bequests) can repay the debt. At the macro level aggregate savings stay constant because public sector dis-saving (i.e. public borrowing) are balanced by the increase in private savings.

In this analysis fiscal policy is rendered irrelevant. Moreover, as far as the burden of the debt on future generations is concerned it is neutral because taxing future generations is equivalent to taxing current generations.

The Barro-Ricardo model, however, rests on a number of strong assumptions and is not universally supported by the evidence. How do individuals today know the consequences of current government financial policies for future taxes? Barro's model assumes that individuals possess complete information and knowledge about the economy and are able to accurately perform complex inter-temporal optimization calculations when forming their expectations about the future. In practice individuals know very little about the public debt or the public finances generally. The model also assumes that taxes are lump sum and, therefore, non-distortionary. Finally, altruism between generations is a strong assumption.

Capital market imperfections are ruled out of the Barro model. These can play an important role. Suppose that some households discount the future using a high rate of interest and that they expect rapidly rising future incomes. This implies that they will consume more income when young – they will borrow now and repay later in their life cycle. There is, however, always the possibility of bankruptcy or default. This prevents them from borrowing for current consumption. They could respond by consuming all of their income today. A debt financed by public sector deficit increases current period personal disposable income and in effect provides the individual with the "loan" that they cannot obtain from the capital market. Households respond by consuming all of it, even though they know that future taxes will need to be paid (see Elmdorf and Mankiw 1998).

Consumers might also assume that the government will not repay its debt but will instead roll it over. They, therefore, believe that there will be no *future* taxes. This would be a false perception because future taxes will probably increase just to pay the increased interest and debt-servicing costs. Governments could of course play a "Ponzi game", i.e. old investors are paid off from money borrowed from new investors or the government pays interest on the debt from new borrowing. Ponzi games are not sustainable and depend crucially upon the interest rate on the debt relative to the long-run growth rate.

A number of empirical tests have been carried out on the Barro-Ricardo theorem. Gramlich (1989) tested the model for the USA. The large increase in the Federal deficit for the 1980s was associated with a fall in savings. An increase in savings would have been expected. Other variables could have affected savings which were not identified in Gramlich's study. Bernheim (1989) reviewed the empirical literature on the Barro-Ricardo proposition and concluded that on balance large deficits are not linked to increases in savings big enough to finance the deficits – each dollar of the tax cuts raised private consumption by 20 to 30 cents. Barro-Ricardo effects are, therefore, smaller than predicted by the theory.

Studies of the Barro-Ricardo model for developing countries have been carried out. Ghatak and Ghatak (1996) examined the case of India between 1950 and 1986. They concluded that the model was invalidated for India. Reviewing the literature for a number of developing countries, Khalid (1996) came to a similar conclusion.

The twin deficits

The twin deficits hypothesis can be simply stated: fiscal deficits promote current account deficits. This hypothesis emerged in the 1980s when the US current account balance became significantly negative at the same time as the Federal budget deficit increased. It was, therefore, hypothesized that the two deficits were closely related.

The underlying logic for the twin deficit hypothesis can be sketched out in the following way. An increase in the federal deficit increases GDP and, therefore, incomes. This in turn causes consumption to increase and public sector savings to decline. If domestic investment plans are not cut back then it is necessary to borrow from abroad or to reduce overseas lending. This increases the current account deficit. If the economy is not open then there will be an increase in interest rates and investment will decline: see "crowding out" above. This logic can be summarized in equilibrium accounting terms as:

$$\text{Trade Deficit} = \text{Capital Flows} = \text{Investment} - \text{(Public and Private) Domestic Savings}$$

An increase in the Federal deficit is equivalent to a reduction in public sector savings which results in an increase in the trade deficit.

Stiglitz (2006), however, has an alternative view. Fiscal deficits, he argues, are endogenous and designed to keep the economy at full employment. Capital flows are exogenous. Because the US dollar is a reserve currency foreigners demand US Treasury Bills and government bonds. The US is in effect exporting T-Bills rather than cars etc. Treasury Bills, however, do not generate employment. To stimulate employment it is necessary to use fiscal and monetary policies. As IOUs (reserves) accumulate, confidence in the US dollar can erode, with the result that overseas central banks move out of the dollar and the value of the dollar falls. Thus, Stiglitz argues, it is the trade deficit that "causes" the fiscal deficit. The impact of the decline in the dollar on the domestic economy requires the fiscal authorities to take corrective action through increasing the federal deficit.

Empirical evidence is mixed. Miller and Russek (1989) and Enders and Lee (1990) found support for the twin deficit hypothesis while Dewald and Ulan (1990) and Gruber and Kamin (2005) found no support. Other studies find that while there is a link between fiscal deficits and current account deficits, the link is so weak that deficit reductions will not have a significant policy impact on correcting a country's current account imbalance (Bartolini and Lahiri 2006).

The burden of public borrowing

What is the nature of the "burden" of public borrowing and how is this burden distributed between present and future members of society? The traditional answer to these questions was provided by Lerner (1948), who argued that internally held debt is not a burden on future generations. This was the dominant view during the 1950s but was challenged by a new orthodoxy in a series of articles in the 1960s. Since then developments of overlapping generations models, crowding-out arguments and the Barro-Ricardo equivalence theorem have strengthened the new orthodoxy, namely that internally held debt does pose a burden for future generations.

Lerner's (1948) argument was that internal public sector debt did not represent a burden on future generations because future generations simply owed the debt to one another. When the time comes to pay the debt off income is transferred from those who do not hold the debt to those who do (i.e. bond holders). Because internal debt is held collectively by the citizens of a country there is no burden since we owe the debt to ourselves. Payments of interest on the public debt and repayment of the principal, when the debt is retired, is simply an internal transfer, i.e. tax revenues are transferred to debt holders.

This traditional view was challenged by the new orthodoxy through a series of books and articles in the 1960s – see Ferguson (1964), Musgrave (1965) and Tobin (1965). The work of James Buchanan made significant contributions to the debate (see Buchanan and Flowers 1975). Buchanan demonstrated the fallacy of the Keynesian and new classical orthodoxy which maintained that public debt involves no temporal shift of burden because we owe the debt to ourselves.

Public sector debt involves a number of substitutions. There is a substitution of present and future consumption and a substitution of public debt for private debt in portfolios. Because of the issuance of public debt, current generations can enjoy a higher level of current period consumption. If debt had not been issued then taxation would have been higher and personal disposable incomes and hence consumption (and or savings) would be lower. The repayment of the debt and the associated interest payments are, therefore, pushed on to future generations, whose consumption and savings will be lower as a result.

The dominant argument since the 1960s is that it is future generations who bear the burden of the public debt, even if that debt is internal. It is future generations who will pay future interest on servicing the debt. They will be required to pay back the principal and even if a decision is taken to roll over the debt (i.e. refinance it) future generations will have to pay future taxes to service it.

Not only is there a redistribution of the burden of the public debt from current to future generations, there is also a redistribution of income from taxpayers (of whichever generation) to those who hold the debt.

Externally held public debt in terms of both the traditional and new orthodox views is more burdensome than internally held debt. Moreover, the external debt has to be repaid by future taxpayers to foreign citizens. This represents a transfer of resources out of the country and means that external debt is more burdensome. Just how much more burdensome, however, is a matter of dispute (Buchanan and Flowers 1975). External debt arises when governments sell bonds to foreigners, including overseas governments. This results in an inflow of foreign exchange.

If the external debt is used to finance current consumption (i.e. current public expenditure) then future generations will bear the burden because future consumption is reduced by an amount equal to the value of the principal plus the discounted present value of interest paid overseas. On the other hand, if the external public debt is used to finance capital expenditure (e.g. public infrastructure) then what happens to the size of the burden on future generations depends upon the productivity of the capital expenditure. If the marginal productivity of capital is greater than the marginal cost of the public debt then future generations will be better off. This is in essence the argument which Buchanan advocated. External debt can be beneficial because it generates a higher national income for future generations. By using overseas resources rather than domestic resources it takes pressure off domestic capital markets and reduces the probability of "crowding out". If the external debt is used to fund borrowing that increases productive capability (rather than consumption) then it is less burdensome.

Recent developments of the discussion have employed overlapping generations models (Diamond 1965). These models, which are more theoretically precise, show that there is a transfer from future to current generations which places a burden on future generations. Calculations and simulations using "generational accounting" demonstrate that younger generations do transfer resources (income) to older generations. Generational accounting (Kotlikoff 1988; Auerbach, Gokhale and Kotlikoff 1991), seeks to measure the impact of fiscal policy on different generations. It examines the government's inter-temporal budget constraint and calculates the taxes paid by current and future generations. The model which underlies generational accounting assumes that individuals can assess the impact of current government policies over the life cycle and that there is no bequest motive.

Inter-generational accounting has a number of weaknesses. Its results are very sensitive to the choice of discount rate to solve the inter-temporal optimization. If individuals are liquidity constrained or myopic then they might be more sensitive to the impact of current taxes and not the present value of future taxes. Moreover, if individuals have bequest motives then they will be sensitive to future taxes. It is, therefore, clear that the results produced by generational accounting are very sensitive to the behavioural assumptions made. This severely limits its usefulness for either positive or normative evaluations of fiscal policy. However, those who have employed inter-generational accounting, such as Kotlikoff (1988), show that there is a transfer of the debt burden from today's generation to future generations.

Using a public choice perspective provides additional insight into the impact of public sector debt on future generations. Buchanan (1958, 1967) has consistently used a Wicksellian approach to analyzing public choices. Whilst the purchase of government bonds is voluntary the payment of future taxes is compulsory. Later generations do not participate in the decision to incur the debt, nor do they make the decisions about which projects/policies to invest in. If the current generation decides to issue debt rather than to increase current period taxation then this assumes that the current generation has the authority to make decisions on behalf of future generations (Shoup 1962). Future generations, however, are not in the parliament casting their vote.

Since his early excursion into the analysis of public debt, Buchanan has been one of the principal advocates for fiscal constitutions (Buchanan 1975; Brennan and Buchanan 1980; and Brennan and Buchanan 1985). Fiscal constitutions embody rules which are designed to improve fiscal decision making. One such rule is the balanced budget rule, which forces politicians to make difficult decisions when faced with a binding budget constraint. That is, politically charged projects, which are used to buy votes but which have a low marginal productivity, will be discarded in favour of those projects which generate significant benefits. Buchanan and Wagner (1977) argue that the balanced budget rule will "have the effect of bringing the real effects of public outlays to the awareness of decision makers; it will tend to dispel the illusory 'something for nothing' aspects of fiscal choice" (p.178).

Sovereign and external debt in developing countries

It was noted earlier that domestic borrowing (i.e. issuing sovereign debt) results in a transference of resources within a country while external debt enables a country to gain access to additional resources. External borrowing, however, exposes a country to additional threats and, thereby, makes it more vulnerable to exogenous events.

The composition of public debt for broad groupings of developing countries is shown in Table 10.1. On average public sector external debt, both as a proportion of total public debt and as a proportion of GDP, has fallen between 1994 and 2005. These averages, however, mask a great deal of variation between individual countries as illustrated in Table 10.2.

Developing countries' external indebtedness, expressed as the ratio of external debt to gross national income, peaked at 45 per cent in 1999 and had fallen to 39 per cent by 2003. This has happened while external debt in absolute terms increased by $207 billion over the same period, indicating by implication significant increases in gross national income. Short-term debt as a proportion of total external debt (for low- to middle-income countries) has fallen and public sector external debt as a share of total external debt fell from 82 per cent (1990/95) to 69 per cent (1996/2003). External public sector debt as a proportion of GDP fell from 31 per cent to 27 per cent over the same period.

The traditional distinction between internal and external debt is no longer clear. Such a distinction does not make much sense in a world of open capital markets (Panizza 2007). The question, "What is the optimal structure of the public debt?" remains relevant but is complex and difficult to answer. Drawing a distinction between external and internal debt assumes that the fiscal authorities of a country can identify who holds the debt. In practice they cannot. External debt can be raised on international capital markets but domestic inhabitants can own it. Domestic inhabitants can also purchase external debt on secondary capital markets. External debt is, therefore, a poor proxy for the transfer of resources across countries.

Whilst measurement problems undoubtedly exist, nevertheless, debt composition does matter. The issue about the composition of the debt is, however, more complex than simply whether or not it is held in the portfolios of domestic or overseas investors. Of more significance are maturity and currency mismatches. An open capital account implies that currency and maturity mismatches are an important source of vulnerability. Countries which have a large stock of foreign currency or short-term domestic debt are especially vulnerable to shifts in exchange rates. Those countries with long-term

Table 10.1 Public debt composition: developing countries 1994/2005

	1994				*2005*			
	DD/Y	*ED/Y*	*TD/Y*	*DD/TD*	*DD/Y*	*ED/Y*	*TD/Y*	*DD/TD*
East Asia And Pacific	0.13	0.46	0.59	0.30	0.15	0.35	0.50	0.38
Europe and Central Asia	0.17	0.28	0.45	0.35	0.17	0.19	0.36	0.43
Latin and Caribbean	0.14	0.58	0.72	0.24	0.23	0.39	0.62	0.40
Sub Sahara Africa	0.20	0.85	1.05	0.25	0.25	0.67	0.92	0.30

Source: Panizza (2007)

Notes:
DD/Y Domestic debt as a ratio of GDP
ED/Y External debt as a ratio of GDP
TD/Y Total debt as a ratio of GDP
DD/TD Domestic debt as a ratio of total debt

Table 10.2 External indebtedness of top 20 debtors 1997/2003 (total external debt as a percentage of GDP)

	1997	*2003*
Brazil	25	50
China	17	14
Russian Federation	32	42
Argentina	45	136
Turkey	44	62
Mexico	38	23
Indonesia	65	68
India	23	19
Poland	27	46
Philippines	59	72
Thailand	75	37
Malaysia	50	50
Hungary	57	58
Chile	37	63
Pakistan	49	51
Czech Republic	42	40
Nigeria	84	70
Venezuela	41	42
Colombia	31	44
Egypt	39	38

Source: World Bank Debtor Reporting System

domestic currency external debt are less vulnerable. What this means is that policymakers need to shift attention away from considering the composition of the debt simply in terms of external vs. internal and instead think about designing less risky financial structures. If countries substitute domestic debt for external debt they could be just substituting one uncertainty for another, i.e. the risk of currency mismatch is substituted for maturity mismatch. Moreover, switching to domestic debt can place pressures on the domestic financial system (domestic banks and other financial institutions). Not only might this threaten the stability of the domestic financial system, but it might also result in the public sector crowding out the private sector. Less reliance on external debt undoubtedly means that exchange rate risks are reduced but these risks are replaced by the risks of rolling over short-term domestic debt at higher interest rates because the maturity of domestic debt tends to be shorter than external debt.

It has already been noted in Tables 10.1 and 10.2 that, on average, domestic public debt has increased relative to external debt. There are many reasons for this. Over the past 15 years domestic bond markets have developed in many emerging countries. This reflects the fact that many countries are locked out of international capital markets. In sub-Saharan countries it is commercial banks who hold domestic public debt with an average maturity of 10 months.

The majority of public bonds are of three-month maturity (see Christensen 2005). Bank holdings of domestic public debt for low-income countries increased from an average of 5.5 per cent of GDP (1975/85) to 8.4 per cent (1996/2004). For emerging market economies the corresponding figures are respectively 7.8 per cent and 14.3 per cent (Abbas and Christensen 2007). These changes reflect the conditionality of IMF and other sources of aid which place constraints on external borrowing. External borrowing requires developing countries to borrow in a foreign currency (predominantly US dollars), which exposes them to the risks of fluctuations in real exchange rates (Hausmann *et al.* 2006 and Eichengreen *et al.* 2005). These risks are reduced if borrowings are on domestic financial markets. It should, however, be noted that it is not so much whether or not the debt is internal or external that matters but the currency in which the debt is issued.

In the majority of cases developing/emerging countries are unable to issue domestic currency external debt. Moreover, most are unable to issue long-term domestic currency debt. Interest rates would be prohibitively high, reflecting the risks to lenders. Countries need to invest in building up a reputation for low inflation and macro stability before they can enjoy low long-term interest rates on their public debt. This takes many years. In the case of India, which has done much to build its international reputation for low inflation and macro stability, the average maturity of Indian domestic government bonds was 16.9 years in 2006 (see Gopinath 2007). These bonds are held primarily by domestic banks.

In the case of countries such as India there has been an inward flow of private capital in search of higher yields. Bond spreads are also narrow, indicating that investors assume a low probability of a financial crisis occurring. Taken together these indicate that for countries such as India their economic fundamentals are much stronger than they were years ago. These countries have built up domestic debt and are, therefore, now in a much better position to weather a global financial crisis than they were in the 1990s.

Another policy open to governments is to encourage institutional investors to develop domestic bond markets. Institutional investors obviously take a long-term view and provide stability and liquidity. It is, however, essential that these investors are independent of government and institutional investors must be on their guard not to be "captured" by the government. While the attraction of foreign investors into domestic capital markets has the undoubted benefit of expanding the market there are also risks. A large volume of foreign investment in domestic markets can place constraints on a country's ability to manage its exchange rate and has the potential of generating instability if there are large flows in and out of the market. If, however, foreign investment is long-term these potential risks are less important because the rising share of foreign direct investment and portfolio equity represents a long-term commitment by investors, compared to domestic bank lending which is short-term. More stable sources of long-term financial investment enables countries to ride out short-term shocks.

The development of domestic debt markets has been of major significance. On average the domestic debt burden has increased from 19 per cent of GDP (1993/94) to 34 per cent (2002/03). Many countries have introduced prudent financial policies, financial market regulatory regimes, international best practice standards and more effective macroeconomic policies. The deepening of domestic financial markets and the stronger supporting financial infrastructure has reduced investors' anxieties and raised credit ratings throughout the developing world. International investors are better informed about credit risks in developing countries and thereby more favourably disposed to investing in these countries. By 2006 sixty developing countries had formal credit risk ratings compared to fifteen in 1995. Improvements in statistics, financial disclosure regulations and monitoring systems have greatly improved the quality and quantity of information available to investors to assess risks and to price bonds etc. (Frankel and Roubini 2003 and Elkhoury 2008).

The IMF has developed a number of practical tools (the *Excel-based Risk Measures Template*) to provide better assessments of the risks involved in managing public debt funded by government bonds. This should enable countries to design better-informed macroeconomic policies that embody sustainable public debt strategies. The methodology which underlies these tools takes a number of factors into consideration, including the degree of market and credit risks along with liquidity risks; the level, maturity and composition of the debt; and the costs of implementing the strategy including the coordination of fiscal and monetary goals. Because the Risk Measures Template enables the calculation of one country's public debt risk relative to that of other countries it, therefore, provides an indication of that country's credit rating. This information is important for accessing international capital markets. A number of risk measures are produced by the tool. These include: interest rate and exchange risks (duration, convexity and value at risk (VAR)); credit risks and liquidity risk (i.e. lack of sufficient volume of tradable government debt instruments).

The growth and development of domestic bond markets has been stimulated primarily by the private sector. This has, however, had important positive spillover effects for the public sector, which has also made greater use of these domestic financial markets to fund its debts. Governments can now issue local bonds, which takes pressure off bank finance which can then be used for other purposes. Non-monetization of government debt also means that governments have greater scope to use an active monetary policy to target inflation.

Changes in public debt to GDP ratio

Table 10.3 shows changes in the public debt to GDP ratio for a number of countries, the debt majors. Gill and Pinto (2005) examined changes in the ratios of 15 countries over the period 1990 to 2003. Changes were decomposed

Table 10.3 Public sector debt 1992/2002

	Big MACs (Total debt $ billions)			*Debt majors (% GDP)*	
	1992	*2002*		*1992*	*2002*
India	156	380	Lebanon	70	177
China	68	366	Jamaica	181	149
Brazil	165	284	Argentina	26	126
Mexico	118	280	Uruguay	48	109
Korea	61	232	Jordan	167	100
Turkey	65	173	Turkey	40	94
Indonesia	56	149	India	74	81
Russia	12	118	Pakistan	81	90
Argentina	59	117	Morocco	102	90
Poland	44	72	Philippines	81	89
			Indonesia	40	86

Source: Gill and Pinto (2005)

into: (a) factors contributing to growth in GDP; (b) fiscal effort; (c) exchange rate changes; and (d) interest rate fluctuations (see also Budina and Fiess 2004). They examined debt reduction episodes, i.e. those cases where the ratio fell. All such episodes involved GDP growth as a main contributing factor. In 66 per cent of the episodes the ratio fell because of large primary surpluses. The case of Lebanon (1991/93) was the only one in which the ratio fell whilst running a primary deficit. Appreciation of the real exchange rate accounted for two thirds of the episodes.

Debt increase episodes involved real interest rate or exchange rate changes in all cases. These factors were highly significant. In just over 50 per cent of the episodes the increase in the ratio occurred while the country was running primary surpluses. Large reductions in GDP growth did not play a significant role.

Bank lending to the public sector

It has been noted that in recent years many developing countries have reduced their external debt by using a greater amount of domestic finance. This strategy serves the objective of sustainability because it does not have the high risks associated with external finance denominated in foreign currencies. There is, however, a downside to the strategy. Government debt financed through domestic markets has, in many countries, absorbed an increasing share of the credit available to the economy (Hauner 2006).

Hauner, in his study of 73 middle-income countries, found that the public sector absorbs more than 20 per cent of bank credit. In 13 of the countries it was more than 50 per cent. The public sector's share of credit has been increasing. The average ratio of public sector credit to total credit has increased from 18 per cent in the mid 1990s to 27 per cent in 2003. This is a rapid increase.

These trends give cause for concern. The public sector's increasing absorption of bank credit has the potential to damage economic growth. Another concern which Hauner draws attention to is that banks which lend to government can become lazy and inefficient. Loans to government are profitable because they are large, reasonably secure and low maintenance. This blunts the banks' incentives to be innovative and to develop domestic financial markets. It also increases the deadweight cost of financial inter-mediation by increasing the spread between banks' lending and borrowing rates of interest. Hauner offers evidence to support the claim that banks which invest in government, while being profitable are less efficient than banks with lower holdings of government debt. The expectation of secure high profits from lending to government can weaken incentives for banks to control their costs. Many of the banks that lend to government are state-owned and studies show that such banks are less efficient than private banks. Finally, in the majority of cases the government is the dominant customer for those banks who lend to them. This weakens competition and the interest elasticity on government borrowing is likely to be low.

Public debt and economic growth

The top ten MACs (Market Access Countries – i.e. with access to international capital markets) are India, China, Brazil, Mexico, Korea, Turkey, Indonesia, Russia, Argentina and Poland (see Table 10.3). Between them their combined debt (public and private) in 2002 was \$2.2 trillion, of which \$1.4 trillion was held externally. The MAC countries have pursued a variety of policies including the generation of large primary fiscal surpluses; switching to flexible exchange rates and reforming their fiscal and monetary institutions. They have done this against the global background of reworking the architecture of international financial institutions.

One argument that has been advanced with much a priori conviction is that public sector borrowing will facilitate economic growth. The dominant assumption is that there is a strong link between public sector investment in physical infrastructure and human capital (via social public spending) and economic growth. This growth in GDP could then reduce the ratio of public debt to GDP.

The line of argument set out above, however, begs a number of other questions. Do current levels of public sector debt constrain economic growth and is there a link between sovereign debt (i.e. internal debt) and growth? In a useful review Gill and Pinto (2005) conclude that few empirical studies have linked sovereign debt to economic growth. Those that have do not find a strong link and are severely constrained by measurement and econometric problems. They also find that debt problems tend to be country specific, thereby making it difficult to generalize. This suggests that a case study rather than an econometric approach is probably more appropriate. External debt does not seem to have a large impact on growth and makes the economy more vulnerable to external shocks. In other words, public debt levels have made the economies of developing countries less stable in macroeconomic terms while adding little, if anything, to economic growth. Indeed, some might take a stronger view and argue that sovereign debt has constrained economic growth.

Why then has public sector debt not produced the growth and development that was expected? Is it that the negative constraining aspects of debt outweigh the positive facilitating effects? For some commentators, excessive borrowing was undertaken on the basis of overoptimistic growth projections. Others argue that the infrastructure projects that were invested in were low-productivity schemes. Not all public capital projects are of the same quality. In order to seek favour from particular constituencies or regions, politicians often choose to support large "white elephant" projects, which give the appearance of contributing to the growth and development of the country while really just serving the financial interests of politicians' cronies. The result of this is that governments were unable to grow their way out of the debt problem and, therefore, the public debt to GDP ratio either remained constant or increased. Two other reasons that are offered are the problems of "debt intolerance" and "original sin". Debt intolerance in developing countries simply refers to the fact that some countries cannot handle debt without getting into trouble. Whether this is due to their lack of technical expertise, the quality of their financial infrastructure or political interference is never made clear.

The problem of "original sin" (Goldstein and Turner 2004) refers to the situation when developing countries are unable to borrow long-term in their own currencies in external markets. This results in a currency mismatch so that if the real exchange rate collapses then the debt to GDP ratio will increase. In other words there is a "missing market" type of market failure – i.e. a capital market imperfection. Goldstein and Turner (2004) argue that what is required is for countries to improve their internal policies and be more aware of exchange rate risks. This, however, involves a change in attitudes and takes time.

A study of fiscal programmes and policies in Latin America over the past 20 years (Calderon, Easterly and Serven 2004) shows that they were designed to reduce public sector debt. The means adopted to achieve this was to cut dramatically public sector capital investment programmes. Not only did this produce an infrastructure gap, it also constrained economic growth so that countries were unable to grow their way out of the debt problem. Calderon *et al.* estimated that 30 per cent of the difference in output between Latin American countries and the East Asia tigers over the period 1980/97 could be attributed to the infrastructure gap.

Differences in infrastructure quality, if taken into account, could possibly explain even more of the difference in output levels. High-quality infrastructure spending is, however, constrained by a number of factors. There is the probability of default risk, which is high on existing debt. There is the low creditworthiness of the countries concerned and infrastructure projects tend to be long-term, and hence risky.

The infrastructure gap can also arise if politicians prefer public current spending rather than capital spending. Politicians also might prefer to keep taxes and user charges low in order to serve political objectives such as increasing the probability of their re-election, especially among those whose votes count.

Finally, as Rodrik (1999) persuasively argues, governments do not only borrow to fund public investment in infrastructure, they also borrow to finance the economic rents paid to key powerful people in society and to finance the postponement of policy reforms which are likely to have adverse distributional impacts on the friends of the government.

In summary, therefore, it would appear that many governments have not made productive use of sovereign debt and that political economy arguments are just as powerful as economic theory to explain the weak link between public sector growth and economic growth.

Public sector debt has the potential of constraining economic growth. The "debt overhang" problem was identified by Krugman (1988). Private sector investors expect the debt to be financed out of future taxation. This reduces the expected return to private investment, which falls as a result. High levels of debt and the sustainability of financing the debt can generate uncertainty, which results in macroeconomic instability and the suppression of private investment. High public debt levels result in high debt service levels and this can substitute for other elements of public spending in the "fiscal space" such as public capital spending. Finally, deficit financed public spending can "crowd out" private investment through interest rate increases and the availability of relatively safe government bonds.

The impact of these factors on growth is complex and depends, as Keynes pointed out over seventy years ago, upon private investors' expectations about future inflation and taxation. Constraints placed on economic growth by a large debt overhang also means that a country is unable to grow its way out of its debt problem or solve its debt intolerance. The complexity of the linkages between debt and growth should not be underestimated. Does debt constrain growth or does low growth result in increases in debt? Also, what role do institutions play? Poor macroeconomic policies which cause greater volatility and low growth tend to be the outputs of weak institutions (Acemoglu *et al.* 2003).

The burden of debt in developing countries

Buchanan (1958) argued that public debt did not necessarily place a burden on future generations. This, however, presupposed that the public investment that the debt financed would be used productively and would increase economic growth. Future generations would, therefore, have the fruits of economic growth to service the debt.

The link between public sector debt and economic growth is not, however, as straightforward as Buchanan supposed. Nor has the experience of developing countries been supportive of Buchanan's proposition. The debt in many cases was not well spent. Infrastructure projects were in many cases of low quality and low productivity. The fixed interest rate financing packages became burdensome as global economic conditions changed against those in developing countries. Loans tied to purchasing goods from industrialized countries usually served the interests of the donor and not those of the recipient, who was often forced to spend the aid on worthless projects. Finally, many loans were tied to ensuring the achievement of the political objectives of Western nations. Corrupt political leaders in developing countries were often bought off. Aid improved their personal wealth holdings, which were invested in overseas banks, thereby eliminating any local benefit to the economy.

The result is that today's generation does carry a burden of the debts racked up in the past. This has been vividly put by Versi:

> Every baby born in the developing world owes $485. What chance do future generations have of ever clearing such a mountain of debt? What chance do they have of being able to live off the entire fruits of their own sweat without having to give most of it away to the perpetually extended palm of the money lender? [. . .] All the pleading from the developing world has fallen on deaf ears. Arguments that the debt was contracted by earlier despotic regimes are ignored; evidence that bad advice by the Bretton Woods organizations has led to the debts is produced to no avail; proof that loans were given without due responsibility similarly fails to impact. [. . .] There is no mercy in the heart of the men who deal with money.
>
> (Versi 1998: 7)

The American dollar is now the world's reserve currency just as Sterling was earlier. This means that many developing countries hold dollar reserves in the portfolios of their banks. A simple rule of thumb used by these bankers is: keep dollar reserves equal to the value of short-term dollar-denominated debt. Today this policy is risky given the erosion of confidence in the US dollar. Moreover, developing countries are in effect lending trillions of dollars to the USA at low interest rates. This is illustrated by a simple example. Suppose a company in a developing country borrows 100 US dollars from a US bank at 20 per cent. The developing country has to put 100 dollars in reserves in the form of US Treasury Bills which pay 5 per cent. As Stiglitz (2006) points out, this implies that the developing country is supplying aid to the US!

Strengthening public sector financial management

The major OECD countries have revolutionized their systems of public sector financial management over the past 20 years in an attempt to use existing public sector resources more effectively. These improved practices have resulted in improved financial performance. Improvements in public sector financial management are essential for improving the development process and could be an important contribution to containing and managing public sector debt in developing countries. These reforms have included: rigorous monitoring and evaluation of public expenditure programmes; more effective systems of accountability, which depend upon improved management accounting information; enhanced capability and capacity which require adequate training in and understanding the new techniques that underpin public sector financial management; enhanced efficiency and effectiveness brought about by better information systems that enable improvements in public sector management.

Both the Monterrey Summit of 2004 and the Paris Declaration, March 2005, sought partnerships between developed and developing countries to identify and support good practice. The Public Expenditure and Financial Accountability (PEFA) is a partnership between the World Bank, the European Commission, the UK's Department for International Development (DFID), the Swiss State Secretariat for Economic Affairs, the French Ministry of Foreign Affairs, the Royal Norwegian Ministry of Foreign Affairs, the IMF and the Strategic Partnership with Africa. The aims of PEFA are to support integrated and harmonized approaches to the assessment and reform of public expenditure, procurement and financial accountability, including governance.

There is a great deal of variation among developing countries in regard to the level of sophistication of their public financial management systems. In Chile, for example, extensive financial management reforms were introduced which include evaluations of budget programme performance. This contrasts with rudimentary reforms introduced by Cambodia and Bangladesh. There are a number of problems with the reforms. In many cases a scattergun approach has been used in which many initiatives are introduced simultaneously in an uncoordinated way that lacks prioritization of the various initiatives. There is, in many instances, a lack of involvement of the legislature. The reforms seem to be driven by the executive branch of government. In other cases civil service reforms were divorced from financial management reforms.

Despite these weaknesses in the recent reforms, the poor delivery of essential public services has been, and indeed currently is, due to weakness in systems of public financial management. What is required is a much better link between public policies and budgets; better (realistic) revenue forecasts; the establishment of a medium-term framework for financial management and improvements in the coordination of policies through the joining up of fragmented government departments and the different levels of government. Strengthening the systems of audit, inspection and accountability has the potential of contributing to better debt management. Introducing comprehensive budgets, which bring together the government's current and capital accounts, improves the management of the revenue consequences of capital spending.

Introducing and applying international accounting standards into public sector accounts would greatly improve the quality of information available to decision makers, as too would the use of accrual accounting. The design and implementation of a Resource Based Accounting (RBA) system, similar to that which was fully introduced in the UK in the year 2003/4, and which is based on accruals accounting, would be a significant step forward for all developing countries. Accruals accounting is an accounting methodology under which transactions are recognized when the underlying economic events occur, regardless of the related cash receipts and payments. Revenues are recognized when income is earned and expenses are recognized when liabilities are incurred or resources consumed. Cash accounting recognizes revenues and expenditures when cash is received or paid out.

An accruals accounting system also provides much better information for macroeconomic policy management. It measures the assets and liabilities that should be taken into account when considering the overall stance of fiscal policy and fiscal sustainability. It also helps in the measurement of full economic costing of the public sector's activities.

There are, however, a number of constraints upon governments enjoying the benefits of these financial reforms. First, there is a constraint on the capacity to implement reforms. Second, in the majority of cases the necessary knowledge bases are weak. This makes it extremely difficult to design the information systems. Third, there is the need for institutional and organizational culture change which will embrace the reforms.

Public private partnerships

The boundaries between the public and private sectors are now more flexible and porous than they used to be. Social/public goods, it was traditionally thought, had to be provided through the public sector because of the market failures brought about by excessive externalities and transactions costs. Whilst market failure arguments remain valid for extreme cases, they certainly do not apply to all publicly provided social goods. In those cases where externalities and/or transactions costs are relatively low then there is scope for the private sector to partner with the public sector (see Jackson 2004 and Kaul 2006). This partnering can take a variety of forms. Service production (not provision) is contracted out to private sector organizations or the management of a particular facility is assigned to the private sector (e.g. operating a railway). The private finance initiative (PFI) has been used in large-scale infrastructure projects where the private sector is contracted and is responsible for the design, building and operation of items such as schools, hospitals and highway networks.

In public private partnerships it is the private sector operator who is responsible for raising the finance and ensuring that the project is managed to the highest levels of efficiency and effectiveness. For developing countries these private sector organizations are major multinational corporations who have access to finance on world capital markets. It is the private sector firm which, therefore, absorbs the exchange rate and other risks. These risks are priced and are reflected in the contract. Another feature of public private partnerships such as PFI is that they are accounted for as current rather than capital public expenditure. The annual charge is similar to that which would be incurred in a leasing arrangement. Public private partnerships have the potential, if employed on a significant scale, to change the structure of public sector debt and the composition of public spending in developing countries. They do, however, represent a mortgage on the future which will be picked up by future generations.

Conclusions and the future

The 1980s and 1990s were periods of financial crises for developing countries. Whilst corrective policies have been introduced, nevertheless, the generally held view is that current levels of public debt in developing countries are constraining economic growth, especially if public debt sustainability is a problem. It is acknowledged, however, that the transmission mechanisms through which debt affects growth are imperfectly understood.

A number of institutional reforms that are intended to improve fiscal decision making through better accounting and information systems and public private partnerships do offer the promise of gains in public sector efficiency and effectiveness, thereby expanding the fiscal space and reducing the negative consequences of debt service costs.

In their paper, Gill and Pinto (2005) conclude with an interesting and puzzling question: "Why does the market allow over borrowing especially by debt intolerant countries?" No clear answers to this question have been forthcoming but the pressing nature of the question demands an answer. Is it due to capital market imperfections or is it simply the triumph of hope over realistic expectations? While standard neoclassical economic models provide many deep insights, their behavioural assumptions and lack of institutional detail render them weak when it comes to offering economic advice of a practical nature. The new and emergent literature on behavioural finance at least offers some fresh thinking on what is without doubt a set of issues that have significant consequences for the quality of life of hundreds of millions of today's generations and many billions in the future. One overriding conclusion is, however, not in doubt: if developing countries are to grow and prosper then they must reduce their indebtedness.

Notes

1 Anita Ghatak wrote about public sector debt. In one of her articles, authored jointly with her husband Subrata, she examined the impact of debt on interest rate crowding out and the long-run economic performance of India: see Ghatak and Ghatak (1996).

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11 Labour market and investment effects of remittances*

Stephen Drinkwater, Paul Levine and Emanuela Lotti

1 Introduction

The economic analysis of the effects of remittances has become an increasingly important issue in recent years because of the rapid growth of this form of financial flow. Official estimates put global remittances at around $80bn in 2002, but the total amount, which includes flows through unofficial channels, is thought to be far greater than this. Nevertheless, the official level of remittances greatly exceeds the amount received in overseas aid by developing and emerging economies. According to the World Bank (2006) WDI Database, it appears that for many emerging economies, remittances have been increasing rapidly since the early 1990s. They also appear to be far less volatile in comparison with other international capital flows and uncorrelated with them (Chami *et al.* 2008). Remittances are particularly important to some countries, with remittances in our sample of 19 lower and middle income countries equal to 3.8 percent of GDP.

The purpose of this chapter is to shed light on the relationship between remittances from international migration and imperfections in the labour and capital markets of the sending countries. Different forces can affect the way labour markets perform, especially when migration occurs between countries at different stages of development. Migration can affect the labour market of the origin country through at least two channels. First, migration opportunities can influence the education decision of both migrants and stayers (Stark *et al.* 1998). Second, when migrants remit part of their earning to their families, they can affect the consumption, investment and employment decisions of stayers. The latter is the focus of this chapter. We develop a search-matching model to analyse the role of migration opportunities and remittances on the labour market performance of the home country.

The basic idea of the paper is that migration opportunities can have two opposing effects on the source country's labour market. First, remittances from migrants to their family raise the income of the unemployed individuals back home. As a consequence, the outside option for the unemployed improves, causing the unemployment rate to *increase*. But suppose some remittances are invested. The net effect of remittances in the labour market of the home country is then far from obvious. In particular, we show that when firms are financially constrained, remittances can *decrease* the unemployment rate in the home labour market.

Firms in developing countries often cite credit constraints as a major obstacle to business. Batra *et al.* (2002) summarize the results of a survey of more than 10,000 firms in 80 countries, carried out between late 1999 and mid 2000 on the types of constraints they faced. They report: "firms in Central and Eastern Europe are most likely to identify financing as a serious constraint, followed by those in CIS (former Soviet Union) countries, and then those in Africa, South Asia, and Latin America" (p. vi). The constraint is particularly important for small and medium size firms. The authors add: "It is not surprising that whereas 50 percent of firms in all developing regions cited financing as a serious constraints, only 40 percent of firms in OECD countries found it to be so". Clearly the lack of funds for investment influences the process of economic development, and remittances are a possible way of relaxing these constraints.[1] We therefore develop a dynamic labour-matching model with capital and credit constraints. This gives us a useful theoretical framework to discriminate between the "productive" and "unproductive" uses of remittances.

The chapter is organized in the following way. Section 2 provides an overview of the existing theoretical and empirical literature on the effects of migration on the welfare of stayers. Section 3 introduces the basic model in which we explore the effect of remittances on labour markets where firms' level of investments are sub-optimal owing to credit constraints. Section 4 provides an empirical analysis of the relationship between remittances and unemployment as well as with investment and Section 5 concludes.

2 Related literature

A large literature has developed in recent years concerning the impact of international migration on both the home and host countries. Apart from a few exceptions (e.g. Davis and Weinstein 2002), the general perception is that migration enhances the welfare of people living in the host country even if distributional effects can be important. For example, Borjas (1995) summarizes this literature and reports that immigration increases national income but only results in a small negative impact on native wages and employment.

However, the analysis of the effects of migration is far from complete if we do not take into account the effects of migration on the home (sending country's) labour market. Given that it is often the most skilled individuals who migrate, the most obvious effect of migration from Less Developed Countries (LDCs) is that a brain drain could negatively affect the labour market of the labour exporting country, although some recent studies argue that the brain drain need not harm LDCs (Stark *et al.* 1998; Beine *et al.* 2001). For the remainder of this section, however, we will focus on literature that examines the effects of remittances.

First we relate our theoretical model to what has been found empirically. Income from remittances or from return migrants[2] can be spent on durable and non-durable goods or can be used in a productive way through direct investment in a project or through savings channeled from the banking system. A number of studies have examined the two effects of remittances on employment and investment, although the analysis usually relates to only a single country.

Funkhauser (1992) notes that migration and remittances can have two effects on participation decisions on the home country's labour market. The loss of the migrant worker may mean that other household members, in particular females, enter the labour market. However, the receipt of remittances could reduce participation rates because of the income effect. He further suggests that high levels of remittance flows into local labour markets may increase aggregate demand and hence the demand for labour. Using data from El Salvador, he finds that remittances have a negative and significant influence on the labour force participation of both males and females. However, he finds that the loss of migrants does not have a significant effect on local labour markets. For females the positive but small effect of the local labour market is enough to outweigh the negative remittance effect, but for males, the negative income effect from remittances dominates all other effects.

Further evidence that remittances act in a similar way to welfare payments is provided by Zachariah *et al.* (2001). They report that the worker-population ratio was 55 percent amongst non-migrant households in Kerala, India but only 32 percent in households with an emigrant. They suggest that this finding may be caused by employment seekers from emigrant households being more selective with regards to their job match. Furthermore, they report unemployment rates of 21 percent and 8 percent for emigrant and non-emigrant households respectively. They conclude their section on the effect of migration on employment and unemployment with the comment "because unemployed persons belonging to emigrant households enjoy the financial support of the emigrant members, they are not in any hurry to get employed" (p. 55).

The idea that unemployment benefits act as a safety net for the unemployed worker is theoretically explained in Marimon and Zilibotti (1999). They develop an equilibrium search matching model with two-sided and ex ante heterogeneity to obtain a distribution of match productivities. An increase in unemployment benefits acts as a safety net and the unemployed wait longer for better matches. They find that in an economy with higher unemployment benefits there will be a higher unemployment rate but also a better allocation of skills to jobs.

In terms of the non-productive versus productive use of remittances, Durand *et al.* (1996) report that 10 percent of their sample of Mexican migrants to the US who reported that they sent remittances or brought savings back with them spent at least some of the migradollars (saved/remitted) productively. Fourteen percent reported that they spent some of their migradollars on housing and the remaining 76 percent reported that they spent the migradollars only on consumption. Glytsos (1993) estimates that only 4 percent of the estimated 14 billion drachmas sent in migrant remittances to Greece in 1971 was invested in machinery and another 4 percent was invested in small shops, compared with 63 percent on consumption, 22 percent on housing and 7 percent on land. Using input–output analysis, he estimates that the multiplier effect associated with migrant remittances is 1.7 and this is found to vary between industries. The author also estimates that the potential employment and capital effects of remittances amounted to around 74,000 new non-agricultural and non-public sector jobs and 8 percent of installed manufacturing capacity.

Adams (1998) also finds that external remittances have an important impact on the accumulation of rural assets using Pakistani data and argues that the marginal propensity to invest transitory income is higher than it is for labour income.[3] Rozelle *et al.* (1999) find that remittances help to loosen the constraints on crop production in rural China and also stimulate productivity. Furthermore, given that many LDCs are likely to face capital and liquidity constraints, these constraints can be eased as a result of the savings that are deposited by migrants or their families. Therefore, despite the fact that only a small proportion of remittances may be invested directly by migrants or their families, remittances can be channeled into productive uses by the banking system.

Kule *et al.* (2002) summarize the results of two surveys carried out in Albania in 1998, one directed at individuals and another at firms. It is found that over 50 percent of the remittances sent to Albania were used for consumption, 16 percent were saved in a bank, 7 percent were invested both in financial institutions and in property, and over 7 percent invested in business, while firms indicated that around 17 percent of the capital required to establish a business came from remittances. This evidence suggests that remittances can be seen as a way to overcome credit constraints in the source economy.[4] Leon-Ledesma and Piracha (2004) also adopt a positive view of the relationship between migration and development by modeling the effects of short-term migration on labour productivity. Remittances can be channeled into investments and increase productivity in the home economy. The authors study the impact of migration and remittances on the employment performance of Central and Eastern European Countries and claim that the main sources of migrant savings from overseas are used productively in the home country.

Finally, this issue can also be related to the literature that explores the role of foreign aid as an instrument for financing investment. The links between aid and investment are quite complex. On the one hand, foreign aid finances investment in public infrastructure which can have a positive effect on private investments (Chatterjee and Turnovsky 2005). On the other hand, aid can have an adverse impact on domestic savings and investment (Cassen 1986). Dollar and Easterly (1999), in a study on African countries on the links between aid, investment and growth, find that only eight countries show a positive and significant relationship between aid and investment, while there is a negative and significant relationship in 12 countries.

To the best of our knowledge, the literature on matching theory has been silent until now on the role of migration opportunities in the labour market performance of the home country. In Section 3.1 we build on Pissarides' basic model with capital. Pissarides (2000) assumes perfect capital markets and shows that the standard unemployment model is unaffected by the introduction of capital. Firms choose the optimal level of investment and the introduction of new savings in the economy does not have any effect on the output produced by each firm. In our model, we assume that individuals are risk-averse. Moreover, the introduction of credit constraints generates new effects and creates a link between the literature on matching theory and the one that investigates the effects of remittances on labour exporting counties.

3 The model: remittances with credit-constrained firms

3.1 The basic model with the capital stock

Consider a worker living in a country characterized by unemployment owing to search frictions in the labour market. The worker has the option to migrate and earn a safe return abroad, which we assume is given. We do not model the migration decision of individuals and assume that a fixed proportion of individuals migrate and remit back home.[5] These savings are used by the return migrant to increase his expected lifetime utility in his own country. Alternatively, we can think of a permanent migrant who remits his savings to the members of the family who decide to stay in the home country.[6]

In a world with frictions it takes time to find a job. Trade is a decentralized economic activity and coordination failures together with imperfect information are essential elements of the trading process. The technology of meeting is summarized by a matching function which gives the number of matches in the economy as a function of inputs (i.e. the number of buyers and sellers). Matching functions reflect the fact that trading partners are not fully informed of each other's existence because of horizontal heterogeneity in location, sectors of activity and type of skills. Rationing arises in a world where individuals are imperfectly aware of their economic opportunities from the stochastic nature of the matching process between partners. The number of job meetings and matches is synthesized by the following matching function:[7] $m(u; v)$ where u is the unemployment rate and v the vacancy rate. This function is assumed increasing in both arguments and concave. For simplicity, we assume that the dimension of the market does not affect its performance, namely the function is homogeneous of degree one. Under this assumption, the probability of finding a match will be a function only of the ratio of unemployment to vacancies (i.e. the "tightness" of the market), $\theta = \frac{v}{u}$.

Given the arrival of contacts, the individual transitions from an unmatched to a matched state are $q = \frac{m(u,v)}{v} = q(\theta)$ for firms and $\theta q(\theta)$ for workers, with $q'(\theta) < 0$.

The model includes Bellman equations for the asset values of vacant and non-vacant firms, employed and unemployed workers. The firm opens a vacancy, sustains search costs c, and job creation takes place when the complementary partners meet and agree to a way to share the rents. Let F^m be the present-discounted value of expected profit from a job filled by a worker from a remittance recipient family. Similarly define F^{nm} as the asset value of a job filled by a worker from a "non-migrant" family. Let V be the asset value for the vacant firm. Introducing capital into the model, we follow Pissarides (2000) and let k be the capital stock per efficiency unit of labour. Then, given the wage bargaining process specified below, the value function for each job type is given by:

$$rF^i = pf(k) - pk(r + \delta) - w^i + \lambda(V - F^i);\ i = m,nm \tag{1}$$

where $f(k)$ is the output produced by a firm, which uses k capital and a worker, w^m is the wage for a worker from a "migrant family", w^{nm} is is the wage for a worker from a "non-migrant family", λ is the exogenous destruction rate of jobs and p is a productivity parameter. Capital is lent at the exogenous market interest rate r, which is the discount rate used to calculate asset values, and it is subject to the depreciation rate δ. When a vacancy is opened but the job is not filled, the firm does not hire capital and its asset value in the steady-state, V, satisfies the following Bellman equation:

$$rV = -c + q(\theta)\,[\bar{F} - V] \tag{2}$$

where c represents the recruitment cost and $\bar{F}$ is the average value of a filled vacancy. The expected value of a filled job depends on the proportion of "migrants" and "non-migrants" in the population:

$$\bar{F} = dF^m + (1 - d)\,F^{nm} \tag{3}$$

where d represents the probability that a vacancy is filled by a migrant conditional on the event of meeting a worker. If the firm has free access to financial markets offering finance at the interest rate r, then the maximization of F w.r.t k gives the standard result:

$$f'(k) = r + \delta \tag{4}$$

An important assumption is that workers are risk-averse. Risk-averse workers value remittances more if unemployed and the introduction of these transfers modifies their outside option. Let $\bar{z}$ denote the domestic support for the unemployed and $\tilde{z}$ denote income from remittances. Then $z^m = (\bar{z} + \tilde{z})$ and $z^{nm} = \bar{z}$ are the unemployment incomes for the worker in a migrant and non-migrant family respectively. Similarly, $y^m = (w^m + \tilde{z})$ and $y^{nm} = w^{nm}$. The remaining value functions which summarize unemployed and employed workers' asset values are then respectively:

$$rU^i = \ln(z^i) + \theta q(\theta)[E^i - U^i] \tag{5}$$

$$rE^i = \ln(y^i) + \lambda[U^i - E^i] \tag{6}$$

for a worker in a family of type $i = m, nm$. Equation (5) implies that the asset value of unemployed worker of type i depends on the unemployment income and the probability of finding a job, $\theta q(\theta)$. Equation (6) implies that the asset value of employed worker of type i depends on the employment income and the exogenous probability of losing a job, λ. As in Ortega (2000), we assume that firms are not able to discriminate *ex ante* between an unemployed migrant and non-migrant since only information concerning the average characteristics of workers is available when the vacancy is opened. This implies that firms will open the same vacancy for the non-recipient and recipient unemployed. In the home economy, households will bargain over two different wages and the wage for workers with migrants in the family will be higher than that of workers in non-migrant families since they have a higher "threat point".

In equilibrium, all firms enter the market until the asset value from a vacant job, V, is zero. By manipulating the two Bellman equations for the firms and the zero profit assumptions, we can determine the *job creation curve*, JC:

$$p[f(k) - (r + \delta)k] - w - \frac{(\lambda + r)pc}{q(\theta)} = 0; \; i = nm, m \tag{7}$$

where

$$y = p[f(k) - (r + \delta)k]$$

and w is the average wage in the economy. The relation between the wage and labour market tightness is downward sloping in the (w, θ) space. During the bargaining stage, the partners agree on a way to share the rents. Wages are determined as the solution to a Nash bargaining problem. Given that the firm surplus is equal to $F^i - V$ and the worker surplus is $E^i - U^i$, the wage is contracted by the following maximization problem:

$$w^i = \arg\max\,[E^i - U^i]^{\beta}[F^i - V^i]^{1-\beta}; \; i = nm, m$$

where $0 \leq \beta \leq 1$ is the bargaining power of workers. By solving the maximization problem for the two types of workers, we obtain the following wage-setting relations:

$$\ln\left[\frac{(w^m + z^m)}{z^m}\right] = \frac{\beta}{1-\beta}\left(\frac{1}{w^m + z^m}\right)\left(\frac{y - w^m}{r + \lambda}\right)(r + \lambda + \theta q(\theta)) \tag{8}$$

$$\ln\left[\frac{(w^{nm} + z^{nm})}{z^{nm}}\right] = \frac{\beta}{1-\beta}\left(\frac{1}{w^{nm} + z^{nm}}\right)\left(\frac{y - w^{nm}}{r + \lambda}\right)(r + \lambda + \theta q(\theta)) \tag{9}$$

The wage setting curves are upward sloping relations in the (θ, w^i) space.

To complete the matching model with capital, the evolution of unemployment is given by

$$\dot{u} = \lambda(1 - u) - \theta q(\theta) u \tag{10}$$

In the steady state, $\dot{u} = 0$ and we arrive at the *Beveridge Curve* (BC):

$$u = \frac{\lambda}{\lambda + \theta q(\theta)} \tag{11}$$

Five equations (4), (7), (8), (9) and (11) give steady-state values for k, θ, w^i and u. The "labour market tightness" parameter $\theta = \frac{v}{u}$ gives the vacancy rate and completes the description of the steady-state equilibrium.[8]

3.2 Credit market imperfections

Without some constraint on the ability to raise finance for investment, remittances can affect the unemployment income, but they would have no effect on the capital stock. Firms would choose the optimal level of the capital stock (per efficiency unit of labour) at $k = k^*$, given by (4). However, as discussed in the introduction, the lack of formal channels to obtain credit that characterizes many developing and transitional countries can generate financial constraints for firms. We therefore assume that firms cannot raise sufficient finance to pay for their optimal choice of capital. With credit constraints $k < k^*$, remittances now play a dual role since they also relax credit constraints and enable the firm to get closer to its optimal capital stock. The increase in capital will then have a positive impact on both the wage rate and the labour market tightness and a negative impact on the unemployment rate. This is illustrated in Figures 11.1 and 2. To see this "investment effect" algebraically, we differentiate the wage-setting curve with respect to k and obtain:[9]

$$\frac{d\theta}{dk} = -\frac{\partial f/\partial k}{\partial F/\partial\theta} > 0$$

The second effect of remittances is to increase the search utility.

Lemma

The "search effect" can move in both directions:

$$\frac{d\theta}{d\tilde{z}} = -\frac{\partial f/\partial\tilde{z}}{\partial F/\partial\theta} \gtrless 0$$

since the denominator is negative and the numerator can be both positive and negative.

Proof: see Appendix A. Suppose that variables θ, k and z refer to a

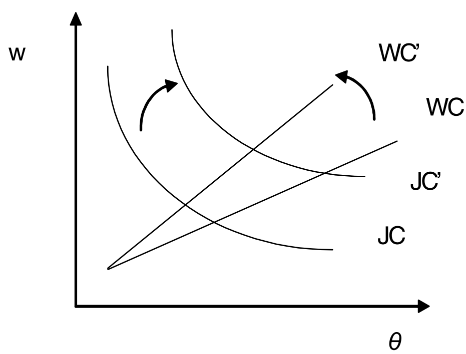

Figure 11.1 The effect of an increase in capital on labour market tightness.

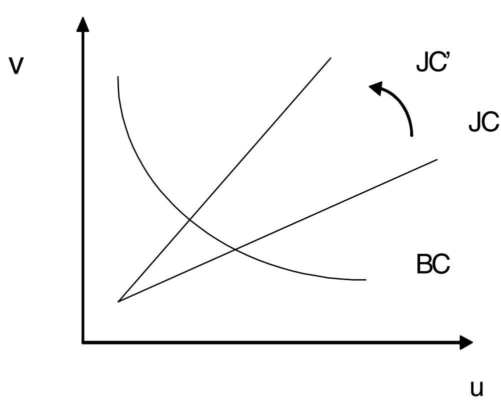

Figure 11.2 The effect of an increase in capital on unemployment and vacancy rates.

post-migration state with remittances and in the pre-migration state without remittances they take values $\bar{\theta}$, $\bar{k}$ and $\bar{z}$. The model is completed by assuming there is a given proportion of workers and entrepreneurs in the economy who receive remittances. Recipient workers use remittances to increase their consumption while entrepreneurs use the income streams to ease the firm's credit constraints.[10] Let us call s the proportion of workers who receive and consume remittances and $(1 - s)$ the proportion of entrepreneurs who invest remittances. In a steady state, per capita capital stock rises by $\tilde{z}\,(1 - s) / \delta = \bar{k}$[11] until such a point where $k = k^*$. The complete model with migration now consists of (4), (7), (8), (9) and (11) and the capital stock is given by:

$$\begin{aligned} k &= \bar{k} + \tilde{z}\,(1 - \gamma) / \delta = \bar{k} + \tilde{k}, \quad \text{if } \bar{k} + \tilde{k} \leq k^* \\ &= k^*, \quad \text{if } \bar{k} + \tilde{k} \geq k^* \end{aligned} \tag{12}$$

We can now summarize our results as a proposition:

Proposition

Remittances can have two opposite effects on the unemployment rate: First, given risk-averse workers, they increase search utility and the impact on the unemployment rate can be both positive and negative. Second, they relax the credit constraint facing firms, raising the capital stock towards its optimal level and reducing the unemployment rate. When remittance income is sufficiently high, the optimal capital stock is reached and any further increase only has the search effect.

The analysis shows that remittances can have a positive impact on the employment rate (negative impact on the unemployment rate) since the increase in capital increases the labour market tightness. It also shows that the final impact of remittances on the unemployment rate depends on the value of the parameters. When remittance income is sufficiently high, the investment effect is zero and the search effect has a positive impact on the labour market tightness. This implies an unambiguously positive impact of remittance income on the unemployment rate. This is a characteristic of our model with risk-averse workers.

4 Empirical analysis

4.1 Data

The theoretical model presented in the previous section predicts that whilst the effect of remittances on unemployment is ambiguous, they have a positive impact on investment. In order to test these predictions, aggregate data have been collected for those countries where remittances constitute an important

Table 11.1 Descriptive statistics for countries in dataset

	Unemployment models			*Investment models*		
	Sample period	$\bar{u}_{it}$	$\bar{r}_{it}$	*Sample period*	$\bar{\imath}_{it}$	$\bar{r}_{it}$
Barbados	1987–2002	15.8	2.31	1987–2002	16.29	2.31
Belize	1994–1997	12.5	2.31	1984–2003	24.08	3.73
Columbia	1976–2003	11.5	1.07	1986–2003	18.61	1.54
Croatia	1994–2002	13.4	2.67	1994–2003	23.44	2.68
Dominican Republic	1992–2001	16.4	7.23	1991–2003	22.36	7.55
Ecuador	1990–2003	9.2	3.41	1990–2003	21.73	3.41
Egypt	1977–1984, 1990–2002	7.8	8.24	1977–2003	23.85	8.19
Greece	1981–1997	7.8	2.28	1976–1990	25.06	2.31
Honduras	1996–2002	4.7	6.09	1987–2003	28.30	4.10
Jamaica	1976–1985	25.6	1.88	1976–2003	23.89	5.25
Mexico	1981–1988, 1992–2003	3.4	1.04	1993–2003	22.36	1.29
Morocco	1986–2003	17.9	6.97	1978–2003	23.37	6.76
Nicaragua	1992–2002	14.4	4.80	1992–2003	29.63	5.29
Pakistan	1981–2002	5.0	4.72	–	–	–
Paraguay	1990–2001	7.0	1.33	1990–2003	23.09	1.40
Peru	1991–2001	7.9	1.04	1991–2000	21.32	1.00
Portugal	1980–1998	6.7	6.40	–	–	–
Sri Lanka	1991–2001	11.5	6.21	1978–2001	24.97	5.51
Turkey	1983–2001	8.6	2.23	–	–	–
All Countries	1976–2003	10.3	3.78	1976–2003	23.36	4.37

Notes: Pakistan and Turkey are excluded from the investment models because of a lack of data on interest rates in these countries, whilst there is no information on aid to Portugal.

part of the economy. More specifically, countries were selected if remittances were at least 1 percent of GDP during the sample period, which begins in 1976 and finishes in 2003. Inclusion within the sample also required an adequate number of observations on unemployment and the other covariates to be included in the econometric models. As a result of these restrictions we are left with 19 countries. However, given the lack of complete data on remittances, unemployment and the other explanatory variables for some countries, we have an unbalanced panel.[12]

Before estimating econometric models of unemployment, it is useful to observe the importance of remittances to the countries contained in the dataset and the extent to which these countries have suffered from unemployment. Table 11.1 therefore reports some descriptive statistics on remittances and unemployment for the countries in the sample. Remittances are most important to Egypt, the Dominican Republic, Morocco, Portugal, Sri Lanka and Honduras, where they were equivalent to more than 6 percent of GDP over the sample period. However, there has been a general increase in the importance of remittances to developing countries over time. This is illustrated by the average level of remittances as a percentage of GDP rising to 4.72 percent since 2000, compared to an average of 3.78 percent over the whole sample period. Unemployment also varies across the countries in the sample, with Jamaica experiencing average unemployment rates in excess of 25 percent between 1976 and 1985 and average rates of at least 15 percent in Barbados, the Dominican Republic and Morocco. In contrast, the average unemployment rate was 5 percent or less in Mexico and Pakistan.[13]

Given that one of the predictions from the theoretical analysis was that remittances should increase investment levels in credit-constrained economies, econometric models which investigate the impact that remittances have on investment are also estimated. Therefore, Table 11.1 also reports the average level of investment for the countries in the sample, together with the average levels of remittances given that the sample period differs for some countries from the unemployment models, as a result of data availability.[14] Gross Capital Formation as a percentage of GDP is found to range from an average of 16 percent in Barbados to almost 30 percent in Nicaragua, although most countries are clustered between 21 and 25 percent.

4.2 Econometric specification

Because of the opposing effects that remittances are expected to have on the source country's labour market, as shown in previous sections, and the need to control for other influences on unemployment, it is necessary to test this relationship by estimating an econometric model.

The following equation represents the general form of the model to be estimated:

$$u_{it} = x'_{it} + \delta r_{it} + \varepsilon_{it}$$

$$i = 1, 2. . .n; \quad t = 1,2. . .T \tag{13}$$

where u_{it} denotes the unemployment rate in country i in period t and r_{it} the amount that country i receives in remittances (as a proportion of GDP) in period t. x_{it} is a vector of regressors that represents other factors that are expected to influence the unemployment rate. The parameters will predominantly be estimated using fixed effects models. This is because the nature of the panel under consideration (both a relatively small N and small T) precludes the use of more sophisticated panel data models. For example, Generalised Method of Moment Models (Arellano and Bond 1991) are commonly used in panels with a large N because of the potentially endogenous nature of some of the explanatory variables, whilst in panels with a large T, mean group models have been developed by Pesaran and Smith (1995) because of heterogeneity between the cross-sectional units.

Data limitations also constrain the explanatory variables that can be included in the econometric models. For example, few if any of the countries have information on the types of institutions (e.g. union density, centralization of wage bargaining, tax wedges, employment protection, duration of benefits and replacement rates) that have been examined by recent studies of OECD unemployment (Blanchard and Wolfers 2000; Nickell *et al.* 2005). Given these restrictions and the fact that countries in the sample are less developed than those in the OECD, more dated studies of OECD unemployment, which focus more on demand and supply factors, i.e. the influence of economic shocks, as well as studies that analyse unemployment in individual developing countries, have been used to inform which explanatory variables to include.

Bruno (1986) estimates a reduced form equation for unemployment, which is expressed as a function of the real wage gap and aggregate demand factors, namely the real money stock and the government fiscal deficit. Contractionary monetary or fiscal policies, to reduce inflation, will shift the aggregate demand curve inwards. For example, Bruno argues that a restrictive monetary policy, such as those followed by several OECD governments in the early 1980s, should cause unemployment to rise. He includes two lags for each of the explanatory variables and estimates a pooled model in first differences for eight countries for the period 1962 to 1982. He finds that the lagged first difference of the real money supply has a negative and significant effect on unemployment but the difference lagged two periods is not significant (although it is positive). The lagged differences for real wages have a positive and significant influence on unemployment, whereas increases in the government deficit cause unemployment to fall.

McCallum (1986) also includes aggregate demand factors in his model of unemployment in 14 OECD countries between 1980 and 1984. The variables he uses are the percentage change in the narrowly defined money supply deflated by the GNP deflator minus the trend growth in the real money supply in the preceding period and the cyclically adjusted government budget balance as a percentage of GNP. He finds that the fiscal and monetary multipliers have their expected effects and estimates that a 1 percent increase in real money supply causes a 0.18 percent increase in output a year later. Nickell *et al.* (2005) also include money supply shocks in their model of unemployment in 20 OECD countries between 1961 and 1995.

Marquez and Pages (1997) estimate the effect of trade liberalization on unemployment using a panel of 18 Latin American and Caribbean countries which have at least 15 observations with complete information. Trade liberalization is captured by four variables: openness, tariffs, the black market premium and a trade reform index. Of these, they find that only the trade reform policies exert a significant influence and its effect is to increase unemployment but they also suggest that movements in and out of employment dominate the unemployment effects of the reduction in protection. McCallum (1986) also multiplies each of the explanatory variables in his model by the ratio of imports of goods and services to GNP for each country minus the mean

Table 11.2 Fixed effects estimates of unemployment in developing countries

	(1)		*(2)*	
	FE	*FE*	*FE*	*FE*
u_{it-1}	0.724	0.723	0.721	0.719
	(0.057)	(0.060)	(0.045)	(0.049)
r_{it}	–0.119	–0.133	–0.102	–0.160
	(0.075)	(0.095)	(0.122)	(0.131)
r_{it-1}	–	–	–0.028	0.024
			(0.120)	(0.129)
m_{it}	0.017	0.007	0.032	0.028
	(0.014)	(0.018)	(0.039)	(0.045)
m_{it-1}	–	–	–0.012	–0.021
			(0.039)	(0.045)
d_{it}	–0.050	–0.080	–0.035	–0.058
	(0.034)	(0.038)	(0.053)	(0.056)
d_{it-1}	–	–	–0.028	–0.046
			(0.055)	(0.058)
o_{it}	–0.017	–0.020	–0.010	–0.009
	(0.010)	(0.014)	(0.019)	(0.021)
o_{it-1}	–	–	–0.010	–0.015
			(0.020)	(0.022)
Constant	3.456	4.958	3.562	5.240
	(0.943)	(1.307)	(1.004)	(1.683)
Time Dummies	No	Yes	No	Yes
R^2	0.569	0.616	0.571	0.619
NT	260	260	260	260

Notes:

1. The explanatory variables in the table are as follows: *u* denotes the unemployment rate, *r* remittances as a percentage of GDP, *m* the money supply as a percentage of GDP, *d* the budget deficit as a percentage of GDP, and *o* is a measure of openess. See the data appendix for details of the definitions and sources of these variables.
2. Heteroskedasticity robust standard errors are in parentheses.

value for all countries to indicate how much the estimated parameters are influenced by openness.

4.3 *Results for unemployment*

Table 11.2 presents estimates of the determinants of unemployment in developing countries. Two specifications of the model are estimated. The first specification captures the influence of openness, monetary and fiscal polices, as well as remittances and lagged unemployment and should to some extent capture the influence of omitted variables. The latter variable is included in each of the models estimated by Nickell *et al.* (2005).[15] A second specification includes more dynamics; in particular it adds the lagged values of all explanatory variables.

The impact of remittances is negative and insignificant in both of the specifications. When the lag of remittances is included, the coefficient attached to the level of remittances is reduced when time dummies are excluded, but the lagged term also changes sign when time dummies are added. In terms of the other explanatory variables, the influence of the lagged unemployment term is positive and also highly significant. The coefficient attached to the lagged dependent variable is in excess of 0.7 in all cases, which is of similar magnitude to the Generalised Least Squares estimates obtained by Nickell *et al.* (2005) for OECD countries.[16] In both of the specifications, the coefficient attached to the money supply variable is positive, which is contrary to expectations and to the findings of Bruno (1986), but it is not significantly different from zero. The coefficients on the other explanatory variables also tend not to reach the commonly used levels of significance, although higher deficit levels are associated with lower unemployment rates at the 5 percent level in the first specification when time dummies are included.

4.4 Results for investment

To further examine the effect that remittances have on relaxing credit constraints, Table 11.3 reports panel data estimates for the determinants of Gross Capital Formation as a percentage of GDP. Knack and Keefer (1997) use a similar dependent variable to examine the effect that social capital has on economic performance in 29 countries. To estimate the determinants of investment, we mainly follow the empirical strategy used by Pindyck and Solimano (1993) and Goel and Ram (2001), by including uncertainty (proxied by the five-year moving average of inflation), the real lending rate (proxied by the real interest rate) and the change in economic activity (proxied by the one-period lag on the rate of growth of real GDP) as explanatory variables. We also add controls for remittances and aid to this specification; the latter variable is included to compare its effect relative to that of remittances. The basic model is initially estimated by OLS and subsequently by fixed effects. A second specification replaces the contemporaneous remittances variable with its lagged value because of the possible endogeneity of the variable when entered as a level. Estimates from the fixed-effects models which include time dummies are also reported.

In specification 1, the effect of the current level of remittances on investment is particularly strong and highly significant, which appears to provide strong support for the hypothesis that remittances ease credit constraints in developing countries. This result is obtained regardless of whether the model is estimated using OLS or fixed effects and whether time dummies are included or not. The other variables also generally have their expected signs. The influence of the lag of economic activity is particularly strong, whilst the measure of uncertainty is significant at the 15 percent level or better. The impact of the real interest rate is weak, which is consistent with the findings of Goel and Ram (2001), since they do not report a significant effect for this

Table 11.3 Panel estimates of investment in developing countries

		(1)		*(2)*	
	OLS	*FE*	*FE*	*FE*	*FE*
p_{it}	–0.003	–0.003	–0.003	–0.004	–0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
g_{it-1}	0.322	0.418	0.437	0.428	0.451
	(0.068)	(0.066)	(0.071)	(0.067)	(0.074)
i_{it}	0.005	–0.023	–0.016	–0.009	–0.001
	(0.027)	(0.031)	(0.034)	(0.032)	(0.034)
r_{it}	0.428	0.784	0.827	–	–
	(0.107)	(0.118)	(0.124)		
r_{it-1}	–	–	–	0.701	0.733
				(0.129)	(0.138)
a_{it}	0.309	–0.034	–0.141	0.014	–0.058
	(0.075)	(0.104)	(0.132)	(0.128)	(0.146)
Constant	19.268	18.978	17.430	19.134	–17.142
	(0.637)	(0.826)	(3.047)	(0.932)	(3.256)
Time Dummies	No	No	Yes	No	Yes
R^2	0.315	0.328	0.402	0.275	0.352
NT	245	245	245	245	245

Notes:
1. The explanatory variables in the table are as follows: *p* denotes the 5-year moving average of the inflation rate, *g* the real growth rate, *i* the real interest rate, *r* remittances as a percentage of GDP and *a* aid as a percentage of GNI.
2. Heteroskedasticity robust standard errors are in parentheses.

variable in any of their models. Aid also exerts a significant influence on investment when OLS is used but the coefficient loses significance and also changes sign once fixed effects are controlled for. This is in accordance with the findings of Rajan and Subramanian (2005), who note that remittances may not increase the demand for scarce resources as much as aid and may simutaneously contribute to their supply. The effect of remittances is slightly weakened in the second specification, which includes the lag of remittances rather than the level but it still remains large and highly significant.

5 Conclusions

Given that the remittances that accrue from international migration are becoming an ever-increasing and important aspect of the global economy, it is important to examine the impact of such flows. In this paper, the focus has been placed on the effect that remittances have on the source economy, in particular what impact they have on unemployment. It is argued that remittances can have two opposing effects on unemployment in the labour-exporting country. Firstly, unemployment could be raised if remittances are seen by their recipients as providing some sort of welfare payment. Second, remittances could reduce credit constraints in developing economies and hence encourage firms to increase their investment levels. The overall effect on unemployment will depend on which of these effects dominates.[17] The relationship between remittances and unemployment was tested using data from a panel of developing economies. It is found that remittances have a negative but insignificant effect on unemployment, thus suggesting that the investment and search income effects of remittances have partially offsetting influences. The effect of remittances on investment was also tested econometrically and the results indicate that there is a stronger relationship between investment and remittances. In particular, a positive and significant association is found to exist between remittances and a country's investment levels in the fixed-effects models that are estimated.

The analysis in this chapter has mainly been conducted at an aggregate level, both in terms of the theory and empirics. This has a number of advantages such as providing an overall perspective on the effects of remittances. However, to gain a better understanding of the links between remittances, the decision to work and investment, it is also necessary to examine these relationships at a more disaggregated level. For example, performing the theoretical analysis at the household level and examining microdata would provide further insights into these important issues, which could be used to inform on the likely impact of particular development policies. Thus, future research should be focused in this direction.

Notes

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1 Foreign direct investment (FDI) is another possible way of relaxing credit constraints. However, Harrison and MacMillan (2001), using firm level data from the Ivory Coast, show that borrowing by foreign firms can have a negative effect on the credit constraints of domestic firms.

2 As clarified in Rapoport and Docquier (2005): "At a macro level, there are only minor differences between remittances *stricto sensu* and repatriated savings upon return [. . .]. The relevant questions are: How much income earned abroad is repatriated? And are the amounts repatriated being used for investment or consumption?" Therefore, we use the term "remittances" to cover both sources of income.

3 He also finds that remittances from international migration have a much larger impact on the accumulation of physical assets (irrigated and rain-fed land) than remittances from internal migration.

4 There is also evidence to indicate that remittances increase human as well as physical capital levels (Cox Edwards and Ureta 2003; Lopez Cordova 2004).

5 It is beyond the scope of this chapter to model the migration decision. In fact, the evidence shows that part of the income earned abroad is repatriated in

the home economy and that the decision to remit is driven by different motives. See Rapoport and Docquier (2005) for a detailed survey on the motives to remit.
6 See the previous section for the definition of repatriated income earned abroad.
7 The matching function is a technical device that captures the frictions of the economy. It is possible to derive it from particular specifications of the meeting process.
8 Please refer to Lehmann and Van der Linden (2004) for a proof of existence and uniqueness in the presence of risk-aversion.
9 In Appendix A we show that the denominator is always negative and the numerator is positive in presence of credit constraints.
10 For simplicity we assume that all entrepreneurs are recipients.
11 Using $\dot{k} = -\delta k + i$ where i is investment.
12 Further details of the dataset can be found in the data appendix.
13 Underemployment is also a major issue in some developing countries because their labour markets tend not to be efficient and they usually have large informal sectors. For an analysis of underemployment in Trinidad and Tobago see Gorg and Strobl (2003). However, the underemployment rates they present for the four countries in our sample that feature in their international comparison in Table 1 (Ecuador, Mexico, Paraguay and Turkey) suggest that the problem is relatively small in these countries.
14 The investment variable used here is Gross Capital Formation as a percentage of GDP, which is very similar to the Gross Domestic Investment variable created by Easterly and Sewadeh (2001) since the correlation coefficient between these two measures is in excess of 0.95.
15 Ideally we would also like to include some measure of wages, as Bruno (1986) does. However, wage data are not readily available for many developing economies, which means that it is not possible to control for wages in this way.
16 The coefficient on the remittances variable is similar if the lagged dependent variable is excluded and remains insignificant at the 5 percent level.
17 Credit constraints have been modeled in a simple way with an imposing limit on the amount of capital that can be financed. Further work will endogenize this decision using the idea of a financial accelerator as in Cespedes, Chang and Velasco (2004) and Gertler, Gilchrist and Natalucci (2003).

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Appendix A Proof of Lemma

Two wage setting curves, one for the migrant family and one for the non-migrant family:

$$\ln\left[\frac{(w^m + z^m)}{z^m}\right] = \frac{\beta}{1-\beta}\left(\frac{1}{w^m + z^m}\right)\left(\frac{y - w^m}{r+\lambda}\right)(r + \lambda + \theta q(\theta))$$

$$\ln\left[\frac{(w^{nm} + z^{nm})}{z^{nm}}\right] = \frac{\beta}{1-\beta}\left(\frac{1}{w^{nm} + z^{nm}}\right)\left(\frac{y - w^{nm}}{r+\lambda}\right)(r + \lambda + \theta q(\theta))$$

with $z^m = \bar{z} + \tilde{z}$ and $z^{nm} = \bar{z}$. We call f_1 the first relation and f_2 the second one. We can take the average expression for the value of the filled vacancy:

$$\bar{F} = \frac{c}{q(\theta)}$$

and substitute in $f_1 f_2$. We then obtain two relations in function of θ.

The average wage is then obtained as:

$$w = df_1\left(\bar{z}; \tilde{z}\right) + (1 - d) f_2\left(\bar{z}\right)$$

We also know, from the free-entry condition that:

$$w = py - \frac{(r + \lambda)\, c}{q(\theta)}$$

We are interested on the sign of $\frac{d\theta}{d\tilde{z}}$ and $\frac{d\theta}{dk}$ in order to investigate the search income and the investment effects algebrically. Let us define:

$$F_1(\theta) = f_1(\theta, \sigma(\theta))$$
$$F_2(\theta) = f_2(\theta, \sigma(\theta))$$

where $w^i = \sigma^i(\theta) > 0$. For example:

$$w^m = \sigma^m(\theta) = y - \frac{c\,(r + \lambda)}{sq(\theta)} + \frac{1 - p}{p}(y - w^{nm})$$

So

$$F_\theta = pF_{1\theta} + (1 - p)\, F_{2\theta}$$

Then

$$F_{1\theta} = f_{1\theta} + \sigma^{m\prime}(\theta)\, f_{w^m}$$
$$F_{2\theta} = f_{2\theta} + \sigma^{nm\prime}(\theta)\, f_{w^{nm}}$$

Similarly:

$$F_{1k} = f_{1k} + \sigma^{m\prime}(\theta)\, f_{w^m}$$
$$F_{2k} = f_{2k} + \sigma^{nm\prime}(\theta)\, f_{w^{nm}}$$

and

$$F_k = dF_{1k} + (1 - d)\, F_{2k}$$

while

$$F_{\tilde{z}} = df_{\tilde{z}}$$

and

$$F_{\tilde{z}} = d\frac{(w^m + z^m)(1 - \beta q(\theta))(1 - w^m - z^m) + \beta c z^m}{z^m (w^m + z^m)^2 (1 - \beta q(\theta))}$$

$$f_{1\theta} = \frac{\beta}{(1-\beta)}\frac{c}{q(\theta)}\left\{\frac{q'(\theta)(r+\lambda) - [q(\theta)]^2}{q(\theta)}\right\} < 0$$

and similarly

$$f_{2\theta} < 0$$

$$\sigma^{m'}(\theta) = \sigma^{nm'}(\theta) = \frac{q'(\theta)\, c\,(r+\lambda)}{p\,[q(\theta)]^2} < 0$$

$$F_k \geq 0$$

and positive in presence of credit constraints. By totally differentiating

$$F(\theta) = 0$$

with respect to $\tilde{z}$ and k we have:

$$F_\theta \frac{d\theta}{d\tilde{z}} + F_{\tilde{z}} = 0$$

and

$$F_\theta \frac{d\theta}{dk} + F_k = 0$$

To show the search and investment effect algebrically, we need to study the sign of:

$$\frac{d\theta}{d\tilde{z}} = -\frac{F_{\tilde{z}}}{F_\theta}$$

and

$$\frac{d\theta}{dk} = -\frac{F_k}{F_\theta}$$

As before, the denominator is always negative and the sign of the two expressions depends on the sign of $F_{\tilde{z}}$ and F_k.

$$F_k > 0$$

when credit constraints are binding while $F_{\tilde{z}} \gtreqless 0$. In particular, $F_{\tilde{z}} < 0$ for β large, c large and $w^m + z^m$ large.

B Data appendix

Definitions of variables included in the model and data sources

Dependent variables

Unemployment rate – Definitions vary slightly by country but typically relate to the number of unemployed divided by the economically active population. Main source: International Labour Organisation (ILO). These data are used if there are any inconsistencies with the other sources, which include the World Bank's World Development Indicators (WDI), the International Monetary Fund's International Financial Statistics (IFS) and Turnham and Erocal (1990).

Investment – Gross Capital Formation as a percentage of GDP. Source: WDI.

Explanatory variables

Remittances – Total amount of workers' remittances received in the country as recorded in the Balance of Payment Statistics in current US$ as a percentage of GDP. Source: WDI.

Money Supply – Money and Quasi Money (M2) as a percentage of GDP. Source: Easterly-Sewadeh and WDI.

Openness – Total trade as a percentage of GDP. Sources: Easterly-Sewadeh and WDI.

Fiscal Policy – Budget deficit as a percentage of GDP. Source: IFS and WDI.

Uncertainty – 5-year Moving Average of the Consumer Price Index. Source: WDI.

Economic Activity – Real Growth Rate of GDP. Source: WDI.

Real interest rates – Nominal interest rate minus the inflation rate. Source: WDI.

Aid – Aid as a percentage of GNI. Source: WDI.

12 International consumption patterns

Evidence from the 1996 International Comparison Programme

James L. Seale, Jr. and Anita Regmi[1]

Recently, Seale and Regmi (2006) have addressed a number of key problems commonly confronted in the literature on international cross-country demand analyses. Among the problems they address are data requirements, conversions of national currency data to a base-country unit, commodity aggregation, data quality, separability (multistage budgeting), model selection for cross-country demand analysis, and estimation issues and solutions including data outliers, maximum likelihood estimation, and group heteroskedasticity.

Empirically, Seale and Regmi (hereafter SR) fit the Florida (PI) Preference Independence model developed by Theil, Chung and Seale (TCS 1989) to the 1996 International Comparison Programme (ICP) data for nine broad categories of consumer goods.[2,3] The 1996 ICP data contain consumption data for 115 low-, middle-, and high-income countries. SR divide the countries into three groupings: countries that were included in each of the ICP Phases II, III, and IV, countries added to the ICP sample in Phase IV; and those added into the 1996 ICP data. The covariance matrices of these three groups exhibit heteroskedasticity, and SR develop and implement a heteroskedastic-correction-maximum-likelihood (HCML-SR) procedure to correct for it.[4]

SR calculate information inaccuracy measures (Theil 1965) and identify 23 outliers. These 23 countries and one other, Herzegovina, a country without 1996 population data, are omitted from the full 1996 ICP data of 115 countries.[5] Using the data of the remaining 91 countries, they fit the Florida PI model to nine consumption categories and estimate the parameters of the system with the HCML-SR procedure. The resulting parameter estimates are utilized to calculate 91 country-specific income and own-price elasticities of demand for the nine categories of goods. However, these elasticities are not reported for the full set of 91 countries.[6]

In this chapter, we extend the analysis of SR by fitting the Florida PI model to the data of 114 countries (omitting only Herzegovina's data), estimate the system's parameters with the HCML-SR procedure, and calculate and report 114 country-specific income and three types of own-price elasticities of demand for the nine categories of goods. In the next section, the 1996 ICP data are described and discussed. This is followed by a section that presents the Florida PI model and discusses its origination and its properties. Next, empirical estimation of the model is discussed, and parameters are reported and compared to those of TCS and of SR. It is pointed out that all parameter estimates from fitting the Florida PI model to 114-country and 91-country data sets are statistically equivalent pair wise. Information inaccuracy and Strobel measures are calculated from the 114 country-based parameters, and the results are discussed. Next, income and three types of own-price elasticities of demand are derived based on the Florida PI model, and the 114 country-based parameters are used to calculate income and three types of price elasticities of demand for each of the nine aggregate goods in each of the 114 countries. Finally, conclusions are drawn.

International Comparison Programme data

International consumption data, when available, are usually reported in different national currencies. However, consumption expenditures and prices in different currencies must be expressed in terms of a base-country currency before conducting cross-country demand analyses. One solution is to convert expenditures into a single currency denomination by using official exchange rates, but this strategy has serious problems and can lead to spurious results (Kravis, Heston and Summers 1982; TCS; SR).

Fortunately, Kravis and his colleagues develop a currency-exchange methodology based on purchasing-power parity (PPP). From their efforts, the ICP is established to provide comparable gross-domestic-product and consumption data based on PPP conversions for a large number of consumption items across countries (Kravis *et al.* 1975). Over the years, the number of countries included in the ICP has increased; there are 10 countries in the 1970 Phase I (Kravis *et al.* 1975), 16 countries in the 1970 Phase II (Kravis, Heston and Summers 1978), 34 countries in the 1975 Phase III (Kravis, Heston and Summers 1982), 60 countries in the 1980 Phase IV (United Nations 1986–7), and 115 countries in 1996 (Table 12.1).[7] The 1996 ICP data introduce an additional 65 countries not included in Phases II through IV, but 10 previously included countries are not represented in the data for a total of 60 + 65 – 10 = 115 countries.

The 1996 ICP data are collected between 1993 and 1996 by six agencies contracted by the United Nations for countries in Asia, Africa, the Middle East, the Caribbean, Latin America, the Organization for Economic Co-operation and Development (OECD), and the Commonwealth of Independent States (CIS). Each of the agencies has collected price and expenditure data in its assigned region at disaggregate levels. To obtain real volumes (quantities) expressed in terms of a base-country currency (in most cases the 1996 USA dollar), the Gheary-Khamis method is implemented.[8] The resulting PPPs convert values in national currencies into "international" dollars that represent real volumes (quantities) that are comparable across countries. A major advantage of the Gheary-Khamis method is that the

Table 12.1 Countries represented in the International Comparison Programme, 1970–1996

Africa	*America*	*Asia*	*Europe*	*Africa*	*America*	*Asia/Oceania*	*Europe*
Countries represented in Phase I				*Additional countries in 1996*			
Kenya	Colombia	India	France	Benin	Antigua & Barbuda	Armenia	Albania
	United States	Japan	Germany	Congo	Bahamas	Australia	Belarus
			Hungary	Egypt	Barbados	Azerbaijan	Bulgaria
			Italy	Gabon	Belize	Bahrain	Czech Republic
			United Kingdom	Guinea	Bermuda	Bangladesh	Estonia
				Mauritius	Dominica	Fiji	Herzegovina
Countries added in Phase II				Sierra Leone	Grenada	Georgia	Hungary
				Swaziland	Jamaica	Iran	Iceland
		Iran	Belgium		Mexico	Jordan	Latvia
		South Korea	Netherlands		Trinidad & Tobago	Kazakhstan	Lithuania
		Malaysia			St. Kitts & Nevis	Kyrgyzstan	Macedonia
		Philippines			St. Lucia	Lebanon	Moldova
					St. Vincent & the	Mongolia	Romania
Countries added in Phase III					Grenadines	Nepal	Russia
						New Zealand	Slovakia
Malawi	Brazil	Pakistan	Austria			Oman	Slovenia
Zambia	Jamaica	Sri Lanka	Denmark			Qatar	Sweden
	Mexico	Syria	Ireland			Singapore	Switzerland
	Uruguay	Thailand	Luxembourg			Syria	Turkey
			Poland			Tajikistan	Ukraine
			Romania			Thailand	
			Spain			Turkmenistan	
			Yugoslavia			Uzbekistan	
						Vietnam	
						Yemen	

Countries added in Phase IV				*Countries excluded in 1996*			
Botswana	Argentina	Hong Kong	Finland	Ethiopia	Colombia	India	Yugoslavia
Cameroon	Bolivia	Indonesia	Greece				
Ethiopia	Canada	Israel	Norway				
Cote d'lvoire	Chile		Portugal		Costa Rica		
Madagascar	Costa Rica				Dominican Republic		
Mali	Dominican Rep.				El Salvador		
Morocco	Ecuador				Guatemala		
Nigeria	El Salvador				Honduras		
Senegal	Guatemala				Panama		
Tanzania	Honduras						
Tunisia	Panama						
Zimbabwe	Paraguay						
	Peru						
	Venezuela						
Countries excluded in Phase IV							
	Jamaica	Iran	Romania				
	Mexico	Malaysia					
		Syria					
		Thailand					

resulting volumes (quantities) are additive in that subcategory volumes sum to the calculated category volume.

Not all PPPs for all countries in the 1996 ICP are expressed relative to the United States (USA) data. Asian-country data are expressed relative to Hong Kong, and data of Latin American countries are expressed relative to Mexico. Because Mexico is represented in the OECD data, merging Latin American data with the rest of the data is relatively easy. Merging Asian-country data is more challenging. The Asian-country data are originally expressed with Hong Kong as the base country. SR's first step in transforming the Asian-country data to the USA base is by making Japan, represented in the OECD data, the base country instead of Hong Kong. However, the transformed Asian-country data still have scaling problems. For example, Singapore appears to be poorer than sub-Saharan African countries (Figure 12.1). By comparing the PPP-based per capita real consumption from the 1996 ICP data to those from the World Bank's *World Development Indicators* (*WDI* 2001), SR notice a close match for all countries except those in Asia. Accordingly, they use the *WDI* rankings as a new scale for the Asian data. For example, Hong Kong's PPP real per capita personal consumption in 1996 (according to the *WDI* 2001) is 79.8 percent that of the USA level, and SR multiply the real per capita volumes (in 1996 international dollars) of the broad consumption categories of Asian countries by 79.8 to get real volumes relative to those of the USA. This process adequately corrects the scaling problem encountered within the Asian-country data as illustrated by Figure 12.2.

A nine-good consumption classification

We confine ourselves to the consumption component of the gross domestic product and, in particular, to nine consumption categories: food, beverages

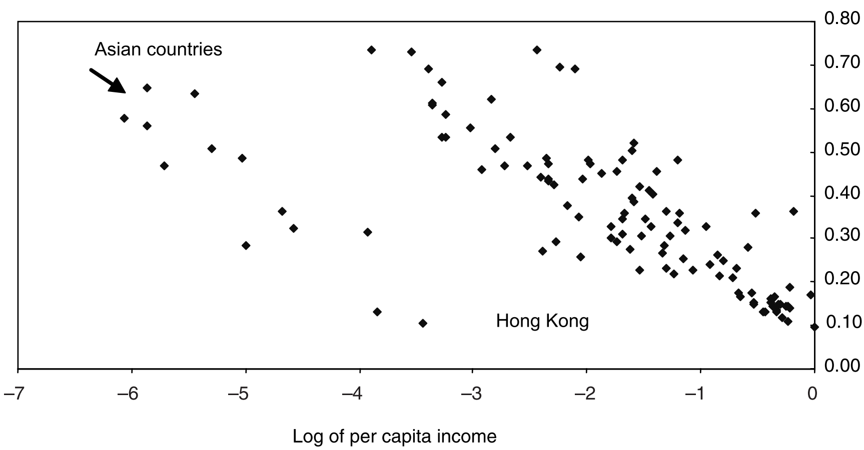

Figure 12.1 Scatter of income and food budget share without Asian countries rescaled.

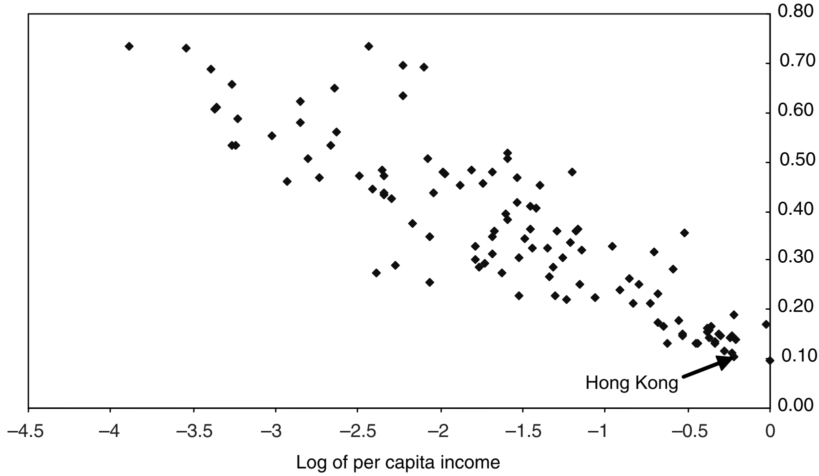

Figure 12.2 Scatter of income and food budget share with Asian countries rescaled.

and tobacco; clothing and footwear; gross rent and fuel; house furnishings and operations; medical care; transport and communications; recreation; education; and other items. These are the same categories used by SR.

The 114 countries are divided into low-, middle-, and high-income countries based on their real per capita income relative to that of the USA.[9] Low-income countries represent those with real per capita income less than 15 percent of the USA level, middle-income countries represent those with real per capita income equal to or greater than 15 percent but less than 45 percent of the USA level, and high-income countries represent those with real per capita income equal to or greater than 45 percent of the USA level. This criterion for grouping indicates that the majority of Sub-Saharan African countries, poor transition economies such as Mongolia and Turkmenistan, and low-income Middle Eastern and Asian countries such as Yemen and Nepal fall within the low-income group. High-income countries include most Western European countries, Australia, New Zealand, Canada and the USA. Middle-income countries include many Latin American countries, North African countries, and better-off transition economies such as Estonia, Hungary and Slovenia.

The range of per capita real income among the countries is striking as shown in Table 12.2. Tanzania, the poorest African country, has a per capita income level that is 50 times less than that of the USA. Thirty-eight countries have income levels less than 15 percent that of the USA level, 44 countries have income levels equal to or above 15 percent but below 45 percent of the USA level, and 32 countries have income levels above 45 percent that of the USA level.

The food, beverages and tobacco expenditure group includes food prepared and consumed at home plus beverages and tobacco. It does not include

Table 12.2 Per capita real income and food budget shares (in percentages)

Country	*Per capita real income. US = 1*	*Total food expenditure*	*Country*	*Per capita real income. US = 1*	*Total food expenditure*	*Country*	*Per capita real income. US = 1*	*Total food expenditure*
Low-income countries			*Middle-income countries*			*High-income countries*		
Tanzania	0.020	73.24	Ukraine	0.153	45.03	Czech Republic	0.451	25.00
Nigeria	0.029	72.97	Philippines	0.163	48.35	Greece	0.485	21.17
Tajikistan	0.034	68.94	Peru	0.168	30.31	Korea	0.494	31.64
Zambia	0.035	60.81	Botswana	0.168	32.80	Portugal	0.505	23.23
Yemen	0.035	61.13	Thailand	0.170	28.56	Spain	0.508	17.52
Malawi	0.038	53.35	Morocco	0.176	45.61	Ireland	0.522	16.59
Madagascar	0.038	65.88	Venezuela	0.177	29.47	Singapore	0.536	13.04
Mali	0.039	53.27	Macedonia	0.185	34.73	Mauritius	0.558	28.12
Mongolia	0.039	58.74	Belize	0.185	31.17	Israel	0.577	17.70
Benin	0.049	55.40	Egypt	0.186	48.08	New Zealand	0.585	15.19
Kenya	0.053	45.82	St.Vincent & Grenadines	0.187	35.87	Finland	0.587	14.67
Sierra Leone	0.058	62.09	Swaziland	0.197	27.48	Bahamas	0.593	35.73
Nepal	0.058	57.88	Lebanon	0.201	39.33	Sweden	0.638	13.26
Turkmenistan	0.060	50.82	Belarus	0.203	50.45	Netherlands	0.646	13.29
Congo	0.065	46.92	Kazakhstan	0.203	51.82	France	0.682	15.34
Senegal	0.069	53.35	Dominica	0.203	38.27	United Kingdom	0.686	16.37
Vietnam	0.071	64.75	Latvia	0.214	41.76	Belgium	0.693	14.36
Bangladesh	0.072	56.05	St. Lucia	0.216	46.62	Norway	0.695	15.98
Pakistan	0.082	46.99	Brazil	0.217	22.71	Italy	0.701	16.59
Azerbaijan	0.088	73.51	Bulgaria	0.218	30.70	Austria	0.715	13.53
Cote d'Ivoire	0.090	44.32	Russia	0.225	34.35	Germany	0.718	13.09
Paraguay	0.091	27.27	Fiji	0.232	36.28	Australia	0.732	15.07
Uzbekistan	0.095	48.33	Grenada	0.233	40.99	Japan	0.741	14.88
Kyrgyzstan	0.096	47.15	Turkey	0.236	32.60	Canada	0.754	11.68

Cameroon	0.096	43.80	Lithuania	0.243	40.42	Bermuda	0.782	14.23
Moldova	0.096	43.45	Romania	0.248	45.26	Switzerland	0.794	14.57
Bolivia	0.101	42.52	Iran	0.258	32.55	Barbados	0.796	11.10
Ecuador	0.103	29.09	Mexico	0.263	26.63	Hong Kong	0.799	10.28
Armenia	0.107	69.66	Bahrain	0.269	28.55	Iceland	0.801	18.90
Sri Lanka	0.108	63.55	Chile	0.273	22.96	Denmark	0.808	14.02
Jordan	0.114	37.67	Antigua & Barbuda	0.273	36.12	Luxembourg	0.972	17.08
Albania	0.123	69.26	Poland	0.283	30.65	United States	1.000	9.73
Indonesia	0.126	50.62	Trinidad & Tobago	0.291	22.06			
Jamaica	0.126	34.78	Estonia	0.299	33.45			
Zimbabwe	0.127	25.58	Gabon	0.301	47.94			
Guinea	0.130	43.69	Tunisia	0.307	35.95			
Syria	0.138	47.92	St. Kitts & Nevis	0.311	36.33			
Georgia	0.139	47.39	Uruguay	0.314	25.25			
			Slovakia	0.319	32.06			
			Hungary	0.346	22.54			
			Argentina	0.385	32.79			
			Oman	0.403	24.14			
			Qatar	0.426	26.22			
			Slovenia	0.437	21.34			
Low-income average	0.080	52.58	*Middle-income average*	0.249	34.69	*High-income average*	0.674	16.97

food consumed away from home. As expected, the budget share for food accords to Engel's law and it tends to decrease as income rises, ranging from 73 percent of the total budget in Tanzania to just below 10 percent in the USA (Table 12.2). Although the relationship for clothing and footwear is not as clear as with the case of food, beverages, and tobacco, the simple average budget shares are also higher for low-income countries compared with the other two groups (Table 12.3). The budget shares for the other seven categories are higher for high-income countries compared with the middle-income and low-income countries; the budget shares for gross-rent and fuel, house furnishings and operations, medical care, transport and communication, recreation, education, and other items generally increase as income levels increase. On average, consumers in low-income countries spend less than 4 percent of their total budget on medical care, while consumers in middle-income and high-income countries spend over 7 percent and 10 percent respectively. On average, low-income countries spend less than 2 percent of their total budget on recreation while high-income countries spend approximately 8 percent of their total budget on recreation. It is also noteworthy that, according to the 1996 ICP data, several African and Asian countries spend less than 1 percent of total real per capita income on recreation. The average expenditure share by low-income countries spent on education is approximately 4 percent while average expenditure shares on education by middle-income and high-income countries are approximately 7 percent and 10 percent, respectively.

Florida Preference Independence (PI) model

The Florida PI model, developed by TCS, is derived from Working's (1943) model by incorporating prices.[10] Working develops his model to estimate USA household demand for broad categories of goods, and he assumes that all households face the same price vector. In its general form, Working's model states that, for n goods ($i = 1, \ldots,$ n),

$$w_i = \alpha_i + \beta_i \log E + \varepsilon_i \tag{1}$$

where $w_i = \frac{P_i E_i}{E}$ equals the budget share for good i, P_i and E_i represent the price of and expenditure on good i, respectively, $E = \Sigma_{i=1}^{n} E_i$ is total expenditure, ε_i is a random error term, and α_i and β_i are parameters to be estimated. Since the budget shares across all consumption groups sum to 1, the α's and β's are subject to the adding-up conditions,

$$\sum_{i=1}^{n} \alpha_i = 1 \text{ and } \sum_{i=1}^{n} \beta_i = 0. \tag{2}$$

Table 12.3 Average budget shares (in percentages) for nine goods

Country groups	*Food, beverage and tobacco (2)*	*Clothing & footwear (3)*	*Gross rent, fuel (4)*	*House operations (5)*	*Medical care (6)*	*Transport, communications (7)*	*Recreation (8)*	*Education (9)*	*Other (10)*
	Percent of total expenditures								
Low-income	52.58	7.67	9.65	4.99	3.80	7.94	1.67	5.40	6.30
Middle-income	34.69	7.01	14.55	6.70	7.36	10.72	3.91	6.88	8.18
High-income	16.97	5.65	17.37	6.60	10.16	12.36	7.84	7.72	15.32

The marginal budget share, θ_i, varies by affluence and exceeds the budget shares by β_i:

$$\theta_i = \frac{dE_i}{dE} = \alpha_i + \beta_i\,(1 + \log E) = w_i + \beta_i. \tag{3}$$

Accordingly, the budget and marginal shares are functions of income; when income changes, w_i changes as does θ_i, the marginal share.[11]

In developing the Florida PI model, TCS rewrite equation (1) in terms of a cross-country model,

$$w_{ic} = \alpha_i + \beta_i \ln Q_c + \varepsilon_{ic} \tag{4}$$

where the subscript $c = 1, \ldots, N$ represents country c, N is the total number of countries, and Q_c is real per capita income (volume) in country c. Let p_{ic} be the price of good i in country c and note that the absolute prices p_{ic} and p_{id} from countries c and d will have different dimensions. However, for cross-country analyses, we must have prices for all countries in the same dimension. The solution is to use relative instead of absolute prices. Also note that the price ratio p_{ic}/p_{jc} depends on country c and implies that different countries have different sets of prices. To extend equation (4) to include prices and still have fixed parameters (i.e., α_i and β_i), one must select a particular set of relative prices. TCS choose to deflate the absolute price of i in c by the geometric mean price[12] of i across all N countries, that is,

$$\ln \bar{p}_i = \frac{1}{N}\sum_{c=1}^{N} \ln p_{ic} \tag{5}$$

The model that emerges has the budget share on the left and is polynomial in the parameters:

$$w_{ic} = \text{LINEAR} + \text{QUADRATIC} + \text{CUBIC} + \varepsilon_{ic}, \text{ where} \tag{6}$$

LINEAR = real-income term,

$$= \alpha_i + \beta_i q_c, \tag{6.a}$$

QUADRATIC = pure price term,

$$= (\alpha_i + \beta_i q_c)\left[\log\frac{p_{ic}}{\bar{p}_i} - \sum\nolimits_{j=1}^{n} (\alpha_j + \beta_j q_c)\log\frac{p_{jc}}{\bar{p}_j}\right], \tag{6.b}$$

CUBIC = substitution term,

$$= \phi(\alpha_i + \beta_i q_c^*)\left[\log\frac{p_{ic}}{\bar{p}_i} - \sum_{j=1}^{n}(\alpha_j + \beta_j q_c^*)\log\frac{p_{jc}}{\bar{p}_j}\right], \tag{6.c}$$

and q_c is the natural logarithm of Q_c, $q_c^* = (1 + q_c)$, $\bar{p}_i$ is the geometric mean price of good i across all countries, and ϕ represents the income flexibility (the inverse of the income elasticity of the marginal utility of income).

The linear term in the model, equation (6.a), represents the effect of a change in real income (i.e. the volume of total expenditure) on the budget share. Since the quadratic and cubic terms vanish at geometric mean prices, the linear term is also the budget share at geometric mean prices. The quadratic term, equation (6.b) (quadratic because it contains products of the αs and the βs), is the pure-price term and shows how an increase in price results in a higher budget share on good *i*, even if the volume of total expenditure stays the same. The cubic term, equation (6.c) (cubic because it involves ϕ as well as the αs and βs), is a substitution term reflecting how higher prices may cause lower budget shares for good *i* due to substitution away from good *i* towards other (now) relatively cheaper goods.

Maximum likelihood

The Florida PI model, equation (4), can be estimated with maximum likelihood (ML). If all countries or groups of countries have identical covariance matrices, the model is estimated under the condition of homoskedasticity. If countries or groups of countries have covariance matrices of differing magnitudes, the system exhibits heteroskedasticity. If so, the ML estimator should explicitly take heteroskedasticity into account.

TCS are the first to note heteroskedasticity between the covariance matrices of two groups of countries in the 1980 ICP Phase IV countries. They divide the Phase IV data into two groups: countries in either Phases II or III; and those that are not in either. Fitting the Florida PI model to the data of the two groups individually, they find that the group covariance matrices are not equal; the covariance matrix of the group of newly added countries is almost twice as large as that of the group of Phase IV countries that participated in Phases II or III. Given this difference, they infer that the covariance matrices of these two groups do indeed exhibit heteroskedasticity.

TCS introduce two parameters, K_i (i = 1, 2), into the likelihood function that properly weight the covariance matrices of the two groups with ML. Their heteroskedastic-correction-maximum-likelihood (HCML-TCS) procedure normalizes $K_1 = 1$ for the first group and estimates K_2 for the second group through a grid search.[13] In a subsequent paper, Seale, Walker, and Kim (SWK 1991) disaggregate the pooled data of TCS into an 11-good system that includes energy, and they estimate the Florida PI model's parameters, including the heteroskedasticity parameter, with a heteroskedastic-correction-maximum-likelihood (HCML-SWK) procedure based on the scoring method (Harvey 1990: 133–5).

SR generalize the HCML-SWK procedure by allowing for heteroskedasticity among any number of groups (HCML-SR). In their empirical analysis, they form three separate groups of countries within the 115-country data of the 1996 ICP: Group 1, those included in TCS's estimation from the first three phases of the ICP; Group 2, those added in Phase IV; and Group 3, those countries first appearing in the 1996 ICP data (and not in the first four phases). Group 1 has 26 countries, Group 2 has 23 countries, and Group 3 has 66 countries (Table 12.4).

SR normalize $K_g = 1$ for Group 1 countries in the log-likelihood function. As such, they estimate two heteroskedasticity parameters. Income is normalized so that the per capita real income of the USA equals one, and all other country per capita real incomes are relative to that of the USA. After omitting the data of Herzegovina, they fit the Florida PI model to the remaining 114 country-based data estimating nine αs, nine βs, ϕ, and two K_gs along with their associated asymptotic standard errors (ASE) with the HCML-SR procedure. Based on these parameters, they estimate information inaccuracy measures for each country and identify 23 countries as outliers. The data of the 23 outliers are omitted from the sample, leaving data for 91 countries. From this sub-sample of 91 countries, SR obtain and report their final parameter estimates with associated ASE. Their parameter estimates and asymptotic standard errors are duplicated in column (3) of Table 12.5.

For the current analysis, we estimate the data of the full set of 114 countries with the HCML-SR procedure, and these results are presented in column (4) of Table 12.5. For comparative purposes, we also duplicate and report the parameter estimates obtained by TCS (Table 5-4, column (3), p. 105) for their 1980 normalized and pooled data in column (2) of Table 12.5.

The βs appear to be quite stable across all three studies. As indicated by negative βs, food, beverage and tobacco, and clothing and footwear are the only necessities in all three studies; all other consumption categories except education are luxuries. The category education has a near zero β_i and hence has near-unitary income elasticity. The β parameter for food, beverages and tobacco is by far the largest β in absolute value in all three studies. Its estimate of −.135 (with an asymptotic standard error of .006) is comparable to the values −.132, obtained by SR, and −.134, obtained by TCS (Table 5-4, p. 105) for the 1980 normalization of their extended and pooled data.[14] This parameter estimate in all three studies retains the property of the strong version of Engel's law: when income doubles, the budget share of food declines by approximately 0.1 (TCS, p. 44).

Our estimated income flexibility, −.809, is negative, consistent with expectations, and is only somewhat less negative than the value −.839 obtained by SR and slightly more negative than the value −.723 obtained by TCS.[15] Our and SR's estimated ϕs are statistically the same (a = .05) but are statistically

Table 12.4 Classification of 115 countries for heteroskedastic-corrected-maximum likelihood

Africa	*America*	*Asia*	*Europe*	*Africa*	*America*	*Asia/Oceania*	*Europe*
Group 1. Countries included from the first 3 phases				*Group 3. Additional countries in 1996*			
Malawi[2]	Brazil	Japan	Austria	Benin	Antigua & Barbuda	Armenia[2]	Albania[2]
Zambia	United States	Pakistan	Belgium	Cameroon	Bahamas[2]	Australia	Belarus
	Uruguay	Philippines[2]	Denmark	Congo	Barbados	Azerbaijan[2]	Bulgaria
		South Korea	France	Cote d'Ivoire[2]	Belize	Bahrain[2]	Czech Republic
		Sri Lanka[2]	Germany	Egypt[2]	Bermuda	Bangladesh	Estonia
		Syria	Hungary	Gabon	Dominica	Fiji	Herzegovina[1]
		Thailand	Ireland	Guinea	Grenada	Georgia[2]	Iceland
			Italy	Kenya	Jamaica	Iran[2]	Latvia
			Luxembourg	Mali	Mexico	Jordan	Lithuania
			Netherlands	Mauritius	Trinidad & Tobago	Kazakhstan	Macedonia
			Poland	Sierra Leone	St. Kitts & Nevis	Kyrgyzstan	Moldova
			Romania	Swaziland	St. Lucia	Lebanon	Russia
			Spain		St. Vincent & the	Mongolia[2]	Slovakia
			United Kingdom		Grenadines	Nepal	Slovenia
						New Zealand	Sweden
Group 2. Countries added in Phase IV						Oman	Switzerland
						Qatar	Turkey
Botswana	Argentina	Hong Kong[2]	Finland			Singapore	Ukraine
Madagascar[2]	Bolivia	Indonesia	Greece			Tajikistan[2]	
Morocco	Canada	Israel	Norway			Turkmenistan[2]	
Nigeria[2]	Chile		Portugal			Uzbekistan	
Senegal	Ecuador[2]					Vietnam	
Tanzania[2]	Paraguay[2]					Yemen[2]	
Tunisia	Peru						
Zimbabwe[2]	Venezuela						

Notes:
1. Herzegovina has no reported population figures for 1996 and is excluded from all analyses.
2. These 23 countries, identified by SR as outliers and excluded from their final anlysis, are included in the regression analysis in this paper.

Table 12.5 Parameters from maximum likelihood estimation

Good or parameter (1)	*Pooled data, 1980 normalization[a] (2)*	*1996 data, 91 countries[b] (3)*	*1996 data, 114 countries (4)*
		Coefficient ϕ	
Income flexibility	−.723 (.025)	−.839 (.022)	−.809 (.021)
		Coefficient β_i	
Food, beverage, tobacco	−.134 (.009)	−.132 (.006)	−.135 (.006)
Clothing, footwear	−.004 (.003)	−.010 (.003)	−.006 (.002)
Gross rent, fuel	.018 (.004)	.027 (.005)	.027 (.004)
House furnishings, operations	.014 (.003)	.009 (.003)	.012 (.001)
Medical care	.022 (.003)	.027 (.003)	.024 (.003)
Transport, communications	.030 (.004)	.019 (.004)	.021 (.003)
Recreation	.018 (.002)	.022 (.002)	.020 (.002)
Education	.005 (.004)	.001 (.003)	.005 (.002)
Other	.030 (.003)	.038 (.004)	.032 (.003)
		Coefficient α_i	
Food, beverage, tobacco	.214 (.015)	.145 (.009)	.151 (.011)
Clothing & footwear	.078 (.004)	.054 (.004)	.059 (.004)
Gross rent, fuel	.146 (.006)	.181 (.008)	.179 (.008)
House furnishings, operations	.087 (.004)	.073 (.004)	.077 (.004)
Medical care	.089 (.004)	.112 (.005)	.106 (.005)
Transport, & communications	.126 (.006)	.134 (.006)	.133 (.006)
Recreation	.069 (.003)	.076 (.004)	.074 (.004)
Education	.066 (.005)	.071 (.004)	.074 (.004)
Other	.124 (.005)	.154 (.006)	.147 (.006)
		Coefficient K_g	
K_1	1.606	1.310 (.159)	1.089 (.114)
K_2		1.540 (.108)	1.294 (.080)

a Column 2 figures are from Table 5-4, column 3, page 105, TCS (1989).
b The estimate of −.134 for food, beverages, tobacco is simply obtained by adding their parameter estimate of food, −.135, to that of beverages and tobacco, .001.

different from that obtained by TCS. The point estimates of the K_1s and K_2s from our study and from SR's study exceed one, indicating group heteroskedasticity, although our K_1 is close to 1. The αs from this study are comparable to those of SR, but not to those of TCS. Their parameter estimates are based on data normalized on 1980 geometric-mean prices while the current data are in 1996 prices.

Previous consumption studies using ICP data identified and omitted outliers because including the outliers significantly biased the resulting parameter estimates. However, upon comparing the parameter estimates of SR, obtained from fitting the Florida PI model to the 91 country-based data, to those obtained from fitting the model to the 114 country-based data, it is clear that the two sets of parameters are pairwise similar. Careful inspection reveals that all αs, βs, ϕ, K_1, and K_2 are pairwise statistically the same at the 95 percent confidence level. Accordingly, inclusion or omission of the 23 identified outliers by SR makes no statistical difference to any of the parameter estimates. Given the advantages of using the full 114 country-based data, we choose to include all 114 countries in our analysis and to use the resulting parameters to calculate income and three types of own-price elasticities for the nine aggregate consumption goods for all 144 countries. First, we calculate information inaccuracy and Strobel measures as indicators of our preferred model's goodness of fit.

Information inaccuracy measures and goodness of fit

Information inaccuracy measures may be used as measures of a model's goodness of fit. They may also be used to identify outliers as done by TCS, SWK, and SR. Specifically, the information inaccuracy measure is

$$I_c = \sum_{i=1}^{n} w_{ic} \log \frac{w_{ic}}{\hat{w}_{ic}} \tag{7}$$

where w_{ic} is the observed budget share of good i in country c, and $\hat{w}_{ic}$ is the fitted budget share of good i in country c based on equation (6). When the model fits perfectly, $\hat{w}_{ic} = w_{ic}\ \forall i$, and the value of I_c is zero. The value is positive when, for some i in c, $\hat{w}_{ic} - w_{ic}$ is non-zero. Let the difference equal the residual, e_{ic}. A Taylor expansion shows that when these residuals are sufficiently small, $I_c \approx \frac{1}{2}\sum_{i=1}^{n}\frac{e_{ic}^2}{w_{ic}}$. This illustrates how I_c increases when the residuals become larger in absolute values.

Information inaccuracy measures can be decomposed into Strobel (1982) measures, an indication of the goodness-of-fit of the model for each of the nine goods in the Florida system. The Strobel measure is defined as

$$I_{ic} = \hat{w}_{ic} - w_{ic} + w_{ic} \log \frac{w_{ic}}{\hat{w}_{ic}}, \tag{8}$$

and $I_c = \Sigma_i I_{ic}$. Strobel measures, like I_c, have a lower bound of 0 and no upper bound. If $\hat{w}_{ic} = w_{ic}$, then $I_{ic} = 0$; otherwise, the measure is positive.

Information inaccuracy and Strobel measures for the Florida PI model are calculated for all 114 countries based on the parameters estimated using 114 countries as reported in Table 12.5, column (4), and the predicted budget shares from equation (6). These measures, significant to three decimal places, are reported in Table 12.6 for all countries as well as the overall group averages for low-, middle-, and high-income countries. The high-income countries have the smallest average value of information inaccuracy measures (second column in Table 12.6). Its average information inaccuracy measure, .038, is 65 percent the size of the middle-income country group's average of .058 and

Table 12.6 Information inaccuracies and Strobel measures, 114 countries in 1996[a]

Country (1)	*lc* (2)	*Food, beverage & tobacco* (3)	*Clothing & footwear* (4)	*Gross rent, fuel* (5)	*House operations* (6)	*Medical care* (7)	*Transport & communication* (8)	*Recreation* (9)	*Education* (10)	*Other* (11)
Low-income countries										
Tanzania	i	0.003	0.001	0.001	0.003	0.003	0.018	i	0.011	0.002
Nigeria	i	0.004	0.005	0.008	0.000	0.001	0.017	i	0.022	0.003
Tajikistan	0.078	0.001	0.001	0.047	0.001	0.000	0.001	0.002	0.000	0.025
Zambia	0.039	0.000	0.000	0.001	0.009	0.019	0.002	0.003	0.002	0.002
Yemen	i	0.001	0.003	0.002	0.004	0.003	0.006	i	0.000	0.011
Malawi	i	0.003	0.009	0.000	0.010	0.002	0.000	i	0.002	0.000
Madagascar	0.073	0.002	0.000	0.005	0.000	0.000	0.006	0.052	0.006	0.001
Mali	0.072	0.003	0.014	0.000	0.000	0.006	0.030	0.000	0.017	0.000
Mongolia	0.143	0.000	0.012	0.001	0.007	0.017	0.015	0.021	0.029	0.042
Benin	0.049	0.000	0.002	0.025	0.002	0.000	0.003	0.004	0.007	0.007
Kenya	0.058	0.014	0.000	0.004	0.021	0.001	0.001	0.004	0.011	0.002
Sierra Leone	0.032	0.003	0.008	0.004	0.000	0.000	0.003	0.005	0.003	0.006
Nepal	0.060	0.003	0.002	0.002	0.000	0.000	0.042	0.005	0.001	0.004
Turkmenistan	0.095	0.004	0.004	0.038	0.002	0.034	0.005	0.001	0.002	0.004
Congo	0.071	0.005	0.018	0.000	0.005	0.004	0.014	0.002	0.003	0.021
Senegal	0.022	0.000	0.009	0.001	0.000	0.006	0.004	0.001	0.001	0.000
Vietnam	0.037	0.001	0.002	0.004	0.002	0.000	0.004	0.011	0.000	0.013
Bangladesh	0.093	0.006	0.005	0.023	0.010	0.005	0.028	0.010	0.000	0.005
Pakistan	0.059	0.001	0.000	0.038	0.002	0.001	0.011	0.004	0.001	0.001
Azerbaijan	0.115	0.034	0.003	0.046	0.013	0.012	0.000	0.001	0.003	0.003
Cote d'Ivoire	0.127	0.004	0.001	0.024	0.013	0.010	0.000	0.012	0.044	0.019
Paraguay	0.125	0.052	0.004	0.018	0.006	0.000	0.011	0.008	0.014	0.012
Uzbekistan	0.077	0.001	0.015	0.006	0.010	0.002	0.000	0.001	0.026	0.016
Kyrgyzstan	0.065	0.002	0.003	0.008	0.001	0.001	0.043	0.005	0.000	0.001
Cameroon	0.041	0.003	0.030	0.004	0.002	0.000	0.000	0.001	0.000	0.000
Moldova	0.090	0.005	0.000	0.019	0.004	0.019	0.002	0.000	0.038	0.001

Bolivia	0.032	0.001	0.000	0.001	0.000	0.003	0.002	0.001	0.008	0.015
Ecuador	0.113	0.034	0.004	0.000	0.010	0.004	0.004	0.031	0.007	0.020
Armenia	0.104	0.036	0.008	0.010	0.014	0.013	0.016	0.000	0.007	0.001
Sri Lanka	0.170	0.019	0.060	0.023	0.002	0.011	0.040	0.004	0.007	0.004
Jordan	0.036	0.005	0.000	0.018	0.000	0.003	0.001	0.001	0.002	0.005
Albania	0.172	0.052	0.020	0.010	0.005	0.009	0.019	0.003	0.017	0.037
Indonesia	0.090	0.012	0.014	0.007	0.000	0.013	0.012	0.003	0.027	0.002
Jamaica	0.104	0.006	0.004	0.027	0.004	0.000	0.046	0.013	0.001	0.003
Zimbabwe	0.145	0.052	0.006	0.018	0.014	0.001	0.000	0.000	0.049	0.005
Guinea	0.058	0.000	0.042	0.007	0.001	0.001	0.000	0.005	0.000	0.001
Syria	0.075	0.000	0.000	0.011	0.023	0.004	0.023	0.003	0.000	0.011
Georgia	0.150	0.000	0.003	0.027	0.011	0.001	0.000	0.001	0.008	0.098
Middle-income countries										
Ukraine	0.018	0.000	0.001	0.001	0.004	0.001	0.000	0.001	0.001	0.010
Philippines	0.133	0.005	0.008	0.023	0.020	0.030	0.013	0.008	0.024	0.003
Peru	0.065	0.010	0.000	0.001	0.003	0.000	0.001	0.044	0.000	0.005
Bostswana	0.108	0.006	0.003	0.005	0.025	0.000	0.001	0.001	0.047	0.019
Thailand	0.059	0.018	0.007	0.008	0.001	0.000	0.011	0.009	0.000	0.004
Morocco	0.020	0.001	0.001	0.001	0.000	0.001	0.000	0.001	0.002	0.014
Venezuela	0.051	0.006	0.000	0.006	0.000	0.000	0.013	0.002	0.019	0.003
Macedonia	0.022	0.001	0.003	0.002	0.008	0.005	0.002	0.000	0.000	0.000
Belize	0.037	0.003	0.002	0.008	0.000	0.005	0.006	0.001	0.001	0.011
Egypt	0.114	0.013	0.005	0.019	0.036	0.002	0.012	0.017	0.008	0.001
St. Vincent & Grenadines	0.038	0.000	0.003	0.000	0.001	0.019	0.002	0.006	0.002	0.005
Swaziland	0.095	0.018	0.002	0.001	0.049	0.000	0.001	0.000	0.016	0.007
Lebanon	0.079	0.003	0.023	0.003	0.005	0.000	0.001	0.025	0.013	0.006
Belarus	0.048	0.011	0.000	0.008	0.008	0.002	0.008	0.002	0.006	0.003
Kazakhstan	0.080	0.017	0.010	0.003	0.013	0.002	0.011	0.004	0.003	0.017
Dominica	0.049	0.001	0.000	0.001	0.001	0.003	0.012	0.001	0.006	0.025

(*Continued Overleaf*)

Table 12.6 Continued

Country (1)	*lc* (2)	*Food, beverage & tobacco* (3)	*Clothing & footwear* (4)	*Gross rent, fuel* (5)	*House operations* (6)	*Medical care* (7)	*Transport & communication* (8)	*Recreation* (9)	*Education* (10)	*Other* (11)
Middle-income countries Continued										
Latvia	0.023	0.002	0.000	0.001	0.011	0.002	0.001	0.000	0.005	0.001
St. Lucia	0.055	0.017	0.000	0.004	0.001	0.000	0.006	0.012	0.003	0.010
Brazil	0.067	0.020	0.013	0.010	0.003	0.001	0.002	0.001	0.016	0.001
Bulgaria	0.053	0.004	0.001	0.029	0.006	0.006	0.002	0.000	0.004	0.001
Russia	0.027	0.001	0.014	0.008	0.001	0.001	0.000	0.000	0.002	0.000
Fiji	0.040	0.002	0.001	0.000	0.005	0.002	0.000	0.007	0.005	0.018
Grenada	0.037	0.003	0.003	0.000	0.001	0.012	0.004	0.007	0.001	0.007
Turkey	0.057	0.000	0.000	0.013	0.013	0.012	0.000	0.009	0.004	0.006
Lithuania	0.013	0.004	0.002	0.000	0.004	0.000	0.001	0.000	0.001	0.001
Romania	0.053	0.008	0.001	0.032	0.001	0.000	0.001	0.008	0.001	0.000
Iran	0.184	0.010	0.009	0.096	0.000	0.001	0.009	0.013	0.001	0.045
Mexico	0.036	0.002	0.006	0.002	0.001	0.001	0.006	0.005	0.001	0.013
Bahrain	0.124	0.003	0.001	0.003	0.001	0.000	0.010	0.007	0.013	0.086
Chile	0.064	0.016	0.007	0.004	0.005	0.000	0.001	0.000	0.023	0.007
Antigua & Barbuda	0.061	0.013	0.006	0.001	0.000	0.015	0.006	0.011	0.000	0.010
Poland	0.014	0.000	0.004	0.001	0.003	0.003	0.000	0.001	0.002	0.000
Trinidad & Tobago	0.100	0.004	0.005	0.016	0.000	0.002	0.009	0.009	0.000	0.055
Estonia	0.022	0.000	0.003	0.002	0.003	0.002	0.000	0.006	0.003	0.004
Gabon	0.093	0.029	0.013	0.008	0.012	0.002	0.004	0.026	0.000	0.000
Tunisia	0.059	0.000	0.005	0.022	0.015	0.005	0.006	0.000	0.000	0.005
St. Kitts & Nevis	0.052	0.015	0.003	0.001	0.000	0.007	0.006	0.011	0.000	0.010
Uruguay	0.034	0.002	0.000	0.002	0.000	0.019	0.003	0.000	0.006	0.000
Slovakia	0.024	0.000	0.001	0.004	0.005	0.007	0.003	0.002	0.002	0.000
Hungary	0.030	0.007	0.005	0.001	0.002	0.000	0.000	0.014	0.000	0.001

Argentina	0.049	0.011	0.004	0.000	0.001	0.003	0.001	0.002	0.027	0.001
Oman	0.091	0.000	0.001	0.024	0.001	0.014	0.013	0.018	0.000	0.019
Qatar	0.075	0.001	0.012	0.008	0.012	0.001	0.012	0.015	0.001	0.015
Slovenia	0.018	0.002	0.001	0.001	0.005	0.000	0.006	0.001	0.001	0.001
High-income countries										
Czech Republic	0.017	0.000	0.001	0.000	0.001	0.001	0.003	0.010	0.000	0.000
Greece	0.051	0.000	0.004	0.002	0.001	0.003	0.012	0.004	0.006	0.019
Korea	0.040	0.009	0.005	0.002	0.000	0.002	0.005	0.003	0.009	0.005
Portugal	0.029	0.002	0.000	0.019	0.001	0.000	0.001	0.001	0.002	0.003
Spain	0.051	0.001	0.000	0.008	0.002	0.000	0.001	0.004	0.001	0.034
Ireland	0.034	0.005	0.000	0.005	0.003	0.002	0.000	0.002	0.001	0.016
Singapore	0.082	0.011	0.000	0.007	0.000	0.013	0.012	0.036	0.001	0.002
Mauritius	0.055	0.001	0.000	0.005	0.021	0.005	0.004	0.003	0.007	0.008
Israel	0.021	0.001	0.004	0.002	0.000	0.000	0.001	0.000	0.008	0.004
New Zealand	0.016	0.003	0.005	0.003	0.000	0.000	0.001	0.002	0.001	0.000
Finland	0.030	0.004	0.008	0.001	0.008	0.001	0.000	0.002	0.001	0.006
Bahamas	0.166	0.068	0.003	0.043	0.000	0.001	0.003	0.042	0.006	0.000
Sweden	0.027	0.003	0.005	0.010	0.006	0.000	0.000	0.001	0.000	0.001
Netherlands	0.010	0.001	0.000	0.000	0.002	0.001	0.001	0.001	0.000	0.003
France	0.013	0.000	0.002	0.000	0.001	0.008	0.000	0.000	0.000	0.001
United Kingdom	0.055	0.000	0.003	0.001	0.006	0.017	0.008	0.001	0.013	0.007
Belgium	0.005	0.000	0.000	0.000	0.001	0.001	0.001	0.002	0.000	0.000
Norway	0.011	0.001	0.001	0.000	0.003	0.000	0.000	0.001	0.000	0.004
Italy	0.009	0.000	0.002	0.001	0.000	0.000	0.002	0.000	0.001	0.003
Austria	0.008	0.000	0.000	0.001	0.001	0.001	0.000	0.001	0.000	0.004
Germany	0.008	0.000	0.000	0.001	0.001	0.003	0.000	0.000	0.003	0.000
Australia	0.019	0.000	0.006	0.000	0.001	0.000	0.000	0.010	0.001	0.000
Japan	0.025	0.002	0.000	0.001	0.004	0.008	0.004	0.005	0.001	0.000
Canada	0.014	0.003	0.003	0.002	0.003	0.001	0.000	0.002	0.001	0.000
Bermuda	0.089	0.008	0.001	0.014	0.025	0.005	0.001	0.006	0.015	0.015

(*Continued Overleaf*)

Table 12.6 Continued

Country (1)	*lc* (2)	*Food, beverage & tobacco* (3)	*Clothing & footwear* (4)	*Gross rent, fuel* (5)	*House operations* (6)	*Medical care* (7)	*Transport & communication* (8)	*Recreation* (9)	*Education* (10)	*Other* (11)
High-income countries Continued										
Switzerland	0.031	0.003	0.003	0.001	0.011	0.002	0.006	0.000	0.001	0.004
Barbados	0.090	0.019	0.000	0.053	0.000	0.005	0.000	0.005	0.002	0.005
Hong Kong	0.123	0.015	0.049	0.005	0.004	0.006	0.006	0.031	0.001	0.007
Iceland	0.011	0.001	0.000	0.003	0.001	0.000	0.000	0.004	0.000	0.000
Denmark	0.027	0.000	0.004	0.000	0.009	0.003	0.000	0.006	0.001	0.004
Luxembourg	0.038	0.025	0.001	0.005	0.000	0.006	0.000	0.001	0.000	0.000
United States	0.024	0.001	0.000	0.002	0.007	0.014	0.000	0.000	0.000	0.000
Low-income average	0.086	0.011	0.009	0.013	0.006	0.006	0.012	0.007	0.011	0.011
Middle-income average	0.058	0.007	0.004	0.009	0.007	0.004	0.005	0.007	0.006	0.010
High-income average	0.038	0.006	0.003	0.006	0.004	0.003	0.002	0.006	0.003	0.005

a Countries are reported based on ascending per capita real income levels, 1996.

Note: lc represents information inaccuracy measure. i = imaginary number resulting from negative predicted budget shares. Low-income average Strobel measures exclude imaginary values.

only 44 percent of the low-income countries' average of .086. Average Strobel measures (columns (3) to (11), last three rows, Table 12.6) are smallest for the high-income group and range from .002 to .006. In comparison, the range is higher, from .004 to .010, for middle-income countries and highest for low-income countries, ranging from .006 to .011.

Gross rent, fuel and power has the highest Strobel measures across all three country groups. Food, beverage, and tobacco and recreation have the next highest Strobel measures for the middle-income and high-income country groups. For the low-income country group, although the average Strobel measure on recreation is smaller compared to other consumption categories, the actual goodness-of-fit is particularly bad. The average Strobel measure presented in Table 12.6 excludes the undefined values for the four countries whose predicted budget shares for recreation are negative.

Group 1, countries included in the first three phases of the ICP, has the smallest average information inaccuracy measure. Its average, .031, is only 69 percent the size of Group 2's average, .045, and only 57 percent the size of Group 3's average, .054. Group 4 is the group of 23 countries identified by SR as outliers and has the largest average of .143.

Average Strobel measures are also smallest for Group 1 except in the case of gross rent, fuel and power; its average Strobel measure of .006 is larger than the average Strobel measure, .004, of Group 2. In the case of food, beverages and tobacco, Group 1 and Group 2 have similar average Strobel measures at .004, but Group 1's Strobel measure for clothing and footwear is half the size of that of Group 2 and less than half the size of Groups 3 and 4.

The group identified as outliers by SR, Group 4, has, in general, the largest average Strobel measures for all goods and, in particular, for food, beverages and tobacco, gross rent, fuel and power, education, and other items. The goodness-of-fit of this group is particularly bad for recreation. This is because the predicted budget share for this good in three African countries (Malawi, Nigeria, and Tanzania) and one Asian (Yemen) is negative, making the associated Strobel and information inaccuracy measures undefined.

Income and price sensitivity

The most prominent measures of income and price sensitivities for a good are income and own-price elasticities. These measures are not constant but should vary with different levels of affluence. For example, the income elasticity of demand for a necessity such as food, beverages and tobacco should be larger for a low-income county than for a high-income country. Own-price elasticities of demand should also be larger in absolute value for low-income countries than for high-income ones (Timmer 1981). As shown below, income and own-price elasticities based on the Florida PI model have the desired properties discussed above. In this section, we present the income elasticities of demand for the nine categories of goods for each of the 114 countries.

This is followed by a discussion and reporting of three types of own-price elasticities of demand for the nine goods in the 114 countries.

Income elasticities

The income elasticity of demand is the ratio of the marginal share to the budget share,

$$\frac{\theta_i}{w_i} = \frac{dE_i}{dE}\frac{E}{E_i} = \frac{d(\log E_i)}{d(\log E)} = 1 + \frac{B_i}{w_i}. \tag{9}$$

From this equation, we note that a luxury good (with income elasticity greater than 1) is associated with a positive β_i, while the β_i is negative for a necessity (income elasticity less than 1); if β_i equals zero, the good has unitary elasticity.

Table 12.7 presents the income elasticities of demand calculated at 1996 geometric mean prices for the 114 countries. These estimates are based on equations (4) and (9).[16] For better illustration, the countries are arranged according to their per capita income levels in ascending order. These country-specific income-elasticity values represent the estimated percent change in demand for a particular good if total income changes by one percent. The elasticities are grouped as previously by low-, middle-, and high-income countries. Of the 114 countries, 38 are low-income countries, 44 are middle-income countries, and the remaining 32 are high-income countries.

The income (expenditure) elasticity of demand for food, beverages and tobacco varies greatly among countries and is highest among low-income countries; it varies from .80 for Tanzania to .68 for Georgia. It ranges between .67 to .49 for middle-income countries and from .48 to .10 for high-income countries. The average income elasticity of demand for food, beverages, and tobacco for the low-income group is .73, and it is over twice the size of the high-income countries' average, .34. Another feature to note is that, for high-income countries, the income elasticity of demand for food, beverages and tobacco gradually decreases from .48 for the Czech Republic, with an income level 45 percent that of the USA, to .25 for Denmark, whose income level is 81 percent that of the USA. Thereafter, the elasticity measure decreases rapidly to .13 for Luxembourg and .10 for the USA.

The income elasticity for clothing and footwear, the other necessity, also decreases in value from low-income to high-income countries. However, because the absolute value of the β of this good is close to zero, the elasticity values are close to one for all countries. The income elasticities for clothing and footwear range in the low-income countries from .93 for Tanzania to .92 for Georgia, in the middle-income countries from .92 for Ukraine to .91 for Slovenia, and in the high-income countries from .91 in the Czech Republic to .90 in the USA.

Table 12.7 Income elasticity of demand for nine goods, 114 countries in 1996 from the ICP[a]

Country (1)	*Food, beverage & tobacco* (2)	*Clothing & footwear* (3)	*Gross rent, fuel* (4)	*House operations* (5)	*Medical care* (6)	*Transport & communication* (7)	*Recreation* (8)	*Education* (9)	*Other* (10)
Low-income countries									
Tanzania	0.80	0.93	1.37	1.36	2.95	1.42	3.78[b]	1.09	2.62
Nigeria	0.79	0.93	1.33	1.32	2.17	1.36	4.03[b]	1.09	2.04
Tajikistan	0.78	0.93	1.31	1.30	1.99	1.34	3.97	1.09	1.89
Zambia	0.78	0.93	1.31	1.30	1.96	1.34	3.75	1.09	1.87
Yemen	0.78	0.93	1.31	1.30	1.96	1.34	4.08[b]	1.09	1.87
Malawi	0.77	0.93	1.30	1.29	1.88	1.33	4.13[b]	1.09	1.80
Madagascar	0.77	0.93	1.30	1.29	1.88	1.33	3.17	1.09	1.80
Mali	0.77	0.93	1.30	1.29	1.86	1.33	3.05	1.09	1.79
Mongolia	0.77	0.93	1.30	1.29	1.85	1.33	3.02	1.09	1.78
Benin	0.76	0.92	1.28	1.27	1.72	1.30	2.41	1.08	1.67
Kenya	0.75	0.92	1.27	1.27	1.68	1.30	2.25	1.08	1.63
Sierra Leone	0.75	0.92	1.27	1.26	1.64	1.29	2.13	1.08	1.60
Nepal	0.75	0.92	1.27	1.26	1.64	1.29	2.13	1.08	1.60
Turkmenistan	0.75	0.92	1.26	1.26	1.63	1.29	2.08	1.08	1.59
Congo	0.74	0.92	1.26	1.25	1.60	1.28	2.00	1.08	1.56
Senegal	0.74	0.92	1.25	1.25	1.58	1.28	1.94	1.08	1.54
Vietnam	0.73	0.92	1.25	1.25	1.57	1.27	1.92	1.08	1.54
Bangladesh	0.73	0.92	1.25	1.25	1.57	1.27	1.92	1.08	1.53
Pakistan	0.72	0.92	1.24	1.24	1.52	1.26	1.81	1.08	1.50
Azerbaijan	0.72	0.92	1.24	1.24	1.51	1.26	1.77	1.08	1.48
Cote d'Ivoire	0.72	0.92	1.24	1.23	1.50	1.26	1.76	1.08	1.48
Paraguay	0.71	0.92	1.24	1.23	1.50	1.26	1.75	1.08	1.47
Uzbekistan	0.71	0.92	1.24	1.23	1.49	1.25	1.72	1.08	1.46
Kyrgyzstan	0.71	0.92	1.24	1.23	1.49	1.25	1.72	1.08	1.46
Cameroon	0.71	0.92	1.23	1.23	1.48	1.25	1.72	1.08	1.46

(*Continued Overleaf*)

Table 12.7 Continued

Country *(1)*	*Food, beverage & tobacco* *(2)*	*Clothing & footwear* *(3)*	*Gross rent, fuel* *(4)*	*House operations* *(5)*	*Medical care* *(6)*	*Transport & communication* *(7)*	*Recreation* *(8)*	*Education* *(9)*	*Other* *(10)*
Low-income countries Continued									
Moldova	0.71	0.92	1.23	1.23	1.48	1.25	1.72	1.08	1.46
Bolivia	0.71	0.92	1.23	1.23	1.47	1.25	1.70	1.08	1.45
Ecuador	0.71	0.92	1.23	1.23	1.47	1.25	1.69	1.08	1.45
Armenia	0.70	0.92	1.23	1.22	1.46	1.25	1.67	1.08	1.44
Sri Lanka	0.70	0.92	1.23	1.22	1.46	1.25	1.67	1.08	1.44
Jordan	0.70	0.92	1.23	1.22	1.45	1.24	1.64	1.08	1.43
Albania	0.69	0.92	1.22	1.22	1.43	1.24	1.60	1.08	1.41
Indonesia	0.69	0.92	1.22	1.22	1.43	1.24	1.60	1.08	1.41
Jamaica	0.69	0.92	1.22	1.22	1.43	1.24	1.60	1.08	1.41
Zimbabwe	0.69	0.92	1.22	1.22	1.43	1.24	1.60	1.08	1.41
Guinea	0.68	0.92	1.22	1.22	1.42	1.23	1.59	1.08	1.40
Syria	0.68	0.92	1.22	1.21	1.41	1.23	1.57	1.08	1.40
Georgia	0.68	0.92	1.22	1.21	1.41	1.23	1.57	1.08	1.39
Middle-income countries									
Ukraine	0.67	0.92	1.21	1.21	1.40	1.23	1.54	1.08	1.38
Philippines	0.66	0.92	1.21	1.21	1.39	1.22	1.52	1.08	1.37
Peru	0.66	0.92	1.21	1.20	1.38	1.22	1.51	1.08	1.37
Botswana	0.65	0.92	1.21	1.20	1.38	1.22	1.51	1.08	1.37
Thailand	0.65	0.92	1.21	1.20	1.38	1.22	1.51	1.08	1.36
Morocco	0.65	0.92	1.21	1.20	1.38	1.22	1.50	1.08	1.36
Venezuela	0.65	0.92	1.21	1.20	1.37	1.22	1.50	1.08	1.36
Macedonia	0.64	0.92	1.20	1.20	1.37	1.22	1.49	1.08	1.35
Belize	0.64	0.92	1.20	1.20	1.37	1.22	1.49	1.08	1.35
Egypt	0.64	0.92	1.20	1.20	1.37	1.22	1.49	1.08	1.35
St. Vincent & Grenadines	0.64	0.92	1.20	1.20	1.37	1.22	1.49	1.08	1.35

Swaziland	0.64	0.92	1.20	1.20	1.36	1.21	1.48	1.08	1.35
Lebanon	0.63	0.92	1.20	1.20	1.36	1.21	1.47	1.08	1.34
Belarus	0.63	0.92	1.20	1.20	1.36	1.21	1.47	1.08	1.34
Kazakhstan	0.63	0.92	1.20	1.20	1.36	1.21	1.47	1.08	1.34
Dominica	0.63	0.92	1.20	1.20	1.36	1.21	1.47	1.08	1.34
Latvia	0.62	0.92	1.20	1.19	1.35	1.21	1.46	1.08	1.34
St. Lucia	0.62	0.92	1.20	1.19	1.35	1.21	1.46	1.08	1.34
Brazil	0.62	0.91	1.20	1.19	1.35	1.21	1.45	1.08	1.34
Bulgaria	0.62	0.91	1.20	1.19	1.35	1.21	1.45	1.07	1.33
Russia	0.62	0.91	1.20	1.19	1.34	1.21	1.45	1.07	1.33
Fiji	0.61	0.91	1.19	1.19	1.34	1.21	1.44	1.07	1.33
Grenada	0.61	0.91	1.19	1.19	1.34	1.21	1.44	1.07	1.33
Turkey	0.61	0.91	1.19	1.19	1.34	1.21	1.44	1.07	1.33
Lithuania	0.60	0.91	1.19	1.19	1.33	1.20	1.43	1.07	1.32
Romania	0.60	0.91	1.19	1.19	1.33	1.20	1.43	1.07	1.32
Iran	0.60	0.91	1.19	1.19	1.33	1.20	1.42	1.07	1.32
Mexico	0.59	0.91	1.19	1.19	1.33	1.20	1.42	1.07	1.31
Bahrain	0.59	0.91	1.19	1.19	1.32	1.20	1.41	1.07	1.31
Chile	0.59	0.91	1.19	1.19	1.32	1.20	1.41	1.07	1.31
Antigua & Barbuda	0.59	0.91	1.19	1.19	1.32	1.20	1.41	1.07	1.31
Poland	0.58	0.91	1.19	1.18	1.32	1.20	1.41	1.07	1.31
Trinidad & Tobago	0.57	0.91	1.19	1.18	1.32	1.20	1.40	1.07	1.31
Estonia	0.57	0.91	1.19	1.18	1.31	1.20	1.40	1.07	1.30
Gabon	0.57	0.91	1.19	1.18	1.31	1.20	1.40	1.07	1.30
Tunisia	0.56	0.91	1.18	1.18	1.31	1.20	1.39	1.07	1.30
St. Kitts & Nevis	0.56	0.91	1.18	1.18	1.31	1.19	1.39	1.07	1.30
Uruguay	0.56	0.91	1.18	1.18	1.31	1.19	1.39	1.07	1.30
Slovakia	0.56	0.91	1.18	1.18	1.31	1.19	1.39	1.07	1.30
Hungary	0.54	0.91	1.18	1.18	1.30	1.19	1.38	1.07	1.29

(*Continued Overleaf*)

Table 12.7 Continued

Country (1)	*Food, beverage & tobacco* (2)	*Clothing & footwear* (3)	*Gross rent, fuel* (4)	*House operations* (5)	*Medical care* (6)	*Transport & communication* (7)	*Recreation* (8)	*Education* (9)	*Other* (10)
Middle-income countries Continued									
Argentina	0.52	0.91	1.18	1.17	1.29	1.19	1.36	1.07	1.28
Oman	0.51	0.91	1.18	1.17	1.29	1.19	1.35	1.07	1.28
Qatar	0.49	0.91	1.17	1.17	1.28	1.18	1.35	1.07	1.27
Slovenia	0.49	0.91	1.17	1.17	1.28	1.18	1.34	1.07	1.27
High-income countries									
Czech Republic	0.48	0.91	1.17	1.17	1.28	1.18	1.34	1.07	1.27
Greece	0.46	0.91	1.17	1.17	1.27	1.18	1.33	1.07	1.26
Korea	0.45	0.91	1.17	1.17	1.27	1.18	1.33	1.07	1.26
Portugal	0.44	0.91	1.17	1.17	1.27	1.18	1.33	1.07	1.26
Spain	0.44	0.91	1.17	1.17	1.27	1.18	1.33	1.07	1.26
Ireland	0.43	0.91	1.17	1.17	1.27	1.18	1.32	1.07	1.26
Singapore	0.42	0.91	1.17	1.16	1.26	1.18	1.32	1.07	1.26
Mauritius	0.41	0.91	1.17	1.16	1.26	1.17	1.32	1.07	1.25
Israel	0.40	0.91	1.17	1.16	1.26	1.17	1.31	1.07	1.25
New Zealand	0.39	0.91	1.16	1.16	1.26	1.17	1.31	1.07	1.25
Finland	0.39	0.91	1.16	1.16	1.26	1.17	1.31	1.07	1.25
Bahamas	0.39	0.91	1.16	1.16	1.26	1.17	1.31	1.07	1.25
Sweden	0.36	0.91	1.16	1.16	1.25	1.17	1.30	1.07	1.25
Netherlands	0.36	0.91	1.16	1.16	1.25	1.17	1.30	1.07	1.25
France	0.33	0.91	1.16	1.16	1.25	1.17	1.30	1.07	1.24
United Kingdom	0.33	0.91	1.16	1.16	1.25	1.17	1.30	1.07	1.24
Belgium	0.33	0.91	1.16	1.16	1.25	1.17	1.30	1.07	1.24
Norway	0.32	0.91	1.16	1.16	1.25	1.17	1.30	1.07	1.24
Italy	0.32	0.91	1.16	1.16	1.25	1.17	1.30	1.07	1.24

Austria	0.31	0.91	1.16	1.16	1.25	1.17	1.29	1.07	1.24
Germany	0.31	0.91	1.16	1.16	1.25	1.17	1.29	1.07	1.24
Australia	0.30	0.91	1.16	1.16	1.24	1.17	1.29	1.07	1.24
Japan	0.29	0.91	1.16	1.16	1.24	1.17	1.29	1.07	1.24
Canada	0.28	0.90	1.16	1.16	1.24	1.17	1.29	1.07	1.24
Bermuda	0.27	0.90	1.16	1.16	1.24	1.17	1.29	1.07	1.23
Switzerland	0.26	0.90	1.16	1.15	1.24	1.16	1.29	1.07	1.23
Barbados	0.26	0.90	1.16	1.15	1.24	1.16	1.29	1.07	1.23
Hong Kong	0.25	0.90	1.16	1.15	1.24	1.16	1.29	1.07	1.23
Iceland	0.25	0.90	1.16	1.15	1.24	1.16	1.29	1.07	1.23
Denmark	0.25	0.90	1.16	1.15	1.24	1.16	1.28	1.07	1.23
Luxembourg	0.13	0.90	1.15	1.15	1.23	1.16	1.27	1.07	1.22
United States	0.10	0.90	1.15	1.15	1.23	1.16	1.27	1.07	1.22
Low-income average	0.73	0.92	1.26	1.25	1.64	1.28	2.04	1.08	1.59
Middle-income average	0.60	0.91	1.19	1.19	1.34	1.21	1.44	1.07	1.33
High-income average	0.33	0.91	1.16	1.16	1.25	1.17	1.30	1.07	1.24

a Countries are reported based on ascending per capita real income levels, 1996.

b As the estimated budget shares for recreation were negative, these values are calculated using the actual budget shares.

All other consumption categories are luxuries with expenditure elasticities greater than one. The elasticity values are higher for less affluent countries and span a wide range. Recreation is by far the most luxurious good with an income elasticity of demand ranging from 4.13 for Malawi to 1.27 for the USA. The goods, medical care and other items, are the next most luxurious goods followed by transportation and communication, gross rent, fuel and power, and home furnishings and operations. Although education is a luxury good, it is the least luxurious. With the estimated absolute β_i value close to zero, the estimated elasticities for education are close to one and range from 1.09 in Tanzania to 1.07 in the USA.

Three types of price elasticities

Three types of own-price elasticities of demand for a good can be calculated from the parameter estimates of the Florida PI model. The first of these, the Frisch-deflated own-price elasticity of good *i*, is the own-price elasticity when own-price changes and income is compensated to keep the marginal utility of income constant. In the case of the Florida PI model, the Frisch own-price elasticity is

$$F = \phi \frac{\bar{w}_{ic} + \beta_i}{\bar{w}_{ic}} \tag{10}$$

where $\bar{w}_{ic}$ is calculated from equation (4) with the error term suppressed, and ϕ and β_i are estimated parameters of the Florida PI model using the 1996 ICP data of 114 countries.[17]

The Slutsky (compensated) own-price elasticity measures the change in demand for good *i* when the price of *i* changes while real income remains unchanged. Since real income is constant, this elasticity is also referred to as the "pure substitution effect." It is calculated from the following:

$$S = \phi \frac{(\bar{w}_{ic} + \beta_i)(1 - \bar{w}_{ic} - \beta_i)}{\bar{w}_{ic}} = F(1 - \bar{w}_{ic} - \beta_i) \tag{11}$$

The Cournot (uncompensated) own-price elasticity refers to the situation when own-price changes while nominal income remains constant but real income changes. This measure includes both the pure substitution effect and the income effect due to a price change. It is therefore greater in absolute value than the Slutsky own-price elasticity and is calculated from

$$C = \phi \frac{(\bar{w}_{ic} + \beta_i)(1 - \bar{w}_{ic} - \beta_i)}{\bar{w}_{ic}} - (\bar{w}_{ic} + \beta_i) = S - (\bar{w}_{ic} + \beta_i) \tag{12}$$

These three types of own-price elasticities are calculated for all nine goods for the 114 countries and are reported in Tables 12.8 to 12.10. In these Tables, countries are listed in ascending order of affluence. The elasticity measures perform in accordance with Timmer's proposition: own-price elasticities of demand are larger in absolute values for low-income countries than for high-income ones. The values of the Cournot (Table 12.10) and Frisch (Table 12.8) own-price elasticities decline monotonically in absolute value when traveling from poor to rich countries.

The Slutsky own-price elasticity of demand for food, beverages, and tobacco begins at –.30 for Tanzania, increases (absolutely) to –.39 for Thailand, and declines thereafter (absolutely) to –.08 for the USA (Table 12.9). To clarify the reason for this, take the logarithmic derivative of equation (11), using equation (4) and suppressing the error term,

$$\frac{d\log(S/\phi)}{Q_c} = \frac{-\beta_i[\bar{w}_{ic}^2 + \beta_i(1-\beta_i)]}{\bar{w}_{ic}(\bar{w}_{ic}+\beta_i)(1-\bar{w}_{ic}-\beta_i)} \tag{13}$$

If good i is a luxury, $\beta_i > 0$, and the derivative is negative; as real per capita income increases, the Slutsky own-price elasticity of the good decreases. If good i is a necessity, $\beta_i < 0$ so that $-\beta_i > 0$. If the term in brackets on the right-hand side of equation (13) is positive, then both the numerator and the derivative are positive. This is the case for food, beverages and tobacco. When $\bar{w}_{ic}$ is sufficiently large, that is, when Q_c is sufficiently small, the derivative for this good is positive for the poorest countries. Eventually, however, $\bar{w}_{ic}$ becomes sufficiently small so that the derivative becomes negative. In this case, the Slutsky own-price elasticity becomes smaller in absolute value. The turning point, when the Slutsky own-price elasticity starts declining with increasing per capita income, is at the per capita income level of Lithuania or at 25 percent of the per capita income level of the USA.

The Cournot and Frisch elasticity values are all larger than the corresponding Slutsky elasticities. The Frisch values are between the corresponding Cournot and Slutsky ones for food, beverages and tobacco, clothing and footwear, and education, while they are larger than both the corresponding Cournot and Slutsky elasticities for the other three goods. To see the reason for this result, recall that, in equation (12) and (11), $C = S - (\bar{w}_{ic} + \beta_i)$ and $S = F(1 - \bar{w}_{ic} - \beta_i)$. By manipulation, $C = F - F(\bar{w}_{ic} + \beta_i) - (\bar{w}_{ic} + \beta_i)$. Noting that in all the cases, F < 0 and $(\bar{w}_{ic} + \beta_i) > 0$, if |F|<|–1.00| then |C| > |F|, if |F|>|–1.00|, then |C| < |F|, and if |F| ≈|–1.00|, then C = F.

House furnishings and operations and transport and communications have Slutsky own-price elasticity values greater than unity in absolute values for a few of the countries with the lowest income levels. Recreation, medical care and other goods have Slutsky own-price elasticity measures greater than unity in absolute values for all or most of the low-income countries and many of the middle-income countries. For Tanzania, the Slutsky own-price elasticities of demand for recreation, medical care, and other items are –3.05, –2.39,

Table 12.8 Frisch own-price elasticity for aggregate consumption categories, 114 countries in 1996[a]

Country (1)	*Food, beverage & tobacco* (2)	*Clothing & footwear* (3)	*Gross rent, fuel* (4)	*House operations* (5)	*Medical care* (6)	*Transport & communication* (7)	*Recreation* (8)	*Education* (9)	*Other* (10)
Low-income countries									
Tanzania	–0.65	–0.75	–1.11	–1.10	–2.39	–1.14	–3.06[b]	–0.88	–2.12
Nigeria	–0.64	–0.75	–1.07	–1.07	–1.75	–1.10	–3.26[b]	–0.88	–1.65
Tajikistan	–0.63	–0.75	–1.06	–1.05	–1.61	–1.09	–3.21	–0.88	–1.53
Zambia	–0.63	–0.75	–1.06	–1.05	–1.59	–1.08	–3.03	–0.88	–1.51
Yemen	–0.63	–0.75	–1.06	–1.05	–1.58	–1.08	–3.30[b]	–0.88	–1.51
Malawi	–0.62	–0.75	–1.05	–1.05	–1.52	–1.08	–3.34[b]	–0.88	–1.46
Madagascar	–0.62	–0.75	–1.05	–1.05	–1.52	–1.08	–2.56	–0.88	–1.46
Mali	–0.62	–0.75	–1.05	–1.04	–1.50	–1.07	–2.47	–0.88	–1.45
Mongolia	–0.62	–0.75	–1.05	–1.04	–1.50	–1.07	–2.45	–0.88	–1.44
Benin	–0.61	–0.75	–1.03	–1.03	–1.39	–1.06	–1.95	–0.88	–1.35
Kenya	–0.61	–0.75	–1.03	–1.02	–1.36	–1.05	–1.82	–0.88	–1.32
Sierra Leone	–0.60	–0.75	–1.02	–1.02	–1.33	–1.04	–1.73	–0.88	–1.29
Nepal	–0.60	–0.75	–1.02	–1.02	–1.33	–1.04	–1.72	–0.88	–1.29
Turkmenistan	–0.60	–0.75	–1.02	–1.02	–1.31	–1.04	–1.69	–0.88	–1.28
Congo	–0.60	–0.75	–1.02	–1.01	–1.29	–1.04	–1.62	–0.88	–1.26
Senegal	–0.59	–0.75	–1.01	–1.01	–1.27	–1.03	–1.57	–0.88	–1.25
Vietnam	–0.59	–0.75	–1.01	–1.01	–1.27	–1.03	–1.55	–0.87	–1.24
Bangladesh	–0.59	–0.75	–1.01	–1.01	–1.27	–1.03	–1.55	–0.87	–1.24
Pakistan	–0.58	–0.75	–1.01	–1.00	–1.23	–1.02	–1.47	–0.87	–1.21
Azerbaijan	–0.58	–0.74	–1.00	–1.00	–1.22	–1.02	–1.43	–0.87	–1.20
Cote d'Ivoire	–0.58	–0.74	–1.00	–1.00	–1.21	–1.02	–1.42	–0.87	–1.19
Paraguay	–0.58	–0.74	–1.00	–1.00	–1.21	–1.02	–1.41	–0.87	–1.19
Uzbekistan	–0.58	–0.74	–1.00	–1.00	–1.20	–1.01	–1.40	–0.87	–1.18
Kyrgyzstan	–0.58	–0.74	–1.00	–1.00	–1.20	–1.01	–1.39	–0.87	–1.18
Cameroon	–0.57	–0.74	–1.00	–0.99	–1.20	–1.01	–1.39	–0.87	–1.18

Moldova	–0.57	–0.74	–1.00	–0.99	–1.20	–1.01	–1.39	–0.87	–1.18
Bolivia	–0.57	–0.74	–1.00	–0.99	–1.19	–1.01	–1.37	–0.87	–1.17
Ecuador	–0.57	–0.74	–1.00	–0.99	–1.19	–1.01	–1.37	–0.87	–1.17
Armenia	–0.57	–0.74	–0.99	–0.99	–1.18	–1.01	–1.35	–0.87	–1.16
Sri Lanka	–0.57	–0.74	–0.99	–0.99	–1.18	–1.01	–1.35	–0.87	–1.16
Jordan	–0.56	–0.74	–0.99	–0.99	–1.17	–1.00	–1.33	–0.87	–1.15
Albania	–0.56	–0.74	–0.99	–0.99	–1.16	–1.00	–1.31	–0.87	–1.14
Indonesia	–0.56	–0.74	–0.99	–0.98	–1.16	–1.00	–1.30	–0.87	–1.14
Jamaica	–0.55	–0.74	–0.99	–0.98	–1.15	–1.00	–1.30	–0.87	–1.14
Zimbabwe	–0.55	–0.74	–0.99	–0.98	–1.15	–1.00	–1.29	–0.87	–1.14
Guinea	–0.55	–0.74	–0.99	–0.98	–1.15	–1.00	–1.29	–0.87	–1.14
Syria	–0.55	–0.74	–0.98	–0.98	–1.14	–1.00	–1.27	–0.87	–1.13
Georgia	–0.55	–0.74	–0.98	–0.98	–1.14	–1.00	–1.27	–0.87	–1.13
Middle-income countries									
Ukraine	–0.54	–0.74	–0.98	–0.98	–1.13	–0.99	–1.25	–0.87	–1.12
Philippines	–0.53	–0.74	–0.98	–0.97	–1.12	–0.99	–1.23	–0.87	–1.11
Peru	–0.53	–0.74	–0.98	–0.97	–1.12	–0.99	–1.23	–0.87	–1.11
Botswana	–0.53	–0.74	–0.98	–0.97	–1.12	–0.99	–1.22	–0.87	–1.11
Thailand	–0.53	–0.74	–0.98	–0.97	–1.12	–0.99	–1.22	–0.87	–1.10
Morocco	–0.53	–0.74	–0.98	–0.97	–1.11	–0.99	–1.22	–0.87	–1.10
Venezuela	–0.52	–0.74	–0.97	–0.97	–1.11	–0.99	–1.21	–0.87	–1.10
Macedonia	–0.52	–0.74	–0.97	–0.97	–1.11	–0.98	–1.20	–0.87	–1.10
Belize	–0.52	–0.74	–0.97	–0.97	–1.11	–0.98	–1.20	–0.87	–1.09
Egypt	–0.52	–0.74	–0.97	–0.97	–1.11	–0.98	–1.20	–0.87	–1.09
St. Vincent & Grenadines	–0.52	–0.74	–0.97	–0.97	–1.11	–0.98	–1.20	–0.87	–1.09
Swaziland	–0.51	–0.74	–0.97	–0.97	–1.10	–0.98	–1.19	–0.87	–1.09
Lebanon	–0.51	–0.74	–0.97	–0.97	–1.10	–0.98	–1.19	–0.87	–1.09
Belarus	–0.51	–0.74	–0.97	–0.97	–1.10	–0.98	–1.19	–0.87	–1.09
Kazakhstan	–0.51	–0.74	–0.97	–0.97	–1.10	–0.98	–1.19	–0.87	–1.09

(*Continued Overleaf*)

Table 12.8 Continued

Country (1)	*Food, beverage & tobacco* (2)	*Clothing & footwear* (3)	*Gross rent, fuel* (4)	*House operations* (5)	*Medical care* (6)	*Transport & communication* (7)	*Recreation* (8)	*Education* (9)	*Other* (10)
Middle-income countries Continued									
Dominica	–0.51	–0.74	–0.97	–0.97	–1.10	–0.98	–1.19	–0.87	–1.09
Latvia	–0.50	–0.74	–0.97	–0.97	–1.09	–0.98	–1.18	–0.87	–1.08
St. Lucia	–0.50	–0.74	–0.97	–0.97	–1.09	–0.98	–1.18	–0.87	–1.08
Brazil	–0.50	–0.74	–0.97	–0.97	–1.09	–0.98	–1.18	–0.87	–1.08
Bulgaria	–0.50	–0.74	–0.97	–0.97	–1.09	–0.98	–1.18	–0.87	–1.08
Russia	–0.50	–0.74	–0.97	–0.96	–1.09	–0.98	–1.17	–0.87	–1.08
Fiji	–0.49	–0.74	–0.97	–0.96	–1.08	–0.98	–1.17	–0.87	–1.07
Grenada	–0.49	–0.74	–0.97	–0.96	–1.08	–0.98	–1.16	–0.87	–1.07
Turkey	–0.49	–0.74	–0.97	–0.96	–1.08	–0.98	–1.16	–0.87	–1.07
Lithuania	–0.49	–0.74	–0.96	–0.96	–1.08	–0.97	–1.16	–0.87	–1.07
Romania	–0.49	–0.74	–0.96	–0.96	–1.08	–0.97	–1.16	–0.87	–1.07
Iran	–0.48	–0.74	–0.96	–0.96	–1.07	–0.97	–1.15	–0.87	–1.06
Mexico	–0.48	–0.74	–0.96	–0.96	–1.07	–0.97	–1.15	–0.87	–1.06
Bahrain	–0.48	–0.74	–0.96	–0.96	–1.07	–0.97	–1.14	–0.87	–1.06
Chile	–0.47	–0.74	–0.96	–0.96	–1.07	–0.97	–1.14	–0.87	–1.06
Antigua & Barbuda	–0.47	–0.74	–0.96	–0.96	–1.07	–0.97	–1.14	–0.87	–1.06
Poland	–0.47	–0.74	–0.96	–0.96	–1.07	–0.97	–1.14	–0.87	–1.06
Trinidad & Tobago	–0.46	–0.74	–0.96	–0.96	–1.06	–0.97	–1.13	–0.87	–1.06
Estonia	–0.46	–0.74	–0.96	–0.96	–1.06	–0.97	–1.13	–0.87	–1.05
Gabon	–0.46	–0.74	–0.96	–0.96	–1.06	–0.97	–1.13	–0.87	–1.05
Tunisia	–0.46	–0.74	–0.96	–0.96	–1.06	–0.97	–1.13	–0.87	–1.05
St. Kitts & Nevis	–0.45	–0.74	–0.96	–0.96	–1.06	–0.97	–1.12	–0.87	–1.05
Uruguay	–0.45	–0.74	–0.96	–0.96	–1.06	–0.97	–1.12	–0.87	–1.05
Slovakia	–0.45	–0.74	–0.96	–0.95	–1.06	–0.97	–1.12	–0.87	–1.05

Hungary	–0.44	–0.74	–0.95	–0.95	–1.05	–0.96	–1.11	–0.87	–1.04
Argentina	–0.42	–0.74	–0.95	–0.95	–1.04	–0.96	–1.10	–0.87	–1.04
Oman	–0.41	–0.74	–0.95	–0.95	–1.04	–0.96	–1.10	–0.87	–1.03
Qatar	–0.40	–0.74	–0.95	–0.95	–1.04	–0.96	–1.09	–0.87	–1.03
Slovenia	–0.39	–0.74	–0.95	–0.95	–1.03	–0.96	–1.09	–0.87	–1.03
High-income countries									
Czech Republic	–0.39	–0.74	–0.95	–0.95	–1.03	–0.96	–1.08	–0.87	–1.03
Greece	–0.37	–0.73	–0.95	–0.94	–1.03	–0.95	–1.08	–0.87	–1.02
Korea	–0.36	–0.73	–0.95	–0.94	–1.03	–0.95	–1.08	–0.87	–1.02
Portugal	–0.36	–0.73	–0.95	–0.94	–1.03	–0.95	–1.07	–0.87	–1.02
Spain	–0.36	–0.73	–0.95	–0.94	–1.03	–0.95	–1.07	–0.87	–1.02
Ireland	–0.35	–0.73	–0.94	–0.94	–1.02	–0.95	–1.07	–0.87	–1.02
Singapore	–0.34	–0.73	–0.94	–0.94	–1.02	–0.95	–1.07	–0.87	–1.02
Mauritius	–0.33	–0.73	–0.94	–0.94	–1.02	–0.95	–1.07	–0.87	–1.01
Israel	–0.32	–0.73	–0.94	–0.94	–1.02	–0.95	–1.06	–0.87	–1.01
New Zealand	–0.32	–0.73	–0.94	–0.94	–1.02	–0.95	–1.06	–0.87	–1.01
Finland	–0.32	–0.73	–0.94	–0.94	–1.02	–0.95	–1.06	–0.87	–1.01
Bahamas	–0.31	–0.73	–0.94	–0.94	–1.02	–0.95	–1.06	–0.87	–1.01
Sweden	–0.29	–0.73	–0.94	–0.94	–1.01	–0.95	–1.06	–0.86	–1.01
Netherlands	–0.29	–0.73	–0.94	–0.94	–1.01	–0.95	–1.05	–0.86	–1.01
France	–0.27	–0.73	–0.94	–0.94	–1.01	–0.95	–1.05	–0.86	–1.00
United Kingdom	–0.27	–0.73	–0.94	–0.94	–1.01	–0.95	–1.05	–0.86	–1.00
Belgium	–0.26	–0.73	–0.94	–0.94	–1.01	–0.94	–1.05	–0.86	–1.00
Norway	–0.26	–0.73	–0.94	–0.94	–1.01	–0.94	–1.05	–0.86	–1.00
Italy	–0.26	–0.73	–0.94	–0.94	–1.01	–0.94	–1.05	–0.86	–1.00
Austria	–0.25	–0.73	–0.94	–0.94	–1.01	–0.94	–1.05	–0.86	–1.00
Germany	–0.25	–0.73	–0.94	–0.94	–1.01	–0.94	–1.05	–0.86	–1.00
Australia	–0.24	–0.73	–0.94	–0.94	–1.01	–0.94	–1.05	–0.86	–1.00
Japan	–0.24	–0.73	–0.94	–0.94	–1.01	–0.94	–1.04	–0.86	–1.00

(*Continued Overleaf*)

Table 12.8 Continued

Country (1)	*Food, beverage & tobacco* (2)	*Clothing & footwear* (3)	*Gross rent, fuel* (4)	*House operations* (5)	*Medical care* (6)	*Transport & communication* (7)	*Recreation* (8)	*Education* (9)	*Other* (10)
High-income countries Continued									
Canada	–0.23	–0.73	–0.94	–0.94	–1.00	–0.94	–1.04	–0.86	–1.00
Bermuda	–0.21	–0.73	–0.94	–0.93	–1.00	–0.94	–1.04	–0.86	–1.00
Switzerland	–0.21	–0.73	–0.94	–0.93	–1.00	–0.94	–1.04	–0.86	–1.00
Barbados	–0.21	–0.73	–0.94	–0.93	–1.00	–0.94	–1.04	–0.86	–1.00
Hong Kong	–0.21	–0.73	–0.94	–0.93	–1.00	–0.94	–1.04	–0.86	–1.00
Iceland	–0.20	–0.73	–0.94	–0.93	–1.00	–0.94	–1.04	–0.86	–1.00
Denmark	–0.20	–0.73	–0.94	–0.93	–1.00	–0.94	–1.04	–0.86	–1.00
Luxembourg	–0.10	–0.73	–0.93	–0.93	–0.99	–0.94	–1.03	–0.86	–0.99
United States	–0.08	–0.73	–0.93	–0.93	–0.99	–0.94	–1.03	–0.86	–0.99
Low-income average	–0.59	–0.75	–1.02	–1.01	–1.33	–1.03	–1.65	–0.87	–1.29
Middle-income average	–0.49	–0.74	–0.97	–0.96	–1.08	–0.98	–1.16	–0.87	–1.07
High-income average	–0.27	–0.73	–0.94	–0.94	–1.01	–0.95	–1.05	–0.86	–1.01

a Countries are reported based on ascending per capita real income levels, 1996.

b As the estimated budget shares for recreation were negative, these values are calculated using the actual budget shares.

Table 12.9 Slutsky own-price elasticity for aggregate consumption categories, 114 countries in 1996[a]

Country (1)	*Food, beverage & tobacco* (2)	*Clothing & footwear* (3)	*Gross rent, fuel* (4)	*House operations* (5)	*Medical care* (6)	*Transport & communication* (7)	*Recreation* (8)	*Education* (9)	*Other* (10)
Low-income countries									
Tanzania	–0.30	–0.69	–1.00	–1.05	–2.30	–1.06	–2.97[b]	–0.83	–2.01
Nigeria	–0.32	–0.69	–0.96	–1.02	–1.67	–1.02	–3.17[b]	–0.83	–1.54
Tajikistan	–0.33	–0.69	–0.94	–1.00	–1.53	–1.00	–3.12	–0.82	–1.43
Zambia	–0.33	–0.69	–0.94	–1.00	–1.51	–0.99	–2.95	–0.82	–1.41
Yemen	–0.33	–0.69	–0.94	–1.00	–1.51	–0.99	–3.21[b]	–0.82	–1.41
Malawi	–0.34	–0.69	–0.93	–0.99	–1.44	–0.98	–3.25[b]	–0.82	–1.35
Madagascar	–0.34	–0.69	–0.93	–0.99	–1.44	–0.98	–2.49	–0.82	–1.35
Mali	–0.34	–0.69	–0.93	–0.99	–1.42	–0.98	–2.39	–0.82	–1.34
Mongolia	–0.34	–0.69	–0.93	–0.99	–1.42	–0.98	–2.37	–0.82	–1.34
Benin	–0.35	–0.69	–0.91	–0.97	–1.31	–0.96	–1.88	–0.82	–1.24
Kenya	–0.36	–0.69	–0.90	–0.97	–1.28	–0.95	–1.75	–0.82	–1.21
Sierra Leone	–0.36	–0.69	–0.89	–0.96	–1.25	–0.94	–1.66	–0.82	–1.18
Nepal	–0.36	–0.69	–0.89	–0.96	–1.24	–0.94	–1.66	–0.82	–1.18
Turkmenistan	–0.36	–0.69	–0.89	–0.96	–1.23	–0.94	–1.62	–0.82	–1.17
Congo	–0.37	–0.69	–0.88	–0.96	–1.21	–0.94	–1.56	–0.82	–1.15
Senegal	–0.37	–0.69	–0.88	–0.95	–1.19	–0.93	–1.51	–0.82	–1.13
Vietnam	–0.37	–0.69	–0.88	–0.95	–1.18	–0.93	–1.49	–0.82	–1.13
Bangladesh	–0.37	–0.69	–0.88	–0.95	–1.18	–0.93	–1.48	–0.82	–1.12
Pakistan	–0.38	–0.69	–0.87	–0.94	–1.15	–0.92	–1.40	–0.82	–1.09
Azerbaijan	–0.38	–0.69	–0.86	–0.94	–1.13	–0.91	–1.37	–0.82	–1.08
Cote d'Ivoire	–0.38	–0.69	–0.86	–0.94	–1.13	–0.91	–1.36	–0.82	–1.07
Paraguay	–0.38	–0.69	–0.86	–0.94	–1.12	–0.91	–1.35	–0.82	–1.07
Uzbekistan	–0.38	–0.69	–0.86	–0.93	–1.11	–0.91	–1.33	–0.81	–1.06
Kyrgyzstan	–0.38	–0.69	–0.86	–0.93	–1.11	–0.91	–1.33	–0.81	–1.06
Cameroon	–0.38	–0.69	–0.86	–0.93	–1.11	–0.91	–1.32	–0.81	–1.06

(*Continued Overleaf*)

Table 12.9 Continued

Country *(1)*	*Food, beverage & tobacco* *(2)*	*Clothing & footwear* *(3)*	*Gross rent, fuel* *(4)*	*House operations* *(5)*	*Medical care* *(6)*	*Transport & communication* *(7)*	*Recreation* *(8)*	*Education* *(9)*	*Other* *(10)*
Low-income countries Continued									
Moldova	–0.38	–0.69	–0.86	–0.93	–1.11	–0.91	–1.32	–0.81	–1.06
Bolivia	–0.39	–0.69	–0.85	–0.93	–1.10	–0.90	–1.31	–0.81	–1.05
Ecuador	–0.39	–0.69	–0.85	–0.93	–1.10	–0.90	–1.30	–0.81	–1.05
Armenia	–0.39	–0.69	–0.85	–0.93	–1.09	–0.90	–1.28	–0.81	–1.04
Sri Lanka	–0.39	–0.69	–0.85	–0.93	–1.09	–0.90	–1.28	–0.81	–1.04
Jordan	–0.39	–0.69	–0.85	–0.93	–1.08	–0.90	–1.26	–0.81	–1.03
Albania	–0.39	–0.69	–0.84	–0.92	–1.07	–0.89	–1.24	–0.81	–1.02
Indonesia	–0.39	–0.69	–0.84	–0.92	–1.06	–0.89	–1.23	–0.81	–1.01
Jamaica	–0.39	–0.69	–0.84	–0.92	–1.06	–0.89	–1.23	–0.81	–1.01
Zimbabwe	–0.39	–0.69	–0.84	–0.92	–1.06	–0.89	–1.23	–0.81	–1.01
Guinea	–0.39	–0.69	–0.84	–0.92	–1.06	–0.89	–1.22	–0.81	–1.01
Syria	–0.39	–0.69	–0.83	–0.92	–1.05	–0.88	–1.20	–0.81	–1.00
Georgia	–0.39	–0.69	–0.83	–0.92	–1.05	–0.88	–1.20	–0.81	–1.00
Middle-income countries									
Ukraine	–0.39	–0.69	–0.83	–0.91	–1.03	–0.88	–1.18	–0.81	–0.98
Philippines	–0.39	–0.69	–0.82	–0.91	–1.02	–0.87	–1.16	–0.81	–0.98
Peru	–0.39	–0.69	–0.82	–0.91	–1.02	–0.87	–1.15	–0.81	–0.97
Botswana	–0.39	–0.69	–0.82	–0.91	–1.02	–0.87	–1.15	–0.81	–0.97
Thailand	–0.39	–0.69	–0.82	–0.91	–1.02	–0.87	–1.15	–0.81	–0.97
Morocco	–0.39	–0.69	–0.82	–0.91	–1.01	–0.87	–1.14	–0.81	–0.97
Venezuela	–0.39	–0.69	–0.82	–0.91	–1.01	–0.87	–1.14	–0.81	–0.96
Macedonia	–0.39	–0.69	–0.82	–0.90	–1.01	–0.87	–1.13	–0.81	–0.96
Belize	–0.39	–0.69	–0.82	–0.90	–1.01	–0.87	–1.13	–0.81	–0.96
Egypt	–0.39	–0.69	–0.82	–0.90	–1.01	–0.87	–1.13	–0.81	–0.96
St. Vincent & Grenadines	–0.39	–0.69	–0.82	–0.90	–1.01	–0.87	–1.13	–0.81	–0.96

Swaziland	–0.39	–0.69	–0.81	–0.90	–1.00	–0.86	–1.12	–0.81	–0.95
Lebanon	–0.39	–0.69	–0.81	–0.90	–1.00	–0.86	–1.12	–0.81	–0.95
Belarus	–0.39	–0.69	–0.81	–0.90	–1.00	–0.86	–1.11	–0.81	–0.95
Kazakhstan	–0.39	–0.69	–0.81	–0.90	–1.00	–0.86	–1.11	–0.81	–0.95
Dominica	–0.39	–0.69	–0.81	–0.90	–1.00	–0.86	–1.11	–0.81	–0.95
Latvia	–0.39	–0.69	–0.81	–0.90	–0.99	–0.86	–1.10	–0.81	–0.94
St. Lucia	–0.39	–0.69	–0.81	–0.90	–0.99	–0.86	–1.10	–0.81	–0.94
Brazil	–0.39	–0.69	–0.81	–0.90	–0.99	–0.86	–1.10	–0.81	–0.94
Bulgaria	–0.39	–0.69	–0.81	–0.90	–0.99	–0.86	–1.10	–0.81	–0.94
Russia	–0.39	–0.69	–0.81	–0.90	–0.98	–0.86	–1.10	–0.81	–0.94
Fiji	–0.39	–0.69	–0.81	–0.89	–0.98	–0.86	–1.09	–0.81	–0.93
Grenada	–0.39	–0.69	–0.81	–0.89	–0.98	–0.86	–1.09	–0.81	–0.93
Turkey	–0.39	–0.69	–0.80	–0.89	–0.98	–0.85	–1.09	–0.81	–0.93
Lithuania	–0.39	–0.69	–0.80	–0.89	–0.98	–0.85	–1.08	–0.81	–0.93
Romania	–0.39	–0.69	–0.80	–0.89	–0.97	–0.85	–1.08	–0.81	–0.93
Iran	–0.39	–0.69	–0.80	–0.89	–0.97	–0.85	–1.07	–0.81	–0.92
Mexico	–0.38	–0.69	–0.80	–0.89	–0.97	–0.85	–1.07	–0.81	–0.92
Bahrain	–0.38	–0.69	–0.80	–0.89	–0.96	–0.85	–1.07	–0.81	–0.92
Chile	–0.38	–0.69	–0.80	–0.89	–0.96	–0.85	–1.06	–0.81	–0.92
Antigua & Barbuda	–0.38	–0.69	–0.80	–0.89	–0.96	–0.85	–1.06	–0.81	–0.92
Poland	–0.38	–0.69	–0.80	–0.89	–0.96	–0.85	–1.06	–0.81	–0.91
Trinidad & Tobago	–0.38	–0.69	–0.79	–0.89	–0.96	–0.84	–1.05	–0.81	–0.91
Estonia	–0.38	–0.69	–0.79	–0.88	–0.95	–0.84	–1.05	–0.80	–0.91
Gabon	–0.38	–0.69	–0.79	–0.88	–0.95	–0.84	–1.05	–0.80	–0.91
Tunisia	–0.38	–0.69	–0.79	–0.88	–0.95	–0.84	–1.05	–0.80	–0.90
St. Kitts & Nevis	–0.38	–0.69	–0.79	–0.88	–0.95	–0.84	–1.04	–0.80	–0.90
Uruguay	–0.37	–0.69	–0.79	–0.88	–0.95	–0.84	–1.04	–0.80	–0.90
Slovakia	–0.37	–0.69	–0.79	–0.88	–0.95	–0.84	–1.04	–0.80	–0.90
Hungary	–0.37	–0.69	–0.79	–0.88	–0.94	–0.84	–1.03	–0.80	–0.89
Argentina	–0.36	–0.69	–0.78	–0.88	–0.93	–0.83	–1.02	–0.80	–0.88

(*Continued Overleaf*)

Table 12.9 Continued

Country (1)	*Food, beverage & tobacco* (2)	*Clothing & footwear* (3)	*Gross rent, fuel* (4)	*House operations* (5)	*Medical care* (6)	*Transport & communication* (7)	*Recreation* (8)	*Education* (9)	*Other* (10)
Middle-income countries Continued									
Oman	–0.35	–0.69	–0.78	–0.87	–0.93	–0.83	–1.01	–0.80	–0.88
Qatar	–0.35	–0.69	–0.78	–0.87	–0.92	–0.83	–1.01	–0.80	–0.87
Slovenia	–0.34	–0.69	–0.77	–0.87	–0.92	–0.83	–1.00	–0.80	–0.87
High-income countries									
Czech Republic	–0.34	–0.69	–0.77	–0.87	–0.92	–0.82	–1.00	–0.80	–0.87
Greece	–0.33	–0.69	–0.77	–0.87	–0.91	–0.82	–0.99	–0.80	–0.86
Korea	–0.32	–0.69	–0.77	–0.87	–0.91	–0.82	–0.99	–0.80	–0.86
Portugal	–0.32	–0.69	–0.77	–0.87	–0.91	–0.82	–0.99	–0.80	–0.86
Spain	–0.32	–0.69	–0.77	–0.87	–0.91	–0.82	–0.99	–0.80	–0.86
Ireland	–0.31	–0.69	–0.77	–0.87	–0.91	–0.82	–0.98	–0.80	–0.86
Singapore	–0.31	–0.69	–0.77	–0.87	–0.90	–0.82	–0.98	–0.80	–0.86
Mauritius	–0.30	–0.69	–0.76	–0.86	–0.90	–0.82	–0.98	–0.80	–0.85
Israel	–0.29	–0.69	–0.76	–0.86	–0.90	–0.81	–0.97	–0.80	–0.85
New Zealand	–0.29	–0.69	–0.76	–0.86	–0.90	–0.81	–0.97	–0.80	–0.85
Finland	–0.29	–0.69	–0.76	–0.86	–0.90	–0.81	–0.97	–0.80	–0.85
Bahamas	–0.29	–0.69	–0.76	–0.86	–0.90	–0.81	–0.97	–0.80	–0.85
Sweden	–0.27	–0.69	–0.76	–0.86	–0.89	–0.81	–0.97	–0.80	–0.84
Netherlands	–0.27	–0.69	–0.76	–0.86	–0.89	–0.81	–0.96	–0.80	–0.84
France	–0.25	–0.69	–0.76	–0.86	–0.89	–0.81	–0.96	–0.80	–0.84
United Kingdom	–0.25	–0.69	–0.75	–0.86	–0.89	–0.81	–0.96	–0.80	–0.84
Belgium	–0.25	–0.69	–0.75	–0.86	–0.89	–0.81	–0.96	–0.80	–0.84
Norway	–0.24	–0.69	–0.75	–0.86	–0.89	–0.81	–0.96	–0.80	–0.84
Italy	–0.24	–0.69	–0.75	–0.86	–0.89	–0.81	–0.96	–0.80	–0.84
Austria	–0.24	–0.69	–0.75	–0.86	–0.88	–0.81	–0.96	–0.80	–0.83

Germany	–0.23	–0.69	–0.75	–0.86	–0.88	–0.81	–0.96	–0.80	–0.83
Australia	–0.23	–0.69	–0.75	–0.86	–0.88	–0.80	–0.95	–0.80	–0.83
Japan	–0.22	–0.69	–0.75	–0.86	–0.88	–0.80	–0.95	–0.80	–0.83
Canada	–0.22	–0.69	–0.75	–0.86	–0.88	–0.80	–0.95	–0.80	–0.83
Bermuda	–0.20	–0.69	–0.75	–0.85	–0.88	–0.80	–0.95	–0.80	–0.83
Switzerland	–0.20	–0.69	–0.75	–0.85	–0.88	–0.80	–0.95	–0.80	–0.83
Barbados	–0.20	–0.69	–0.75	–0.85	–0.88	–0.80	–0.95	–0.80	–0.83
Hong Kong	–0.20	–0.69	–0.75	–0.85	–0.88	–0.80	–0.95	–0.80	–0.83
Iceland	–0.19	–0.69	–0.75	–0.85	–0.88	–0.80	–0.95	–0.80	–0.83
Denmark	–0.19	–0.69	–0.75	–0.85	–0.88	–0.80	–0.95	–0.80	–0.83
Luxembourg	–0.10	–0.69	–0.74	–0.85	–0.86	–0.79	–0.93	–0.80	–0.81
United States	–0.08	–0.69	–0.74	–0.85	–0.86	–0.79	–0.93	–0.80	–0.81
Low-income average	–0.37	–0.69	–0.88	–0.95	–1.24	–0.93	–1.59	–0.82	–1.17
Middle-income average	–0.38	–0.69	–0.80	–0.89	–0.98	–0.85	–1.09	–0.81	–0.93
High-income average	–0.25	–0.69	–0.76	–0.86	–0.89	–0.81	–0.96	–0.80	–0.84

a Countries are reported based on ascending per capita real income levels, 1996.
b As the estimated budget shares for recreation were negative, these values are calculated using the actual budget shares.

Table 12.10 Cournot own-price elasticity for aggregate consumption categories, 114 countries in 1996[a]

Country (1)	*Food, beverage & tobacco* (2)	*Clothing & footwear* (3)	*Gross rent, fuel* (4)	*House operations* (5)	*Medical care* (6)	*Transport & communication* (7)	*Recreation* (8)	*Education* (9)	*Other* (10)
Low-income countries									
Tanzania	–0.84	–0.77	–1.10	–1.09	–2.33	–1.13	–3.00[b]	–0.89	–2.06
Nigeria	–0.82	–0.77	–1.07	–1.06	–1.72	–1.09	–3.20[b]	–0.89	–1.61
Tajikistan	–0.81	–0.77	–1.05	–1.05	–1.58	–1.08	–3.15	–0.89	–1.49
Zambia	–0.80	–0.77	–1.05	–1.05	–1.56	–1.08	–2.97	–0.89	–1.48
Yemen	–0.80	–0.77	–1.05	–1.05	–1.55	–1.08	–3.24[b]	–0.89	–1.48
Malawi	–0.80	–0.77	–1.05	–1.04	–1.49	–1.07	–3.28[b]	–0.89	–1.43
Madagascar	–0.80	–0.77	–1.05	–1.04	–1.49	–1.07	–2.51	–0.89	–1.43
Mali	–0.79	–0.77	–1.04	–1.04	–1.48	–1.07	–2.42	–0.89	–1.41
Mongolia	–0.79	–0.77	–1.04	–1.04	–1.47	–1.07	–2.40	–0.89	–1.41
Benin	–0.78	–0.77	–1.03	–1.03	–1.37	–1.05	–1.92	–0.88	–1.32
Kenya	–0.77	–0.77	–1.03	–1.02	–1.33	–1.04	–1.79	–0.88	–1.29
Sierra Leone	–0.76	–0.76	–1.02	–1.02	–1.31	–1.04	–1.70	–0.88	–1.27
Nepal	–0.76	–0.76	–1.02	–1.02	–1.31	–1.04	–1.70	–0.88	–1.27
Turkmenistan	–0.76	–0.76	–1.02	–1.02	–1.29	–1.04	–1.66	–0.88	–1.26
Congo	–0.75	–0.76	–1.02	–1.01	–1.27	–1.03	–1.60	–0.88	–1.24
Senegal	–0.75	–0.76	–1.01	–1.01	–1.26	–1.03	–1.55	–0.88	–1.22
Vietnam	–0.75	–0.76	–1.01	–1.01	–1.25	–1.03	–1.53	–0.88	–1.22
Bangladesh	–0.74	–0.76	–1.01	–1.01	–1.25	–1.03	–1.53	–0.88	–1.22
Pakistan	–0.73	–0.76	–1.01	–1.00	–1.22	–1.02	–1.45	–0.88	–1.19
Azerbaijan	–0.73	–0.76	–1.00	–1.00	–1.20	–1.02	–1.41	–0.88	–1.18
Cote d'Ivoire	–0.72	–0.76	–1.00	–1.00	–1.20	–1.01	–1.40	–0.88	–1.17
Paraguay	–0.72	–0.76	–1.00	–1.00	–1.20	–1.01	–1.39	–0.88	–1.17
Uzbekistan	–0.72	–0.76	–1.00	–1.00	–1.19	–1.01	–1.38	–0.88	–1.16
Kyrgyzstan	–0.72	–0.76	–1.00	–1.00	–1.19	–1.01	–1.38	–0.88	–1.16
Cameroon	–0.72	–0.76	–1.00	–1.00	–1.19	–1.01	–1.37	–0.88	–1.16

Moldova	–0.72	–0.76	–1.00	–1.00	–1.19	–1.01	–1.37	–0.88	–1.16
Bolivia	–0.71	–0.76	–1.00	–0.99	–1.18	–1.01	–1.35	–0.88	–1.16
Ecuador	–0.71	–0.76	–1.00	–0.99	–1.17	–1.01	–1.35	–0.88	–1.15
Armenia	–0.70	–0.76	–0.99	–0.99	–1.17	–1.01	–1.33	–0.88	–1.15
Sri Lanka	–0.70	–0.76	–0.99	–0.99	–1.17	–1.01	–1.33	–0.88	–1.15
Jordan	–0.70	–0.76	–0.99	–0.99	–1.16	–1.00	–1.31	–0.88	–1.14
Albania	–0.69	–0.76	–0.99	–0.99	–1.15	–1.00	–1.29	–0.88	–1.13
Indonesia	–0.69	–0.76	–0.99	–0.99	–1.14	–1.00	–1.28	–0.88	–1.12
Jamaica	–0.69	–0.76	–0.99	–0.98	–1.14	–1.00	–1.28	–0.88	–1.12
Zimbabwe	–0.69	–0.76	–0.99	–0.98	–1.14	–1.00	–1.28	–0.88	–1.12
Guinea	–0.68	–0.76	–0.99	–0.98	–1.14	–1.00	–1.27	–0.88	–1.12
Syria	–0.68	–0.76	–0.99	–0.98	–1.13	–1.00	–1.26	–0.88	–1.11
Georgia	–0.67	–0.76	–0.99	–0.98	–1.13	–1.00	–1.25	–0.88	–1.11
Middle-income countries									
Ukraine	–0.66	–0.76	–0.98	–0.98	–1.12	–0.99	–1.23	–0.88	–1.10
Philippines	–0.65	–0.76	–0.98	–0.98	–1.11	–0.99	–1.22	–0.88	–1.10
Peru	–0.65	–0.76	–0.98	–0.98	–1.11	–0.99	–1.21	–0.88	–1.09
Botswana	–0.65	–0.76	–0.98	–0.98	–1.11	–0.99	–1.21	–0.88	–1.09
Thailand	–0.65	–0.76	–0.98	–0.98	–1.11	–0.99	–1.21	–0.88	–1.09
Morocco	–0.64	–0.76	–0.98	–0.97	–1.10	–0.99	–1.20	–0.88	–1.09
Venezuela	–0.64	–0.76	–0.98	–0.97	–1.10	–0.99	–1.20	–0.88	–1.09
Macedonia	–0.64	–0.76	–0.98	–0.97	–1.10	–0.99	–1.19	–0.88	–1.08
Belize	–0.64	–0.76	–0.98	–0.97	–1.10	–0.99	–1.19	–0.88	–1.08
Egypt	–0.64	–0.76	–0.98	–0.97	–1.10	–0.99	–1.19	–0.88	–1.08
St. Vincent & Grenadines	–0.64	–0.76	–0.98	–0.97	–1.10	–0.99	–1.19	–0.88	–1.08
Swaziland	–0.63	–0.76	–0.98	–0.97	–1.09	–0.98	–1.18	–0.88	–1.08
Lebanon	–0.63	–0.76	–0.98	–0.97	–1.09	–0.98	–1.18	–0.88	–1.08
Belarus	–0.62	–0.76	–0.98	–0.97	–1.09	–0.98	–1.18	–0.88	–1.08

(*Continued Overleaf*)

Table 12.10 Continued

Country (1)	*Food, beverage & tobacco* (2)	*Clothing & footwear* (3)	*Gross rent, fuel* (4)	*House operations* (5)	*Medical care* (6)	*Transport & communication* (7)	*Recreation* (8)	*Education* (9)	*Other* (10)
Middle-income countries Continued									
Kazakhstan	–0.62	–0.76	–0.98	–0.97	–1.09	–0.98	–1.18	–0.88	–1.07
Dominica	–0.62	–0.76	–0.98	–0.97	–1.09	–0.98	–1.18	–0.88	–1.07
Latvia	–0.62	–0.76	–0.97	–0.97	–1.08	–0.98	–1.17	–0.88	–1.07
St. Lucia	–0.61	–0.76	–0.97	–0.97	–1.08	–0.98	–1.17	–0.88	–1.07
Brazil	–0.61	–0.76	–0.97	–0.97	–1.08	–0.98	–1.17	–0.88	–1.07
Bulgaria	–0.61	–0.76	–0.97	–0.97	–1.08	–0.98	–1.16	–0.88	–1.07
Russia	–0.61	–0.76	–0.97	–0.97	–1.08	–0.98	–1.16	–0.88	–1.07
Fiji	–0.60	–0.76	–0.97	–0.97	–1.08	–0.98	–1.15	–0.88	–1.06
Grenada	–0.60	–0.76	–0.97	–0.97	–1.08	–0.98	–1.15	–0.88	–1.06
Turkey	–0.60	–0.76	–0.97	–0.97	–1.07	–0.98	–1.15	–0.88	–1.06
Lithuania	–0.59	–0.76	–0.97	–0.96	–1.07	–0.98	–1.15	–0.88	–1.06
Romania	–0.59	–0.76	–0.97	–0.96	–1.07	–0.98	–1.14	–0.88	–1.06
Iran	–0.58	–0.75	–0.97	–0.96	–1.07	–0.98	–1.14	–0.88	–1.06
Mexico	–0.58	–0.75	–0.97	–0.96	–1.06	–0.98	–1.14	–0.88	–1.05
Bahrain	–0.58	–0.75	–0.97	–0.96	–1.06	–0.97	–1.13	–0.88	–1.05
Chile	–0.57	–0.75	–0.97	–0.96	–1.06	–0.97	–1.13	–0.88	–1.05
Antigua & Barbuda	–0.57	–0.75	–0.97	–0.96	–1.06	–0.97	–1.13	–0.88	–1.05
Poland	–0.57	–0.75	–0.97	–0.96	–1.06	–0.97	–1.13	–0.88	–1.05
Trinidad & Tobago	–0.56	–0.75	–0.97	–0.96	–1.06	–0.97	–1.12	–0.88	–1.05
Estonia	–0.56	–0.75	–0.97	–0.96	–1.06	–0.97	–1.12	–0.88	–1.05
Gabon	–0.56	–0.75	–0.97	–0.96	–1.05	–0.97	–1.12	–0.88	–1.05
Tunisia	–0.55	–0.75	–0.97	–0.96	–1.05	–0.97	–1.12	–0.88	–1.04
St. Kitts & Nevis	–0.55	–0.75	–0.97	–0.96	–1.05	–0.97	–1.12	–0.88	–1.04

Uruguay	–0.55	–0.75	–0.96	–0.96	–1.05	–0.97	–1.11	–0.88	–1.04
Slovakia	–0.54	–0.75	–0.96	–0.96	–1.05	–0.97	–1.11	–0.88	–1.04
Hungary	–0.53	–0.75	–0.96	–0.96	–1.05	–0.97	–1.10	–0.88	–1.04
Argentina	–0.50	–0.75	–0.96	–0.95	–1.04	–0.97	–1.09	–0.88	–1.03
Oman	–0.49	–0.75	–0.96	–0.95	–1.04	–0.96	–1.09	–0.88	–1.03
Qatar	–0.48	–0.75	–0.96	–0.95	–1.03	–0.96	–1.08	–0.88	–1.03
Slovenia	–0.47	–0.75	–0.96	–0.95	–1.03	–0.96	–1.08	–0.88	–1.02
High-income countries									
Czech Republic	–0.46	–0.75	–0.96	–0.95	–1.03	–0.96	–1.08	–0.88	–1.02
Greece	–0.44	–0.75	–0.96	–0.95	–1.03	–0.96	–1.07	–0.88	–1.02
Korea	–0.43	–0.75	–0.96	–0.95	–1.02	–0.96	–1.07	–0.88	–1.02
Portugal	–0.43	–0.75	–0.96	–0.95	–1.02	–0.96	–1.07	–0.88	–1.02
Spain	–0.43	–0.75	–0.96	–0.95	–1.02	–0.96	–1.07	–0.88	–1.02
Ireland	–0.42	–0.75	–0.96	–0.95	–1.02	–0.96	–1.07	–0.88	–1.02
Singapore	–0.41	–0.75	–0.95	–0.95	–1.02	–0.96	–1.06	–0.88	–1.01
Mauritius	–0.40	–0.75	–0.95	–0.95	–1.02	–0.96	–1.06	–0.88	–1.01
Israel	–0.38	–0.75	–0.95	–0.95	–1.02	–0.96	–1.06	–0.88	–1.01
New Zealand	–0.38	–0.75	–0.95	–0.95	–1.02	–0.96	–1.06	–0.88	–1.01
Finland	–0.38	–0.75	–0.95	–0.95	–1.02	–0.96	–1.06	–0.88	–1.01
Bahamas	–0.37	–0.75	–0.95	–0.94	–1.01	–0.96	–1.06	–0.88	–1.01
Sweden	–0.35	–0.75	–0.95	–0.94	–1.01	–0.95	–1.05	–0.88	–1.01
Netherlands	–0.34	–0.75	–0.95	–0.94	–1.01	–0.95	–1.05	–0.88	–1.01
France	–0.32	–0.75	–0.95	–0.94	–1.01	–0.95	–1.05	–0.87	–1.00
United Kingdom	–0.32	–0.75	–0.95	–0.94	–1.01	–0.95	–1.05	–0.87	–1.00
Belgium	–0.31	–0.75	–0.95	–0.94	–1.01	–0.95	–1.04	–0.87	–1.00
Norway	–0.31	–0.75	–0.95	–0.94	–1.01	–0.95	–1.04	–0.87	–1.00
Italy	–0.31	–0.75	–0.95	–0.94	–1.01	–0.95	–1.04	–0.87	–1.00
Austria	–0.30	–0.75	–0.95	–0.94	–1.01	–0.95	–1.04	–0.87	–1.00
Germany	–0.30	–0.75	–0.95	–0.94	–1.01	–0.95	–1.04	–0.87	–1.00

(*Continued Overleaf*)

Table 12.10 Continued

Country (1)	*Food, beverage & tobacco* (2)	*Clothing & footwear* (3)	*Gross rent, fuel* (4)	*House operations* (5)	*Medical care* (6)	*Transport & communication* (7)	*Recreation* (8)	*Education* (9)	*Other* (10)
High-income countries									
Australia	–0.29	–0.75	–0.95	–0.94	–1.01	–0.95	–1.04	–0.87	–1.00
Japan	–0.28	–0.75	–0.95	–0.94	–1.00	–0.95	–1.04	–0.87	–1.00
Canada	–0.27	–0.75	–0.95	–0.94	–1.00	–0.95	–1.04	–0.87	–1.00
Bermuda	–0.25	–0.75	–0.95	–0.94	–1.00	–0.95	–1.04	–0.87	–1.00
Switzerland	–0.25	–0.75	–0.95	–0.94	–1.00	–0.95	–1.04	–0.87	–1.00
Barbados	–0.24	–0.75	–0.95	–0.94	–1.00	–0.95	–1.04	–0.87	–1.00
Hong Kong	–0.24	–0.75	–0.95	–0.94	–1.00	–0.95	–1.04	–0.87	–1.00
Iceland	–0.24	–0.75	–0.95	–0.94	–1.00	–0.95	–1.04	–0.87	–1.00
Denmark	–0.24	–0.75	–0.95	–0.94	–1.00	–0.95	–1.04	–0.87	–1.00
Luxembourg	–0.12	–0.74	–0.95	–0.94	–0.99	–0.95	–1.02	–0.87	–0.99
United States	–0.10	–0.74	–0.95	–0.94	–0.99	–0.95	–1.02	–0.87	–0.99
Low-income average	–0.74	–0.76	–1.01	–1.01	–1.31	–1.03	–1.63	–0.88	–1.26
Middle-income average	–0.59	–0.76	–0.97	–0.97	–1.07	–0.98	–1.15	–0.88	–1.06
High-income average	–0.32	–0.75	–0.95	–0.94	–1.01	–0.95	–1.05	–0.88	–1.01

a Countries are reported based on ascending per capita real income levels, 1996.
b As the estimated budget shares for recreation were negative, these values are calculated using the actual budget shares.

and −2.12, respectively; for the USA, they are −.93, −.86, and −.81, respectively (Table 12.9).

Conclusions

Income and own-price elasticities of demand for the nine categories of goods vary significantly among countries of differing levels of affluence. This is particularly true of food, beverages and tobacco; its income elasticity of demand for the poorest country, Tanzania, is almost ten times greater than that for the richest country, the USA. The USA Cournot (Slutsky) own-price elasticity of demand for this consumption category is nine (seven) times larger in absolute value for Tanzania than for the USA.

The same patterns in the elasticity measures are found for certain luxurious goods: gross rent, fuel and power; house furnishings and operations; medical care; recreation; and other items. The demand for these goods is much more responsive to income changes in low-income than in high-income countries. Interestingly, the own-price elasticities of demand for several goods are larger than unity for low-income countries but less than unity for high-income countries. This is the case for all three types of own-price elasticities for the following goods: medical care; recreation; and other items. It is also the case for the Frisch and Cournot own-price elasticities of demand for gross rent, fuel and power, and for transportation and communications.

Finally, this research provides estimates for income and price elasticities for nine aggregate consumption groups across 114 countries. These elasticities can be used as inputs in various research works designed to forecast future consumer demand and supply, and also in projects designed to simulate the impacts of different government policy options. In addition to the actual elasticity estimates, parameters estimated from our models can be used with appropriate latest expenditure data to estimate new elasticities for recent years for countries included in our analysis as well as for countries excluded from our analysis. For example, Cox and Alm (2007) using the parameters from this study calculate 2006 income elasticities for nine categories of goods and services in 116 countries.

Notes

1 James Seale is Professor, University of Florida, and Anita Regmi is Senior Economist, Economic Research Service, USDA. The authors wish to express their deep appreciation to Yonas Biru and Yuri Dikhanov, World Bank, for making the data available. Without their assistance, the study would not be possible. The contact author is James Seale, Jr., Department of Food and Resource Economics, PO Box 110240, Gainesville, Florida 32611–0240, Phone: (352) 256–5917, Fax: (352) 392–9898, e-mail: jseale@ufl.edu.

2 The model, developed by Theil, Chung, and Seale (TCS 1989), was originally named the Working's PI (Preference Independence) model but was renamed the Florida PI model by Seale, Walker and Kim (1991). In later writings, Theil (1996) also referred to it as the Florida PI model.

3 Prior to 1989, ICP is referred to as the International Comparison Project. After 1989, it is referred to as the International Comparison Programme (Statistics Directorate of the OECD, 2006).
4 TCS and Seale, Walker, and Kim (1991) also find group heteroskedasticity for the 1980 Phase IV data.
5 TCS previously used this method to identify outliers in earlier phases of the ICP.
6 SR report elasticity calculations for a small sub-sample of 14 low-, middle-, and high-income countries from the selected 91 countries.
7 The 1970 Phase II supersedes the 1970 Phase I.
8 See TCS, Appendix A, for a discussion of the Geary-Khamis methodology and how to estimate PPPs based upon it.
9 Note that this classification is merely done to facilitate analysis and is not based on any generally accepted criteria for classification. Since the classification is based on the ICP data used in this analysis, some countries may be in a group with which they normally would not be associated.
10 Theil and Suhm (1981) develop an earlier version of the model and fit it for nine categories of goods for 15 countries of the 1975 Phase II data.
11 The exception to this is when a good has unitary elasticity; as income increases, expenditure on the good increases in the same proportion so that w_i is unchanged.
12 Theil and Seale (1987) prove that the geometric mean price point across countries has a minimum mean-squared distance property. Because the Florida PI model measures prices from these geometric means, the property just mentioned can be viewed as a justification of this procedure.
13 TCS pool countries of three ICP phases (Phases II, III, and IV) and additionally estimate an autocorrelation parameter via the ML grid search.
14 The TCS estimate of –.134 for food, beverages and tobacco is obtained by simply adding the parameter estimate of food, –.135, to that of beverages and tobacco, .001.
15 TCS encounter a similar problem in that the ϕs obtained from individual estimation of the data of ICP Phases II, III, and IV; however, an Efron's (1979) bootstrap simulation showed that the asymptotic standard error of ϕ is biased downward by 65 percent of the true value.
16 There are four exceptions: the income elasticity of demand for recreation of four countries (Tanzania, Nigeria, Yemen, and Malawi) is calculated from the respective observed budget share.
17 See TCS, pp. 110–11, for the derivation of the three types of own-price elasticities.

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