Economic Models for Policy Making

Over the past decades, many different kinds of models have been developed that have been of use to policy makers, but until now the different approaches have not been brought together with a view to enhancing the systematic unification and evaluation of these models. This new volume aims to fill this gap by bringing together four decades' worth of work by S. I. Cohen on economic modelling for policy making. Work on older models has been rewritten and brought fully up to date, and these older models have therefore been brought back to the fore, both to assess how they influenced more recent models and to see how they could be used today.

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The focus of the book is on models for development policies in developing economies, but there are some chapters that relate to economic policies in transition and developed economies. The policy areas covered are of typical interest in developing and transition economies. They include those relating to trade liberalisation reforms, sustainable development, industrial development, agrarian reform, growth and distribution, human resource development and education, public goods, and income transfers. Each chapter contains a brief assessment of the empirical literature on the economic effects of the policy measures discussed in the chapter.

The book presents a platform of economic modelling that can serve as a refresher for practising professionals, as well as a reference companion for graduates engaging in economic modelling and policy preparations.

S. I. Cohen is Emeritus Professor of Economics at the Erasmus University Rotterdam, the Netherlands. He founded the Foundation for Economic Research Rotterdam and is a regular advisor to UN, WB, and EU agencies on development issues and in field missions.

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To Els
To Sophie, Yasmine, Nelson and Midas

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Preface

The vast expansion in economic models for policy making has turned the field almost beyond systemic comprehension. In such a mushrooming world of economic models it is increasingly difficult to oversee the whole and deduct the cores. Deduction is a vital task in the development and application of scientific inquiry. Once in a while there is a need for a consolidation round in which related models are bundled and studied in concert and in retrospect. This book is such a consolidation round for works done by the same author on policy models in the past four decades.

By bringing together in this book various policy modelling applications by the same author, integrating them in retrospect, adapting and rewriting them to highlight standards; and by relating these modelling applications via cross references to policy models of others, this work seeks to humbly contribute to the systemic unification of policy modelling. Furthermore, useful and handy modelling devices, methods and approaches that were developed in the contexts of past policy research, when systematised and simplified by leaving out hanging details, can benefit younger model builders in their modelling applications. Moreover, many of the policy problems of the past in developing and transiting economies are still with us today, albeit in modified shapes and in many more countries.

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The book contains ten economy-wide policy models and six partial models. The economy-wide models cover combined econometric multisector models, social accounting matrix (SAM) models and computable general equilibrium (CGE) models. They model and analyse policies of agrarian reform, basic needs, growth with redistribution, fiscal policy, trade liberalisation and sustainable development; and are applied to Chile, Colombia, India, Indonesia, Korea, Nepal, Pakistan and Sudan, among others. Two models study transiting performance of Russia and China, and regime transition towards price-driven economic systems in Poland and Hungary. And two more investigate dynamics, regional, and fiscal policy in SAM and CGE models for the Netherlands.

The partial models include a normed planning model for human resource development for Ethiopia; a forecasting model of labour imbalances combined with an iterative fitting model to simulate labour market adjustments in Colombia, Korea and Pakistan; a model of privatisation transactions in transiting context, Poland; a model of economising solutions for resolving social queues combined with a random sampling model to investigate probabilities of effective economising

solutions in the Netherlands; modelling and measuring convergence in economic growth between rich and poor countries; and the modelling of distinctive behavioural types in socio-economic systems.

The sixteen models are preceded by an introductory chapter on substantive contents, and an introductory chapter on modelling methods. We have sought to strike a workable balance between content and method in the presentation and analysis of each model; while placing details on content, methods, estimation and elaborations in endnotes.

Taken together, the sixteen models reveal a particular approach towards policy modelling that has its origin in Tinbergen and Havelmo, and has gained support from Lucas, Krugman and many others. The approach perceives policy models as experimental designs: a kind of applied laboratories in which restructured designs and fitting policies can be demonstrated, tested and recommended for decision making and for changing policy. The approach extends and perceives policy models as creative designs to resolve policy problems that are not easily solvable by conventional means, and in conventional policy frameworks (that is, restricted time horizons, restricted instruments and unchanging foundations). The approach is open to experimenting with 'innovative architects', while respecting as the starting point the status of the policy model as econometrically tested 'matching device'. It goes without saying that any element of experimental design incorporated in the policy model must observe that it is scientifically principled, functionally useful and operationally effective.

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Some details and selected results on several models included in the book were published in refereed journals, but all chapters have been rewritten. The renewal and adaptation of the modelling applications to fit within the focus of the book required that many applications had to be reformulated, throwing out some details, extending on others and rerunning some simulations. In their original forms, the applications reflected the changing modes of notations over the years. Besides, as some of the models were jointly developed with collaborators, the notations used for basically the same intended variables, coefficients and indices tended to vary between the models. An attempt was made to harmonise the specification of equations, and facilitate uniformity in the notations used throughout the book.

As regards collaborative work, I wish to acknowledge my indebtedness and thanks to Sanjaya Acharya, Eisa Abdel Galil and Rini Braber for joint work in models presented in Chapters 7, 8 and 11, respectively. My thanks go also to Fred Lafeber, Hans Tuyl and Marco van Kessel for collaborative works done in Chapters 5, 11 and 16, respectively.

The consolidation venture that we are presenting is more than a renovation of recipes to fit to tastes of the day. The final product required concentrated thought across a wide collection of models and applications, finding common denominators, some rerunning of policy simulations, retabulation of results and rewriting. It took close to two years to get the work done. During this period I was fortunate to be freed from the load of incidental preoccupations and social obligations. My deep thanks go to Els, who carried the load and was able to manage with my virtual absence. I am highly indebted to her understanding attitude and

cooperative spirit. I would also like to mention the personal support which I enjoyed from other family members: from Bram and Elles, and from Bas and Angele.

In the two years of work on the book I was able to count on the secretarial, printing and computational support of the Department of General Economics at Erasmus School of Economics, for which I am thankful. In particular, my appreciation goes to Jany, Milky and Thea, who were quick and effective in providing the required support and servicing.

S. I. Cohen
Rotterdam, 2012

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1 Introduction

1 Focus on economic models for exploring policies

This book has some resemblance to renovations of recipes, which existed for years ago, to fit them to changing expectations and tastes of the day. There is the attractive result here that the renovations, recipes, and ingredients fit with each other, have together a common history, and are as topical today as they were then. While most of the content of the book comprises adaptations of research work done over some four decades, each chapter has been practically rewritten so that they reinforce each other and form a coherent whole that would be of special interest and immediate relevance to today's economic modellers, policy analysts, development advisors, and the teaching profession in the related areas. In this first chapter, we introduce the lines along which the renovation venture is focused, formulated, and implemented, and the reasons why it is worthwhile to undertake this renewal attempt. We shall also discuss the outline of the book and the linkages between the chapters, and end with concluding remarks.

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To start with, it is important to underline where our focus will be within the various categories of economic models. There are pure models for formulating theories; and a wide range of applied models for testing theories, explaining events, measuring relations, forecasting variables, planning development, policy analysis, for decision making, and for teaching purposes as well. Our focus is on applied models for policy analysis and policy making, which can simultaneously serve for teaching purposes. Most of the models are economy-wide models applied to developing economies, with a few on transiting and developed economies. The book also includes several partial models.

Analytical frameworks that qualify for what one would call today economic models date back from the nineteenth century, such as the theoretically oriented demand and supply schedules of Marshall; and even before that, in the eighteenth century, there was the empirically oriented *tableau economique* of Quesnay. But, the modern use of the term economic models was first introduced by econometricians of the 1930s, and became the recognised medium of economic sciences among theoretically and empirically oriented economists from about the 1950s onwards. It has become conventional to see economic models as being either theoretical or empirical: the first dealing with theory and the second dealing with applications.[1] There is also a tendency, not altogether correct, to conceive the first

as being more suited for studying micro aspects of economic processes, while the second as being more suited for macro aspects.

The two categories, theoretical and empirical, have different epistemologies, roles, characteristics, and limitations. However, there are cases of overlapping, complementarity and reinforcement between the two groups. There are no also strict rules for developing and using either of them. The result is a fluent and shadowy landscape of models, thus creating significant challenges and difficulties in the systematisation, transparency, and evaluation of the developed models and their use.

Generally speaking, occurrence of these challenges and difficulties is less frequently encountered among the theoretical/mathematical models as compared to the empirical/applied models. There are various reasons for these differences. In epistemic terms, pure economic models are conceived as idealised frameworks for isolating, analysing and formulating crucial economic relationships. In contrast, applied economic models are built constructions of conceived worlds that necessarily contain additional properties and approximations that the modeller introduces to assure some degree of coherence between the presumed theory and the available data. It is often not possible simply to confront theory with data, since the data contain many more things than the theory. In applied modelling it is necessary to reformulate and reconstruct the model to suit the particular situation. For instance, Morgan and Knuuttila (2012) observe that as properties are added and attributed to the modelled economies and their behaviour, the model may start to look like an experimental construction rather than an idealised representation of the actual system. According to Lucas (1980), the fictional, artificial, and simulated elements that the modeller may introduce can allow for applied laboratories in which policies—which would be prohibitively expensive to experiment with in actual economies—can be demonstrated and tested out more quickly and effectively. Much earlier, Haavelmo (1944, 1964) and Tinbergen (1956, 1963) thought along similar lines by postulating that applied models should not be treated as matching devices, but as experimental designs. Today, many prominent economists[2] agree that the way applied model construction takes place is more of an intuitive and creative activity than one of abiding to strict and verifiable rules that fit theory to data.

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Given the nature and purposes of applied modelling assignments, it can be expected that there are no generally agreed upon scientific rules for economic modelling that the profession abides with in executing these assignments. Each modeller, applying his or her artistic and creative skills, can excel by innovating along newer avenues; and if fortunate enough, he or she would end by successfully demonstrating and validating the construction and deriving valuable findings. These endeavours have significantly increased our understandings of policy problems and how to manage them. But there is a cost. The accumulation over the years of mixtures of applied economic policy models that treat hundreds of different problems and policies in different contexts makes the field of policy modelling almost beyond systematic comprehension. Add to this that with each slight difference or variation in assumptions, formulation, closure, measurement, and specifications of the simulated policy, there will always be differences

in results and findings. These differences are read but are seldom subjected to further studies. It is as in many areas of art, when every singer comes up with their own songs. There is little or no effort made to explore common backgrounds. In such a mushrooming world of economic models for policy making, there is a genuine need for consolidation rounds: bundling related models and studying them in concert. Related models can be bundled in terms of their treatment of the same problem, or models that use similar data, or models constructed by the same author. By bringing together in this book various related economic models for policy making by the same author, integrating them in retrospect, and performing appropriate adaptations to highlight standards and commonalities among the models, it is hoped that the bundle contributes in some modest ways to enhancing the systematic unification and evaluation of policy modelling.

There is more reason for taking up this retrospective renovation. It is typical of applied policy modelling studies that their results are read and appreciated at the time of their publication and dissemination, but the technical and research details, devices, and approaches that were developed in the process are forgotten thereafter. It is usual that most of the readers' attention goes to the policy findings, while the technical details are often lost and overshadowed by the policy topic. The technical details may be of interest to a relatively smaller number of readers, and the interest may be of a timely nature. As a result, useful modelling devices, methods, and approaches that were developed in the contexts of past policy research tend to vanish. New applications have to develop their own devices, methods, and approaches; they could have benefited from previous works, if appropriately bundled and systematised. Moreover, it is also true that many of the policy problems of the past are still with us today, albeit in modified shapes and in many more countries. It is hoped that when the modelling details and policy problems are brought together and integrated, as this book will do, there can be a fruitful use of the retrospective outcomes, as they prove to be adaptable and applicable to more policy applications.[3] Some past works and lines of thought can be only effectively linked in retrospect, thus making the linking of works an essential task in scientific research.

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2 Outline: method and content

The selected policy models in this book and their arrangement are the outcome of two considerations: the primary consideration relates to modelling methods; the secondary consideration relates to policy content: aspects of the setting, substance, and topic of the particular models. Regarding modelling methods, the next chapter will discuss technical issues in policy modelling. In this chapter we comment on the policy content.

Chapter 2, as was just mentioned, will deal at some length with methodological issues. On methods, it is sufficient to mention at this point that the book is divided into two parts: we deal in the first part with ten economy-wide policy models and in the second part with six partial or theme models. The economy-wide policy models belong to three model categories: the combined econometric multisector model, which we dub as CEM model, and which was the mainstream

in the sixties and seventies; the social accounting matrix corresponding models, which followed immediately, in short SAM (social accounting matrix) models; and the extensive family of computable general equilibrium (CGE) models, which has become the mainstream for the last three decades. The ten chapters in the first part follow this evolution in the economy-wide policy modelling; there is more on this and related issues in the next chapter. The second part contains six models relating to various policy themes, they are partial models in the sense that they are not economy-wide. Methodologically, they follow different modelling approaches to be reviewed in due course.

It seems natural that the primary consideration in the organisation of the book goes to methods. That settled, we can now introduce aspects relating to content of the various models. First, there are the ten economy-wide policy models. These models can be grouped in terms of the country context to which they apply: thus, models are grouped into those for developing, transiting, and developed economies. Among the ten chapters, six are devoted to developing economies. These are followed by two chapters on transiting economies, and two chapters on developed economies. Second, within each of these country contexts the various models are arranged more or less following their periodic occurrence. This helps in appreciating the changing interest of development policy modelling over time in response to changing realities. Furthermore, a periodic ordering would give insight into the progressive refinement of modelling methods, approaches, and content over the recent past. In this sense, there is a positive correlation between method and content.

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In this first chapter, we introduce the backgrounds to the various models of each chapter and their relations to each other. It is unavoidable in this introduction not to mention circumstantial remarks, since the circumstances at the different times have played their role in the particular specifications and applications of the models. To keep track of the main lines, such circumstantial remarks will be shifted as much as possible to endnotes.

3 Economy-wide policy models

3.1 Development context

Models applied to developing countries form the majority of the book. They represent alternative responses in the later sixties, seventies, and eighties to the felt disappointment with the development planning effort in raising the welfare of the populations at large in developing countries. In the opening decades of development economics, mainly in the 1950s and 1960s, most development planners, economists, and statisticians identified economic development solely with economic growth. The central development objective was the growth of the GDP, and sometimes the GDP per capita. A superficial view, but very prevalent among development economists at the time was that where domestic and foreign savings are insufficient to promote investment and growth, then infusions of foreign aid (that is capital and exchange), if large enough, are by themselves sufficient to induce economic growth and economic development. Next to macro econometric

models that forecasted economic growth, and multisector models that advised on industrial development and foreign trade, it was very convenient at the time to construct and apply so-called gap models to developing countries. These gap models calculated for individual developing countries the kind and height of the gaps that constrain economic growth, and the required infusions and composition of foreign aid to reach predetermined targets of GDP growth. These and related models formed the technical framework for the advisory work of the United Nations Committee for Development Planning (UN/CDP), which acted as the platform for launching and revising various plans for the First, Second, and Third Development Decades, and made recommendations on targeted economic growth and required foreign aid for the developing world.[4]

To the surprise of many observers, as data were gathered and analysed on actual performances in developing countries a new picture emerged. It became recognised that in spite of attaining some reasonable growth rates in their GDP, most developing countries were showing increasing income inequalities, surges in the population falling behind poverty lines, accompanied with increasing underemployment and unemployment, and deteriorating food and other living conditions. With the exception of a few lucky countries in East Asia and the Far East that were successful in combining growth with redistribution, the analysed data for the developing world revealed the contrary.

The new picture brought a revision in interests and insights by economists and planners dealing with development problems. Four different types of reactions emerged as the response to disappointments in the achieved progress in social welfare. The responses were critical, to varying degrees, of the central role of the GDP in development planning, the models, policies, practices, and expectations of development planning. The four types of reactions can be characterised as follows.

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1 The pessimistic perspective saw development planning and development policy as meaningless under the 'soft state'. The postulates were that the skewed distribution of socio-political power hindered state power and economic development, and that radical reforms in the societal structure were necessary if development policy was to achieve its goal of a speedy and balanced social and economic development.
2 The social development perspective was more positive in tone. It saw the fault lying in the planning framework's misplaced focus on GDP. The perspective opened the way for reformulating development models and plans in terms of incomes of social groups, employment and basic needs, and redirecting policy making accordingly.
3 The redistribution with growth perspective brought structure in the picture, and sounded more realistic in tone. It emphasised that there are dualities and linkages in the economy between rich and poor population groups, and between high-productivity and low-productivity activities that determine development structures, growth, distribution, trickle-down effects, and moving-up mechanisms. The advice was to focus on economy-wide modelling of dualities and linkages, and use them in designing and implementing

packages of development strategies aimed at redistribution with growth. Methodologically, this perspective is associated with the popularity of the SAM serving as a helpful statistical tool in highlighting dualities and linkages in the economy-wide circular flow.

4 The free markets perspective took off and became the mainstream response for the time being. It is argued that in the longer run, market-oriented economies develop more rapidly in terms of both growth and equality than planning-oriented economies. Consequently, development policy should be more reliant on the free operation of the market forces of supply and demand and market-determined prices. Where state intervention is necessary due to market failure, state intervention should complement, and not be a substitute for market forces. Methodologically, CGE models came just in time to allow for the realisation of the free-markets perspective in policy modelling. The flexibility of CGE models allowed for extending these models to treat new policy areas such as liberalisation reforms, environmental sustainability, energy resources, fiscal policies, and so on.

The four responses are well represented by the models in Chapters 3 to 8, which were developed and applied consecutively to various developing countries. Chapter 3 represents the pessimistic perspective response. It presents a model that stylises socio-political power in a feudal-oriented system, that is rural India of the 1960s, and in a reform-inclined regime, that is Chile under Allende; and it explores policy alternatives under the two contrasting settings. Chapter 4 represents the social development perspective. It builds up a social development and a basic needs approach and incorporates supporting variables in a combined macro econometric and inter-industry model, and applies the model to Korea. Chapter 5 represents the distribution and growth perspective with its emphasis on linkages and leakages in the circular flow between social groups, firms, government, and sector activities. The SAM is converted in a model that allows tracing of these linkages and leakages. The applications cover various developing countries. Subsequently, we include three chapters or models with a focus on market forces as effective drivers of the development process; these would fall into the free-markets perspective. These models specify the economy along the lines of CGE models. One model displays a simplified transformation of the SAM into a CGE model, and reflects on outcomes of policy simulations. The working of the model in its static and dynamic forms is demonstrated for Indonesia. Another model refines the CGE model to incorporate liberalisation measures with economic restructuring that combine to generate outcomes with higher growth and greater equality. The application is for Nepal. Another model operates within the CGE modelling framework, and incorporates environmental degradation and counteractive policies that assure sustainable growth. The application is to Sudan.

Some introductory remarks will be made on each chapter and its related model. Chapter 3 presents in some way a pessimistic response to disappointments with the development performances of the sixties. The qualification pessimistic has to do with discussions reflecting opposing opinions on the development prospects

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among members of the UN/CDP. Jan Tinbergen, who acted as chairman, held an optimistic view, seeing governments searching genuinely for effective development policies and playing prominent roles in promoting development. In contrast, Gunnar Myrdal stood for the opposite view, that government in many developing countries represented the 'soft state', and that the course of the economy was dictated by powerful interest groups of landowners and other proprietors. Myrdal's voluminous book *The Asian Drama* presented a pessimistic and a rebuffing perspective in which development planning, plans, and targets did not matter, and in which the benefits of economic development went primarily to the wealthy and feudal landlords.[5] When Tinbergen was awarded the Nobel Prize in 1969, he promised to devote the proceeds of the award to fund research on the neglected topic of agrarian reform.[6] The funded research culminated in a book on the modelling of agrarian structures and agrarian reform, followed by several published articles;[7] these are the topic of the chapter.

The basic model specifies four principal actors: landlords, peasants, the non-agricultural sector, and the government. Peasants and landlords are assumed to behave differently according to their own separate institutional attitudes, production function, savings and consumption patterns, tax and interest rates, and so forth. The novelty of the approach lies in adapting the basic model to applied models that represent different configurations of the socio-political power structure, that is, configurations in which the sole dominant actor is the landlords, or the peasants, or the non-agriculturalists. In the applied model only one actor is the leader and he has a decisive role in determining his desired goals, while the other actors are followers. For example, in a feudal society, the landlords are assumed to determine the future course of their welfare variables while other actors are followers. Government policy is supposed to operate within the prescribed socio-political structural constraints.

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In adapting the basic model to fit, and be applied, to different socio-political situations, the procedure followed was, first, to formulate a basic model that is underdetermined with 24 unknown variables and 22 equations, and second, to move towards an applied model, where two variables regarded as crucial in defining a particular political structure were exogenously fixed by the leading actor, thus yielding a determinate model. Which two variables are to be specified exogenously will depend on the particular actor who moves the economy, that is, the 'leader' group and their preferred welfare variables. The remaining actors are 'follower' groups.

The chapter will apply the model to a socio-political system characterised by a landlord-leader configuration, that is, rural India of the 1960s, and will explore policy alternatives for the 'soft state' in the Indian context. The chapter will present also an application to Chile under the Allende regime where the proposed confiscatory reforms corresponded closely with a peasant platform. The applied model predicted grave costs from the proposed reforms for all other actors in Chile, and not least for the influential non-agricultural sector, suggesting that substantive opposition to the proposed reforms was inevitable. (The model was run and its alarming results were obtained in the year preceding the physical liquidation of the Allende regime by opposition forces.)

The role of government in these models depends on the particular socio-political agrarian structure described and simulated. The applied models contain instruments under varying degrees of government control: confiscation, and fiscal and pricing measures. The values of these instruments cannot influence the exogenously set variables of the dominant leading group but can influence other variables of the leading group and all variables of follower groups. The degree of intervention and the choice of the means would depend on the political colour of the government. Reflecting in retrospect, this chapter can be described as a modelling exploration that represents a cross fertilisation between the socio-political and economic realities that Myrdal has so vividly observed and analysed, and the renowned modelling approaches and positivist attitude towards economic policy that Tinbergen developed and applied.

Chapter 4 is the response to the social development perspective. In the later sixties, the United Nations Research Institute for Social Development (UNRISD), Geneva, took the lead in criticising GDP as a development goal; and instead proposed, measured, and compared for many developing countries various basic needs indicators. Soon after, other UN agencies came up with their own lists of development indicators. But there was no work done to incorporate the proposed indicators in an economy-wide policy model. Our attempt at the time to fill this gap is in Chapter 4. It contains an applied model that supplements the development goal of the aggregate GDP by income and employment variables belonging to social groups and other variables on the satisfaction of basic needs; and it extends the scope of policy instruments accordingly.[8] For the better-off groups, income is a sufficient indicator of well-being. For poverty groups, who are not in a position to advance their incomes sufficiently to attain basic needs, non-monetary indicators relating to nutrition, housing, health, and education are considered as targeted aim variables. The model considers also conventional macro and sector instruments, social group related instrument variables such as taxes, transfers, subsidies, and spending on public and merit goods.

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Another main feature relates to the formation and effects of the incorporated basic needs variables. The formation depends on the parts of income spent on the private consumption of these components, government spending, and propensities that apply for converting both types of spending in realised levels of basic needs. Regarding the effects of realised levels of wellbeing, the model integrates what various studies have already established, namely, that greater satisfaction of basic needs increases labour quality and labour productivity; and, in turn, can thus contribute to enhancing economic growth. This is done via specifying the labour input in the production function in a particular sector in terms of full capacity units. As wellbeing increases the worker's capabilities are enhanced towards full capacity.

One central question in development planning at the time was how to proceed with policy making when there are so many aim variables to be targeted and instrument variables to be solved. In answering this question we revert to the causal ordering of the modelled system, due to Simon (1953). It turns out that the prefixing of disposable incomes by social groups is the most logical first move in

the policy-making process, followed by basic needs and employment targets. The GDP variable appears down the list following causal ordering.

Primarily for reasons of data availability the Republic of Korea was selected as a test case for the model. The model was estimated on the basis of data for the sixties and employed to simulate development up to the early eighties. Quite interestingly, the results for Korea showed positive and coherent performances for the introduced socio-economic goal variables and the GDP. Predictions made around 1970, towards the next 12 years, happened to coincide very closely with the realised *ex post* values years later. The relation between the research results, government policy and economic performance is another story.[9]

Next, Chapter 5 represents what can be called the 'redistribution with growth' perspective. The term is due to Hollis Chenery. Under leadership of Chenery, acting as Vice President, Development Policy, World Bank, the world platform for development policy started shifting from the UN/CDP to the World Bank. In 1974 an important milestone in development economics was reached with the publication of Chenery *et al*. (1974). The title of their book was *Redistribution with Growth*, and their general theme was that distributional objectives should become an integral part of development strategy, should be expressed in terms of growth of income and consumption of different socio-economic groups, and be structurally related to their endowments. They surveyed existing multi-sector planning models and found them to be inadequate for formulating development strategies in those terms. They concluded that what is needed is a full circular flow model that provides a compact treatment of the determination of both the growth and distribution of income in different groups. They stressed also the importance of incorporating the dualistic nature of production and income generation in developing countries, that is, the formal and informal segments of economic activities; and the links between the segments and the socio-economic groups.

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Although these structural aspects were also incorporated in our preceding models in Chapters 2 and 3, what is particular for the redistribution with growth perspective is the focus on the trade-off between the two goals of growth and redistribution, and the recommendation for using a full circular flow modelling framework that highlights the linkages and interdependencies between different household groups, their factors of production, and the employment of these factors in economic activities. There is only one unified statistical framework that is capable of (a) collapsing the economy-wide circular flow in one compact shot, (b) is ideally flexible in linking production activities to production factors, income, and expenditure of various actors, (c) is generally accessible with available data, and (d) being squarely designed, and under simplified assumptions, it can be converted into an economy-wide model that covers various dimensions of development strategies. This is the social accounting matrix (SAM) first developed as an integrated system of national accounts by Stone, and brought into life again via a large number of applications and refinements carried by many contributors, including Pyatt, Thorbecke, Adelman, Robinson, Cohen, and many more.

A few SAM applications are selected for Chapter 5. After briefly treating the conversion of the matrix into a model, the first application reviews multiplier

results relating to the trade-off between growth and equality for ten developing countries. The second application decomposes the multipliers into various effects. The third application uses the SAM multipliers to identify gainers and losers. A fourth application highlights the significance of dual structures in production and earnings in producing interdependent patterns of growth and distribution.

Next are the models in Chapters 6, 7, and 8, which operate along the free markets perspective. They have in common a period that was dominated by a neoliberal outlook. In policy making, and in policy modelling, already from the late seventies onwards, there was a gradual shift from state planning proper to reliance on market mechanisms. The standpoint was that—with the exception of a few East Asian countries with high development performances—past government interventions in developing countries have caused incorrect prices, market distortions, limited growth, and regressive redistribution. The remedy sought was to let free-market forces determine the right prices. The free market perspective was strengthened further in the nineties by the collapse of the communist regimes and the rise of the Washington Consensus. Since about the year 2000, the neoliberal outlook has undergone modifications and refinements to accommodate liberalisation reforms to both market and state failures, and to include new areas of development policy such as transparent governance, environmental sustainability, and directed pro-poor economic growth. In terms of policy modelling, the CGE model fitted most with the free market perspective and its aftermath. Methodologically, it was natural that construction and use of the SAM preceded the extensive use of CGE models, since computationally some SAM is required as a benchmark for applying the CGE model. In substantive terms, the CGE model is a more helpful and flexible tool than the SAM model, as it is better able to calibrate price and quantity adjustments in factor and product markets, and thus placing the trade-off between growth and equality in a wider scope.

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Chapter 6 is primarily on transformation of the SAM into a CGE model. This early application, carried out for Indonesia, is of a demonstrative nature; and it is by far the first CGE for Indonesia. The chapter contains a static CGE model with a given supply of capital by sector and given total labour. The static model is modified and extended later towards a dynamic version of the CGE model, in which the supply of capital by sector and various skill types of labour are made endogenous.

Policy simulations pertaining to upward shifts in the efficiency parameter in the production functions of the industrial sector and of the services sector are then simulated in both the static and dynamic versions, and the results compared. These simulations are meant to highlight the operation of the CGE model under the contrasting assumptions of the static and dynamic versions, and to emphasise the importance of the particular specifications in generating differentiated outcomes. For example, the simulated productivity gains in the industrial sector, which can be initially interpreted as a positive development, would turn out to have detrimental effects for wage earners who would experience a fall in their remuneration rate now that less labour is required but labour supply is given in the static CGE model. The fall in their income reduces aggregate demand further and cuts into the prospects for economic growth. By contrast, the flexibility of

the demand and supply of factors in the dynamic version of the CGE model is able to push the results in other directions.

Chapter 7 contains a CGE model that examines the growth and distribution impacts of import liberalisation and structural reforms. Many developing economies have undergone trade liberalisation in the context of the structural adjustment programme of the IMF and the World Bank during the last couple of decades. Most empirical studies find that trade reforms are accompanied by productivity growth, technological advancement, falling mark-ups, and a reshuffling of resources towards more efficient firms. However, the review of the substantial empirical research does not lead to a robust conclusion on the distributional impact of trade liberalisation. Moreover, the combinations of complex but partial phenomena, choice of variables, countries and periods, and data inadequacies and approximations have rendered the empirical works highly heterogeneous and thus defying conclusive findings. The highly diversified results on reforms in so many countries acted as motivation for undertaking this research. The chapter formulates and applies a CGE model for Nepal, making use of the SAM and other Nepalese data.[10]

The model simulated and analysed several liberalisation and stabilisation reforms. Simulation results showed that the liberalisation reforms were growth-enhancing, but that the rich benefited more than the poor. The next stage of policy modelling was to expand and modify the static model to a dynamic model along the lines of the previous chapter, and envisage a restructured future economy that allows for growth with redistribution during a transformational period of ten years. The formulated structural changes were designed to turn the growth impact of the liberalisation reforms into a pro-poor growth impact. The structural changes simulated included improvements in efficiency parameters, reorganisation of investment patterns along with reallocation of factors of production by both household group and activity type. The simulations of trade liberalisation and other reforms were then applied to the dynamic and restructured specification of the CGE model, and the pro-poor growth effects were evaluated. The analysis suggests that a better development performance is possible when some particular phasing of the various reform measures is followed. The timing of the policy reform combinations matters, thus.

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Chapter 8, with title 'Sustained development of land resources: a policy model for Sudan' contributes to policy modelling in the area of environmental economics.[11] There are four adverse interdependencies commonly acknowledged in agricultural activities. First, the inaccessibility of poor farmers to modern technical knowledge and information leads to misuse of natural resources. Second, farm-gate prices in most developing countries are far below their world market levels. This discourages farmers' incentives towards soil conservation and encourages soil depletion. Third, lack of well-defined private property rights over natural resources lead to overexploitation and degradation of these resources. Fourth, pressured by their poverty, poor farmers adopt short-term survival strategies, and overuse land resources, thus giving environmental protection a low priority. The model, which shares common features with CGE models, incorporates these four interdependencies.

The model is used to address two sets of questions. First, what are the future prospects of a green gross domestic product, and is there a need in the medium and long terms for a genuine concern over resource degradation, or not? Second, which combinations of policies are most effective in their contribution to a sustainable and balanced development in terms of growth and distribution? The alternative policies treated relate to human capital, price incentives, property rights, and poverty reduction. In the African context, the results suggest that while the prospects of environment friendly economic development—a rising green GDP—are weak in the medium run, under certain structural conditions there is a range of effective policies that resolve conflicts between economic growth, fair distribution, and resource degradation; thus they contribute to a rising green GDP along with poverty reduction.

3.2 Transiting economy context

Transition economics started coming into being around 1990. The regime crises in the Soviet Union and its European allies, and the breakup of the Soviet Union, opened the door for a new area of applied economic policy. Understandably, the new leaders in these countries looked westwards to the European Union and the United States for a helping hand to restructure their polity and economy. In practical terms, rightly or wrongly, there was only one alternative economic-political system available for adoption. This is the market-based economic system prevalent in the United States and the European Union.[12] Western countries responded enthusiastically, displayed their systems of national institutions for adoption, and mobilised technical assistance towards that end. International agencies such as the IMF, the World Bank, other UN agencies, and the European Union mobilised their resources and gave advice and aid in transmitting these countries from state economies to market economies. Subsequently, from 1990 onwards, there was a surge in demand for economists who were willing and able to contribute towards the economic transition. This new demand for transition economists was especially attractive for economists working on developing countries, who were experiencing, already since the eighties, the negative effects of the fading out of the golden times of development economics.[13] Many academic economists and economic policy advisors working on developing economies joined the caravan of transition economies.[14] The modelling studies included in Chapters 9, 10, and 15 represent some of the activities undertaken on transition economics in the period 1990–2000.

Chapter 9 reports on multiplier analysis of comparable SAMs for Russia and China. The benchmark is around 1990, which constitutes a crucial year in their transition to more mixed market-state economies. Russia's GDP grew between 1979 and 1989 by 43.2 per cent and then decreased between 1989 and 1997 by about 60 per cent. China's GDP has been increasing at an annual average rate of 9.5 per cent since 1979, giving a total increase between 1979 and 1997 of more than four times. The relative sizes of the two economies have reversed position in historically unmatched terms during less than two decades. Contrasting performances in growth and distribution between these two major countries have been

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persistent for a long period since the 1960s, suggesting that the differences in the structures and mechanisms behind these performance trends are enduring, and can be subjected fruitfully to a static comparative systemic analysis along the lines of the SAM framework.

The model derived from the SAM simulates the multiplier effects of two types of policy instruments: (a) the effects of demand injections in sectors of activity on the output growth of activities, that is growth multipliers; and on the income distribution on household groups, that is income multipliers; and (b) the effects of income transfers to household groups on the output growth of activities and the income distribution on household groups. Growth multipliers in China are found to be higher than in Russia, reflecting more intensive and relatively equally spread circular flow interactions. Income multipliers are found to be less regressive in China than in Russia, which reflects stronger trickle-down effects and weaker leakage-up effects in the income and expenditure patterns of rich and poor household groups in China as compared to Russia.

Chapter 10 makes handy use of the characteristic differences between SAM and CGE models to highlight the systemic differences between a planning-oriented economic system that is driven by quantity adjustments, and a market-oriented economic system that is driven by price adjustments. The SAM and CGE models can be seen as the opposite poles between the central planning model and the free market model. The impact multipliers in a fixed-price SAM model assume unchanged relative prices so that all impacts go into quantity changes. In contrast, a free-market economy is commonly modelled as a CGE model. The rules for market clearance in a CGE model are different from those in a fixed-price SAM model. In the CGE model, producers maximise their profits and consumers maximise their utility in markets in which the demand for and supply of products and factors are cleared at flexible equilibrium prices. By switching from the SAM to the CGE model, the latter is able to replicate a free market situation with endogenous prices.

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The chapter simulates alternative policies of demand allocations on sectors, and income transfers on households. The simulations are applied to the fixed-price SAM model, that is, plan regime; and to the flexible-price CGE model to give alternative results that apply for the market regime. In this chapter, different results of the simulated alternative policies under the two models are analysed for Poland and Hungary, and for two different base periods.

3.3 Developed economy contexts

All models above were applied to developing and transiting economies. SAM and CGE models are equally suited to deal with policy analysis for developed economies; and this is the focus of Chapters 11 and 12. Chapter 11 demonstrates the ability of the SAM model to investigate various issues relevant for a developed economy, that is the Netherlands. The applications were implemented in the context of an EU research grant on comparing and integrating national accounts systems in European countries. Other countries for which SAMs were constructed and analysed were Germany, Italy, Spain, Hungary, and Poland. In

this context it was possible to construct for the Netherlands a ten-year series of SAMs starting from 1978 up to and including 1987. The series was supplemented later with SAMs for 1995 and 2000.

The chapter will study the SAM multipliers for an initial year, examine how they change over later years, and identify segments that were gainers and losers over a period of ten years. Available data for the Netherlands allowed for breaking up the population by income deciles groups, and for the regionalisation of the SAM into four geographical areas (North, East, South, and West); and the decomposition of regional economic performance over more years. Another extension of the SAM treats changes in urbanisation patterns. SAM multiplier analysis applied to a developed economy for more years gives some support to the turnaround hypothesis that future growth is conditioned by a weakening of (internal) multiplier effects and an increased dependence of the economy on (external) exogenous variables, that is, spending and transfers by government and rest of the world. This hypothesis gains validity under alternative extensions of the SAM, and for different periods.

Chapter 12 treats a few aspects of modelling fiscal policy in a CGE model in the context of the Netherlands. Successful application of fiscal policy in times of economic crises and low growth is a very challenging job, and the number of countries renowned for a successful management of the fiscal budget is limited, the Netherlands being one of them. The CGE model in this chapter, built in the mid-eighties,[15] was meant to address the fiscal policy problems faced in 1980–3, when the budget deficit recorded its highest share in the GDP, at 6 per cent, and economic growth was stagnant at 0 per cent (or falling at –1 per cent). In deciding on inclusion of this model in the book, the central questions to be answered were whether fiscal policy modelling methods of the mid-eighties are of any value today, and whether the policy content of three decades ago has any relevance for today's discourses. With slight updating of the specifications of the model, and subsequent revisions in results, the answers were affirmative.

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The chapter formulates three forms of the CGE model and runs various fiscal policy simulations. The three CGE model forms are labelled basic, elaborate, and structuralist CGE models. In the basic form price elasticities of consumption, exports, and imports are set at zero, making the model less responsive to price changes. In the elaborate form, these elasticities are set at positive values. The structuralist CGE model specifies sticky wages, causing unemployment, and determining thus that the government paid unemployment benefits. Social security payments are also realistically modelled as sticky, in the sense that they are coupled to the consumer price index. Two revenue-reducing policy simulations with equivalent incidence on the government budget are considered: (a) reduction of indirect tax in the services sector, and (b) instituting a wage subsidy to lighten the wage bill that business firms pay. To allow for a fair appraisal, each simulation is set at 1 per cent of the government revenue. Depending on model mechanisms, the end result of the revenue reduction will differ and can be above or below the 1 per cent loss in government revenue. This end result can be one of the criteria in appraising policy effectiveness.

4 Partial models

The book contains six partial models that are treated in Chapters 13 to 18. Methodologically, each model follows a different approach. We introduce these chapters below.

Chapter 13 formulates a *normed planning model* (NPM), where the development norms (in this case, the parameters of human resource development in the long-term perspective) are derived from cross-country regressions on best-performing countries. These norms are then applied to Ethiopia with the object of formulating a roadmap for the development of their educational system. The work done has its origin in a request for technical assistance in 2007 by the United Nations Development Programme (UNDP) and the Ethiopian Ministry of Education (EMOE). The assignment was to assist Ethiopia with formulation of a roadmap for long-term development of its educational system along lines that could lift Ethiopia's rank among developing countries in the context of UNDP's Human Development Index. Drawing a roadmap for human resource development, HRD, and education for the coming 25 years for a vast country like Ethiopia cannot sensibly rely on such methods as manpower forecasts or educational returns and market signalling that are more valid for the short- or medium-term, and for well-circumscribed country outlooks and data. Furthermore, given the rapid paces of technological change and global competition, and the subsequent changing sector mix in the national economy, these methods may not be valid even for the medium term. A roadmap with a horizon of 25 years, starting from the base year of 2005, can only be drawn by making judgmental use of the past experience of selected countries that are known to have performed best in HRD, and whose realised structure of the education sector can be projected backwards so as to apply to Ethiopia. If the predicted paths of the select group of best-performing countries are followed along with associated institutions and policies, it is most likely that similar successful performances would occur in Ethiopia.

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The first task in the assignment was thus to list the select group of best-performing countries. The second task was to develop a model of HRD and educational development, and estimate it on the basis of data from the select group. The third task was to use the HRD and educational development patterns of the model to outline the Ethiopia roadmap. The fourth task was to plan an adjustment period in which the current situation (that is enrolments, teachers, schools, costs, and the breakup of their financing into government and private resources; each of these for the primary, secondary, and tertiary levels of education) becomes adapted to the long-term balanced path that is predicted by the roadmap.

Chapter 14 models the other end of human resources: utilisation. It formulates a forecasting model of labour imbalances in terms of demand and supply for occupational types and educational levels, and applies an *iterative fitting model* (known as the RAS algorithm or RAS method) to simulate labour market adjustments and clearance of the imbalances in the labour market.

Economic theory has focused more on market equilibrium than on market imbalances. Although underlying causes behind market imbalances are known,

there is relatively less knowledge and analysis on processes of balancing demand and supply in particular markets in the real world. Formulating the demand for manpower skills in terms of demanded occupational types, and formulating the supply of manpower skills in terms of supplied educational levels, there is no reason why a priori the expectations on the occupational demand side would match the expectations on the educational supply side. The RAS-type iteration applied allows these demands and supplies to meet, adjust to each other, and end up in the matched mix of occupational types against educational levels. The model is applied to Colombia, Korea, and Pakistan. A further check is carried out to investigate how far the labour market imbalances are reflected in corresponding gaps in labour earnings.

Chapter 15 presents a model that was developed and applied in the context of the privatisation drive in transiting economies. It models privatisation transactions along approaches of *cost benefit analysis* (CBA) as seen from buyers and sellers.[16] The buyer's price depends on the discounted present value of future sales, additional investment costs which have to be made, and desirability of meeting competitive returns on investment. The seller's price is based on government's calculations of gains and losses from the privatisation decision. Since the transaction may take place only if it satisfies both sides, buyer's offers are set against the seller's; the gaps between the two are evaluated for different sectors. The model includes a possibility of describing the process of negotiations by incorporating values of several exogenous parameters which can be managed by the buyer and the seller in order to satisfy both offers.

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The model is quantified and applied to several sectors of the Polish economy. Empirical results show how these sectors rank in attractiveness to buyer and seller. Simulations are applied also to vary values of several exogenous parameters that are managed by buyer and seller, with the objective of evaluating how these simulations would facilitate a takeover agreement between buyer and seller.

Chapter 16 models benefits and costs of alternative ways of resolving social queues, and uses a *random sampling model*, RSM, to investigate the economic effectiveness of the alternatives. The model is concerned with showing that the formulation of economic criteria and their application to facilitate resolving social queues can bring about higher social welfare levels than, and can be superior to, current practices of allocating the limited public service to the many demanders of the service. The model studies the efficiency and equity effects of discrimination in medical treatments requiring surgical operations. It tries to answer questions on whether a discriminatory approach based on earnings income would increase the capacity and productivity of the health care sector, and result in the shortening or elimination of social queues. The model makes use of the Quality Adjusted Life Years (QALY) approach, as an indication of the effectiveness of medical attention in terms of gained life years in good health after treatment. In this way medical authorities can be guided as to which activities to undertake within their budgetary resources that contribute most to a healthy community. The model introduces the income effects and links them to the QALY approach. Selection of patients to be treated is based on productivity, as represented by the prospective earnings income of the queuing patients. Random sampling

simulations (that is, the Monte Carlo method) show that patient selection based on maximising discounted lifetime earnings would release resources that can be used for treating more patients and thus reduce waiting time, and reduce the overall cost pressures. The results will show a convergence between efficiency and fairness goals.

Although the application is for the health sector in the Netherlands, the problem of social queues is not unique to health services, or developed countries. Social queues can be observed in specific types of education, subsidised housing, unemployment retraining, poverty alleviation, and for many public goods in predominantly centrally planned economies.

Chapters 17 and 18 are somewhat different to the rest. The model in Chapter 17 belongs to *descriptive analytical models* where a specific hypothesis is formulated to explain stylised facts. The hypothesis is then measured, analysed, and its policy implications studied. The hypothesis attempts to explain stylised facts on catching-up tendencies in economic growth between poor and rich countries. Taking all rich versus all poor countries together, various analyses of the statistical material have shown that there is a slight catching-up tendency. Economic theorising on these tendencies and empirical testing emphasised supply factors. We offer a demand-side model based on the SAM. We model the relationship between (a) growth multipliers, and (b) the exogenously assumed shares of government expenditure and foreign trade in the GDP. This is done for a selection of 16 rich and poor countries.

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The empirical results support the hypothesis of conditional convergence. The model predicts, after adjusting for peculiarities of economic systems, higher economic growth for countries at lower as compared to higher levels of income per capita, which is indicative of a convergent tendency. The main cause behind this convergent tendency is the ability of a poor country to increase significantly the shares in the economy of government expenditure and foreign demand; and to reap growth benefits from the associated changes in the compositional patterns of goods and services. In contrast, rich countries are, in relative terms, near satiation with respect to the shares of government and exports in the GDP. The conditional results are obtained after adjusting for system-country peculiarities. The chapter examines policy implications of this conditionality.

The models in Chapter 18 are best described as *conceptual analytical models*. Several hypotheses are formulated to approximate distinctive behavioural types in socio-economic systems. The hypotheses are conceptual and are not readily testable, but their empirical validity can be demonstrated from comparative data across countries that represent differing socio-economic systems. We formulate an analytical framework that considers the roles of changing distributions of agents on behavioural settings and of their interactive behaviour across settings. The framework emphasises the location and interaction of agents in distinct behavioural settings as the clue for understanding how agents, and the economic system they form, become aligned with a particular behavioural setting, take over the typical behavioural type that associates with that behavioural setting, and spread it to other settings via various channels.

These processes lead in the long run to the formation of distinct economic systems with distinct behaviours.

The focus is on three behavioural settings: household, firm, and state. These are primarily driven by social, economic, and political behavioural motives, respectively; and they result in three distinct systems, denoted by HIM, FIM, and SIM. The analytical framework models the evolution of the household intensive economic system (HIM), and its development into either the firm intensive economic system (FIM) or the state intensive economic system (SIM). The framework discusses a fourth economic system that has been named multipolar system (MPM). The empirical part of the chapter positions countries worldwide along the four types of economic systems, validates the positioning via various indicators, and carries the analysis further towards studying the future outlook of economic systems and global governance.

5 Concluding remarks

We started by stating that the field of policy modelling has flourished and mushroomed over the recent past to an extent that makes it increasingly difficult to oversee the whole and deduct the cores. Deduction is a vital task in the development and application of scientific inquiry. Once in a while there is a need for a consolidation round in which related models are bundled and studied in retrospect. This book is such a consolidation round for works of the same author on policy models in the last four decades.

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Taken together, these models reveal a particular approach towards policy modelling that has its origin in Tinbergen and Haavelmo, and has gained support from Lucas, Krugman, and many others. The approach perceives policy models as experimental designs: a kind of applied laboratory in which restructured designs and fitting policies can be demonstrated, tested, and recommended for decision making and for changing policy. The approach extends and perceives policy models as creative designs to resolve policy problems that are not easily solvable by conventional means. The approach sees a promising perspective in the incorporation of 'innovative architects' in policy models; with due respect to the benchmark status of the policy model as an econometrically tested 'matching device'. Of course, it is understood: an experimental design-oriented model must observe that it is scientifically principled, functionally useful, and operationally effective.

Some of the lessons and deductions gained from this consolidation venture are briefly summarised. First, the economy is subordinate to the socio-political regime that overrules it. Explicitly, or implicitly, specification of the socio-political regime is the primary closure rule in a policy model. In some contexts it is necessary to specify this primary closure explicitly. Chapter 3 contains models of agrarian reforms applied to India and Chile that highlight this crucial issue, demonstrate policy limits for subordinate agents, and detect policy opportunities as well.

Second, there is a wide range of secondary closure specifications available in policy modelling. We find that experimenting with alternative secondary closures and investigating their consequences is vital for gaining insight into

how results are generated, and using this insight for recommending policy. Alternative secondary closure specifications recur in most of the economy-wide models presented. This is related to analytical versus planning forms of the model (applied to Korea, Chapter 4), static versus the dynamic (Indonesia, Chapter 6), fixed foreign exchange rate and unknown foreign capital flow versus its opposites (Nepal, Chapter 7), changing versus stable relative prices (Sudan, Chapter 8), fixed versus flexible prices in planning and in market-oriented transitions (Poland and Hungary, Chapter 10), and alternative clearance of product market balances and the savings-investment balance in CGE models.

Third, although it is natural that specification of the model precedes its solution, experimental design in policy models demands a reverse process as well, whereby incorporating desired and removing undesired solutions would require respecification of the model. This may go beyond inserting changes in parameter values, and can involve restructuring of the model and its causal ordering. This is particularly demonstrated in the CGE model that combines liberalisation with redistribution (Nepal, Chapter 7), in the CGE model on constraining fiscal-policy imbalances (Netherlands, Chapter 12), and in modelling the resolution of social queues along economic criteria (Netherlands, Chapter 16).

Fourth, in some modelling contexts, a confrontational approach that shows the benefits and costs of opposite parties is most effective in understanding the conflict situation and resolving it. This is most apparent in the modelling of privatisation as viewed from buying bidder and selling government (Poland, Chapter 15); but is also apparent in the modelling of labour market imbalances among demanders and suppliers (Colombia, Korea, Pakistan, Chapter 14); and to varying extents when applied to social groups in Chapters 3 and 4.

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Fifth, a useful concept, such as the productivity effect of higher wellbeing, can be operationalised by designing it as an attainment index, whereby the effect matures as the observed attainment reaches its maximum. This is fruitfully used in the application to Korea. Attained sustainable productivity use and depletion of land resources is another concept that was designed accordingly (Sudan, Chapter 8). A related concept is that of the Index of Interactive Influence that is indicative of the relative dominance of interacting agents, groups, or countries (Chapter 18), though this index cannot attain its maximum for an agent.

Sixth, in some contexts, combination, linking or feedbacks of different types of models can be helpful in representing the complex realities. This is demonstrated by combining forecasting with iterative fitting models—RAS methods—in simulating labour market adjustments and checking the outcomes against an analysis of differential rates of return (Pakistan, Chapter 14). Other examples are: a cost benefit model and a random sampling model are fruitfully combined to investigate probabilities of social and economic gains (Netherlands, Chapter 16); the combination SAM and CGE models for investigating transition is another example (Poland and Hungary, Chapter 10); and alternative decompositions and designs of the SAM model generate important feedback results (Chapters 5, 9 and 11).

Seventh, the socio-political context, in which the economy functions, matters a lot; but autonomous economic forces matter too, in shaping structure, conduct,

and performance. The relative weights of the 'socio-political' and the 'economic' may change over time, and some believe in favouring the latter, with significant policy implications. For the time being, exploring models of distinct socio-political and economic systems, demonstrating their applicability, and investigating their implications, are some first contributed steps in connecting the otherwise separated disciplines (Chapter 18).

Eight, it was just stated that economic forces matter in shaping structure, conduct, and performance. The SAM, when standardised and applied to more countries, would reflect on advantages that some countries have above others, and on the underlying forces behind them. (This was done for ten countries in Chapter 5, and for China and Russia in Chapter 9.) Furthermore, the same modelled economic forces are able to explain convergence in economic growth between rich and poor countries (Chapter 17).

Ninth, since economic forces matter in determining performance, normed planning models (NPMs) for a particular sector, that are parameterised on the basis of the best-performing countries can be a helpful tool in drawing long-term roadmaps for that particular sector or development theme in a lagging country searching for the highest performance. (This is demonstrated in a HRD roadmap for Ethiopia, Chapter 13.)

Tenth, and finally, the time horizon in experimental-design policy models is longer than in the short-term policy models. The modeller has a lesser degree of freedom in the latter case, which obliges him to conceive the model as a matching device. Creative designs need more years to implement. The exact formulation of time units in the long term is less compelling in most of the presented models, which can be viewed as an advantage. If the trajectory is followed, the outcome will be realised a couple of periods earlier or later. (This is implicit in the NPM, Chapter 13, the long-term models of Chapters 3 and 8, and the SAM models applied to comparative statics of various countries, chapters 5, 9, and 17.)

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A final note is in place before concluding. The renewal and adaptation of earlier research applications to the stated focus required, for many applications, the rewriting of the respective chapters, throwing out some details, extending on others, and rerunning some simulations. In their original forms, the applications reflected the changing modes of notations over the years. Besides, as some of the models were jointly developed with collaborators, the notations used for basically the same intended variables, coefficients, and indices tended to vary between the models. To facilitate uniformity in the notations used throughout the book, an attempt was made to harmonise the specification of equations, and to use throughout the same notations for variables that are more or less similarly defined.[17]

Notes

1 Introduction

1 The division of models into these two categories may have its origin in the distinct orientations of Marshall and Quesnay.
2 Krugman (1993) and Sugden (2002), among others.
3 In this context, mention can be made of a recent study by Estrada (2011) that aimed at developing an analytical tool called the 'Policy Modelling Consistency (PMC) Index' for the purpose of evaluating policy modelling. The evaluation involves checks on the use of input-output tables, and classification of variables, and identification of parameters, among others. Estrada suggests that various possible effects of economic policies can be shown using multidimensional graphical means.
4 See, for instance, Tinbergen (1962).
5 In the weekly common room lunches of Tinbergen with his teammates—these took place in Rotterdam on Thursdays—one could notice the concerns and doubts of Tinbergen at the time. He admitted that the development effort in the Indian subcontinent is obstructed by the feudal system, and that the topic of agrarian reform is neglected by development economists. He emphasised the need and urgency for policy studies on the institution of lump-sum land taxes and crop-purchase schemes by the state.
6 I was approached a year later by Tinbergen on whether I could undertake the funded research on agrarian reform. The research took more time to finish than was originally planned, due to obligations in teaching and other studies.
7 Cohen (1978); Cohen (1977); Cohen (1981).
8 The model, which formed the subject of my dissertation, bears the influences of a two-year period of employment at the United Nations Research Institute on Social Development (UNRISD), subsequent employment at the Netherlands School of Economics, and of Jan Tinbergen as teacher and supervisor, and later as my colleague. The model was first published as an article in Cohen (1972). The dissertation was published later in Cohen (1975).
9 Was there any policy interest in the modelling application from the side of Korean authorities? It is interesting to recall the following. In 1975 the Korean Minister of Finance and Development, on his way to a WB/IMF meeting in Washington, made a stopover in The Hague for a lunch meeting to discuss the study with me and with Jan Tinbergen. It was a Sunday. Tinbergen opted for a soup, excusing himself that it was Sunday and that Mrs Tinbergen had already prepared the evening meal; and I followed his choice. For at least one hour I explained how the model was applied to Korea and emphasised the positive results obtained for both growth and redistribution; while watching the minister's handling of a full three-course lunch. After finishing his meal, he gave his opinion at the end, saying that the Korean government knew all the way through that Korea has no problem combining growth with redistribution, and that he was glad to hear that the Dutch government believes that too!

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The minister apart, there was much more academic interest in the book coming from the Korea Development Institute, and Seoul National University, where a couple of related articles appeared in their economic journals.

10 This work, done in collaboration with Sanjaya Acharya, constituted his PhD. I am grateful for the cooperation and contribution. I have implemented some modifications. Any error or omission in the process is mine.

11 This work, done in collaboration with Eisa Abdel Galil, constituted his PhD. I am grateful for the cooperation and contribution. I have implemented some modifications. Any error or omission in the process is mine.

12 In that sense, the former Soviet Union and allied countries are rightly described as transiting economies (rather than transition economies): transiting from a state-planned economic system to a market-based economic system.

13 The achievements of development economics and development policy were heavily criticised by Hirschman (1981), among others.

14 Work of the author on centrally planned economies and transiting economies dates back from collaboration with Janos Kornai in the early eighties. Major involvement started in the nineties with EU support for the construction of SAMs for East European countries, and was bolstered by giving leadership to several projects funded by EU/TACIS that aimed at introducing economics teaching and research at the Russian Higher School of Economics.

15 The application was done in collaboration with Rini Braber. I am grateful for the cooperation and for his contribution, without which this chapter was not possible. I have implemented some modifications in the model and rerun a few computations. Any error or omission in the process is mine.

16 The study is the result of collaboration with Adam Czysewski. I am grateful for the cooperation and his contribution. The presentation of the model has undergone important changes since then.

17 Some examples of the common uses that the book follows are summarised here. Indexes are expressed in small letters: j = sectors of production, c = commodities, h = household groups, q = skill types, among others. Variables expressed in values that belong to national accounts statistics and that often occur in economy-wide models will be denoted by one capital letter: for example, X for gross production (output), V for value added, Y for income, C for consumption, I for investment, E for exports, and M for imports, and so on. Capital letters P and Q will be reserved for price and quantity, and will be attached to the above variables where applicable. For instance, XP_j is the price index of output in sector j. There are other variables with notations of three letters that signal the meaning of the variables: for example, *FXR* is foreign exchange rate, *FCF* is foreign capital flow. Furthermore, it is noted that throughout the book t is the index used to denote year t.

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2 Some essentials in economy-wide policy models

1 The CES production function, Arrow *et al*. (1961), exhibits constant elasticity of substitution between the factors of production in terms of their factor proportions. Other production functions mostly used are special cases of the CES production function. Where the substitution elasticity approaches 1, we have the Cobb-Douglas function; where it approaches 0, we have the Leontief (perfect complements) function. The Harrod-Domar production function falls into the same category as the Leontief function. Most of the economy-wide models in this book use a combination of Cobb-Douglas and Leontief production functions, while in Chapter 12 the CES and Leontief production functions are jointly used. It goes without saying, that where justifiable, the production functions of different sectors may be specified differently.

2 Installed investment is fixed investment. However, the word 'fixed' may bring misunderstandings as we use the same word in the sense of fixing an exogenous value of the variable. To avoid such overlapping we shall refer to fixed investment as installed investment or simply investment.