Facing the Development Challenge in Mozambique

An Economywide Perspective

Finn Tarp
Channing Arndt
Henning Tarp Jensen
Sherman Robinson
Rasmus Heltberg

RESEARCH REPORT 126

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
WASHINGTON, D.C.

Printed in the United States of America

International Food Policy Research Institute
2033 K Street, NW
Washington, DC, 20006–1002 U.S.A.
Telephone +1-202-862-5600
www.ifpri.org

Library of Congress Cataloging-in-Publication Data

Facing the development challenge in Mozambique : an economywide
perspective / Finn Tarp ... [et al.].
p. cm.—(Research report / International Food Policy Research Institute; 126)
ISBN 0–89629–131–6 (alk. paper)
1. Structural adjustment (Economic policy)—Mozambique–
2. Mozambique—Economic conditions—1975– 3. Mozambique—
Social conditions—1975– 4. Agriculture—Economic aspects—Mozambique.
5. Poverty—Mozambique. I. Tarp, Finn, 1951– II. Research report
(International Food Policy Research Institute); 126
HC890.F3 2002
338.9679—dc21

2002155321

Contents

Tables

Figures

Foreword

Since early 1996, IFPRI's Trade and Macroeconomics Division has been working with country-based and international collaborators on a multiyear research project entitled *Macroeconomic Reforms and Regional Integration in Southern Africa* (MERRISA), with funding from Danida and German Agency for Technical Cooperation. The project comprised two interlinked components: a set of six in-depth country studies on Malawi, Mozambique, South Africa, Tanzania, Zambia, and Zimbabwe, and a study of regional integration possibilities and the impact of global trade reform on the study's subject countries.

MERRISA's central hypothesis was that agricultural growth and transformation are crucial in generating sustainable and equitable growth in southern African economies. But the key question was why various reform programs had failed to generate stronger responses by African agricultural sectors—especially smallholder sectors. MERRISA was specifically designed to examine a variety of macroeconomic and trade policy reform packages for their ability to enhance agricultural performance and contribute to economic growth and poverty reduction.

This volume comprehensively reports the results of the country study on Mozambique. It represents ongoing collaboration between IFPRI's Trade and Macroeconomics Division and a research group based at the Development Economics Research Group (DERG) within the University of Copenhagen's Institute of Economics. Close links were also established with Mozambican researchers at the Research Office of the Ministry of Planning and Finance in Maputo, and, in the later stages of the project, with Purdue University.

In line with the methodology and organization of country studies under MERRISA, this report incorporates both historical analysis and formal modeling. Historical records provide invaluable information on past policies and actual country performance. Historical analysis cannot, however, establish the strength of causal relationships between policy instruments and outcomes. The modeling approaches used in this study, including computable general equilibrium (CGE) modeling, enable the specification of important multisectoral linkages that operate simultaneously and interactively within the national economy. The models also incorporate special structural features that reflect southern African characteristics, such as home consumption and high transportation and transaction costs on staples like cassava and maize.

Underpinning the modeling is an economywide database, a social accounting matrix (SAM), that emphasizes the agricultural sector and different household groups. The SAM integrates national income, input-output, flow-of-funds, and foreign trade statistics into a comprehensive and consistent data set, thereby illustrating that, even in "data-poor" contexts, much can be done in terms of quantitative economic analysis. To facilitate the estimation of a consistent SAM, IFPRI developed a new estimation approach during the 1990s that allows the incorporation of errors in variables, inequality constraints, and prior knowledge about any

part of the SAM. This entropy methodology—further developed in this study—deserves attention because it provides an efficient approach of incorporating data from scattered sources into a consistent framework.

The more wide-ranging benefit of MERRISA's Mozambique country study is its broad perspective on the economywide effects of agricultural growth and its contribution to the understanding of potential macroeconomic policies in achieving more rapid, equitable, and sustainable growth in Mozambique and the surrounding region. The report confirms the importance of the agricultural sector in any satisfactory development process in Mozambique. Agricultural development is key to achieving the twin goals of growth and improved income distribution. The report also demonstrates that the successful implementation of such a strategy relies heavily on both appropriate government action and active donor support.

The authors outline what can be gained by making better use of available knowledge, tools, and data systems in one of the poorest countries in the world. Importantly, while the analyses in this volume are specific to Mozambique, the analytical approach is applicable to a series of countries both within and outside Africa. As such, this report's research results and policy conclusions should prove relevant and useful to the policymaking process in Mozambique and elsewhere.

Joachim von Braun
Director General

Acknowledgments

This report presents findings from the Mozambique country component of the project *Macroeconomic Reforms and Regional Integration in Southern Africa* (MERRISA). The work is a joint output of a multiyear collaborative research effort involving researchers in IFPRI's Trade and Macroeconomics Division and research institutions in Denmark, the United States, and Mozambique. We are deeply grateful to IFPRI's former director general, Per Pinstrup-Andersen, who was not only instrumental in establishing the project but also provided inspiration, foresight, and continued support during all stages of our work.

This study would not have been possible without the unfailing backing and collaboration of a large group of friends and colleagues. In Mozambique, we relied on support from Dr. Mario F. da Graça Machungo, who—as former Prime Minister of Mozambique and chairman of a leading commercial bank—was an obvious choice as member of the MERRISA advisory board. We are honored he accepted our invitation to serve in this capacity; his presence did much to help achieve our overall aim of producing a policy-relevant study of the academic standard necessary for an IFPRI research report.

Also in Mozambique, we collaborated closely with the *Gabinete de Estudos* (GE) of the Ministry of Planning and Finance, including in particular its director Pedro Couto and his assistant Antonio Sousa Cruz. Their effective advice, help, and friendship provided an indispensable foundation for our work. It is our hope that they have benefited in some measure from our joint efforts in their challenging duties in an important policy think tank of the Government of Mozambique. At the end of the day this will be the ultimate test of whether we have reached our overall goal and increased capacity building in one of the poorest countries of the world. Among other staff with whom we have interacted we would like to mention Tim Buehrer, Bruce Bolnick, Per-Åke Andersson, and Antonio Franco, who all formed part of the Harvard Institute of International Development support team within the GE.

Given our work depended greatly on national accounts data, we sincerely thank Mr. Saide Dade, director of the National Institute of Statistics, as well as João Loureiro, Orlando Comé, Antonio Lazo, Walter Cavero, Argentina Macisse, and Magda Ascues, who did a magnificent job helping us on many occasions by explaining the ins and outs of Mozambican data. Particular thanks are also due to Dr. Admir Bay, then managing director of SEMOC; José Carlos Trinidade, director, AMODER; and Trine Næraa-Nicolajsen, who served as Mozambique country consultants to the MERRISA project and provided welcome inputs and insights.

Among many others who have contributed in their capacity as Mozambican government staff and advisers or as academic researchers, we would like to mention Adriano Maleiane, João Z. Carillho Louisa Diogo, Maria Eugenia Pires, Youlanda Fortes, José Sulemane, Vitoria Ginja, Ken Simler, Gabriel Labão Dava, Ian McDonald, Margaret McCuen, Jan Low, Eduardo Oliveiras, Domingos F. Diogo, Rui Ribeiro, Fernando Songane, Fernanda Cabanas, Ar-

lito Cuco, Eduardo João, Alejandro Antonio Olivares, David Tschirley, Ana Paula Santos, Selma L. Sawaya, Jørgen Strange Hansen, Antonio Olivares, Angelo E. Mondlane, José Loureiro, Artur Gobe, Alberto Bila, Rodrigues Pereira, Clara de Sousa, Carla Honwana, and Bart Pijnenburg.

The international donor community in Mozambique is considerable. We benefited from many interactions with, for example, World Bank staff including Peter Moll, Jehan Arulpragasam, Maria Nieta Dengo, Daniel de Sousa, and others. From the European Union, John Rook was most helpful, and among USAID staff we would like to mention Richard Newberg, Julie Born, Luisa Capelao, Richard P. Harber, Tim Born, and Jim Jackson. Moreover, we would like to express our special thanks to Danida, not only for generous financial support but also for the many productive meetings with the two Danish Ambassadors in Mozambique during project implementation, Thomas Schjerbeck and Ole Blicher-Olsen. We are also grateful for help from their Danish staff, including Peter Juul Larsen, Preben Gondolf, and Esther Lønstrup, and the Mozambican staff at the Danish Embassy in Maputo, who made our many visits so much easier.

Finally, no research project can meet with success without administrative and secretarial support. We are grateful to Maria Cohan and Vibeke Kovsted for all their efforts and patient smiles during long working hours. The same goes for all the other staff in IFPRI's Trade and Macroeconomics Division, who contributed so effectively to this project.

The authors accept sole responsibility for the ideas expressed in this work and for any omissions or errors of fact or interpretation.

Summary

Following Mozambique's economic collapse in 1986, the country began a wide-ranging process of reform, with the support of the international community. The diagnosis was of an economy that failed to maintain monetary control, consumed beyond its means, focused production excessively on nontraded goods, and relied on inefficient and inflexible microeconomic structures. Nevertheless, Mozambique was also at war. The pace of stabilization and structural adjustment quickened after 1992, when, concurrent with the demise of apartheid, civil strife finally came to an end. After more than 10 years of adjustment, the reform program has now been essentially implemented. Yet, this does not imply, as shown in this study, that sufficient conditions for sustained economic development are in place. Mozambique remains very poor, and even under highly optimistic assumptions about the future, the development process is set to last for decades.

This report attempts to respond to some of the basic development challenges facing Mozambique and to provide both qualitative and quantitative insights for policymaking in the years to come. Throughout, the issues addressed are approached from an economywide perspective.

This study forms a part of the multicountry research initiative, *Macroeconomic Reforms and Regional Integration in Southern Africa.* This initiative covers six countries in the region and pays particular attention to the evaluation of the merits of alternative development strategies. The choice and design of an appropriate development strategy is by no means immediately evident for any developing country. However, for a country with abundant arable land and scarce human and physical capital, such as Mozambique, the role of agriculture in development is particularly interesting. In keeping with the focus on agriculture, a social accounting matrix (SAM) for 1995, with significant agricultural sector detail, was constructed as part of this study. The SAM contains 40 activities, including 13 agricultural and 2 food-processing activities, 3 factors of production, and 2 households (urban and rural). It captures two innovative but fundamental features of the Mozambican economy: high marketing costs for domestic, imported, and exported goods; and the significant prevalence of home consumption, particularly for rural households.

The report begins by putting the economic and social characteristics of Mozambique in regional perspective, tracing the historical path to economic collapse and providing a detailed analysis and assessment of the stabilization and structural adjustment program. The study shows that the program successfully stabilized inflation and markedly augmented reliance on market forces. Relative macroeconomic stability combined with the high and stable (reported) investment level give rise to optimism for the future. Indeed, economic growth has been relatively rapid since 1992. Still, recovery from a low point resulting from the war, drought, and prior economic mismanagement has been a major aspect of the turnaround. Underlying real

development constraints remain much the same and the more difficult development challenges lie ahead.

The 1995 SAM provides a picture of the structure of the economy. It is used to highlight the importance of agricultural development through a series of traditional SAM-based multiplier analyses. These analyses show that agriculture has large sectoral multiplier effects relative to nonagriculture and that applying scarce capital to agriculture is generally more effective than applying it to industry and services. The SAM also forms the basis for a static computable general-equilibrium (CGE) model with an unusually solid empirical foundation in terms of its model parameter values and structure, including a maximum entropy approach to parameter estimation for CGE models. This approach applies information theory to estimating parameters in a system of nonlinear simultaneous equations. The trade parameter estimates obtained point strongly to the need for development efforts to aid in the transformation of domestic output into export products. Moreover, the CGE model is capable of capturing many key aspects of the performance of the Mozambican economy in the postwar period.

The CGE model is used in a series of concrete analyses in which attention focuses on the impact and design of economic policy. The challenges addressed are: aid dependency, the price incentives facing the agriculture sector, agricultural technology and marketing margins, risk-reducing behavior and gender roles in agricultural production, and food aid distribution. A variety of insights emerge, including, for example, that priority should be given to simultaneous improvement in agricultural productivity, especially in small-scale farming, and in marketing infrastructure to reduce marketing costs. Another key example is that technological change in cassava appears to be a particularly strong lever for increasing female and overall household welfare. In general, the results in this report suggest a strong potential for agricultural-led development with attractive distributional implications, provided adequate policy measures are taken. The results also suggest that the negative effects of unavoidable natural calamities can be minimized if appropriate schemes for distributing food aid are put in place.

While the static CGE model developed in this study is capable of providing many policy-relevant insights, it cannot be relied on as a guide in budgetary planning within a medium-term framework. This task is important in Mozambique, which is saddled with considerable international debt. For this reason, a set of coherent macroeconomic medium-term scenarios for Mozambique was developed on the basis of standard World Bank and International Monetary Fund simulation tools. While widely used within these institutions, the projection models are less well-known elsewhere, and in Mozambique there is an evident gap in applying them so that both sides of the policy negotiation table are equally in command of analytical results and insights. For this reason, a merged version of these tools is laid out in some detail, and three different scenarios are elaborated on. The importance of debt relief and access to international capital markets in underpinning economic development in Mozambique stand out. Nevertheless, the merged-model framework does not provide critically important information on distributional issues and relative prices. For this reason, Chapter 13 presents a simple, but innovative, SAM methodology for integrating macroeconomic and CGE models. This framework is subsequently applied to integrate the merged and the static CGE model into a dynamic CGE model with an aggregated financial sector. This model amounts to a modern simulation tool that accounts for relative prices and income distribution. Given the growing availability of SAMs for a wide range of developing countries, it is argued that data requirements can in many cases be fulfilled in practice without major difficulty. Implementation of the proposed CGE model is therefore not only desirable but a feasible operational proposal for how to move

beyond the simple framework widely used by the World Bank and the International Monetary Fund.

Finally, this study aims to demonstrate that sophisticated analytical tools can be of significant value, even in "data-poor" situations. The need for a clear perspective and in-depth understanding of the socioeconomic complexities of the country in question stands out. However, while the analyses in this report are Mozambique specific, the basic analytical approach is replicable and could be brought to bear on other countries both within and outside Africa.

CHAPTER 1

Introduction

Few nations have endured the tumultuous changes that have characterized Mozambique in the past three decades. The combined legacies of colonialism, idealism, socialism, war fuelled by racism, economic collapse, and structural adjustment (inspired by stout liberalism) have made a lasting impact on the structure of the economy. In the early 1990s, Mozambique was frequently referred to as "the poorest country in the world." Reasonable economic growth performance since 1992 combined with economic disasters elsewhere has put an end to this unwanted distinction. Nevertheless, the country remains poor by almost any measure.

In economywide studies, such as this report, social accounting matrices (SAMs) and computable general-equilibrium (CGE) models have become important analytical workhorses. These basic frameworks have by now been applied fairly frequently in the African context. For example, Sahn, Dorosh, and Younger (1996) applied a SAM/CGE approach to investigate the impact of structural adjustment on poverty in a number of African countries. They concluded that, in most countries, adjustment policies have not hurt and may have helped the poor. These conclusions are widely contested. De Maio, Stewart, and van der Hoeven (1999) argue that the core result is a reflection of the assumptions made in developing the CGE models rather than of reality. Our study attempts to advance the state of the art in CGE modeling of African economies and, as such, implicitly addresses some (but certainly not all) of the criticisms advanced by de Maio, Stewart, and van der Hoeven.

The analyses conducted in this study run the gamut from the standard (such as descriptive analysis, SAM construction, and multiplier analysis); to the recent (such as estimation of SAM coefficients based on information theory, merged real and financial sector simulation modeling, and incorporation of risk in a CGE model; to the novel (such as explicit incorporation of home consumption in a SAM/CGE framework, examination of gender issues in a CGE model, development of a new method for estimation of critical model parameters, and the treatment of macroeconomics in dynamic CGE models). The research aims to demonstrate that sophisticated tools can be of significant value, even in data-poor situations.

A further word on data and methodologies is merited. Economic collapse and war were not kind to data-gathering systems in Mozambique. One might construe that this study should have been delayed until improved data systems had been established. We reject this conjecture. We do not believe that scattered and potentially inconsistent data sources necessarily imply simplistic analysis. Often, fundamental decisions must be made fairly early in a newly relaunched development process, such as the one ongoing in Mozambique, and those

This chapter was written by Channing Arndt and Finn Tarp.

decisions should be made using the best possible analysis. Also, advanced tools now exist to extract information from scattered or inconsistent data sources, and these tools were employed to develop a fairly detailed and consistent image of the economy. As new data emerge, they can be relatively easily incorporated into the analytical frameworks put forward here for updated economic analyses.

We take as a point of departure the need for moving on from stabilization and adjustment to focusing on transformation and development. As such, we try to respond to the signpost outlined in the work by Cornia and Helleiner (1994). They argue that it is time to call a formal end to the decade of "structural adjustment," agree that there are no economic "quick fixes" for Africa, and reactivate the development debate. This debate is, in their view and ours, nowhere near "the end of its history." Another signpost, the so-called Berg Report (World Bank 1982), is widely regarded as the seminal document in launching the era of structural adjustment. Despite its general focus, the Berg Report recognized up front that the policy changes recommended were basically short-run. Perhaps obscured by the considerable difficulties encountered in the implementation of structural adjustment programs throughout Africa, the same report also highlighted the critical importance of long-run investments and programs that must form part of a coherent development strategy. The report placed particular emphasis on agricultural research, infrastructure, and human resources—a view echoed in this study.

After more than 10 years of structural adjustment in Mozambique the program has, essentially, been implemented. However, more-or-less complete implementation of the structural adjustment program does not imply that sufficient conditions for sustained economic development are in place, and long-run strategy debate should now take center stage. For a country with abundant arable land and scarce human and physical capital such as Mozambique, the role of agriculture is of particular interest. This report pursues this approach with the working hypothesis that the agricultural sector is crucially important in any workable development strategy.

CHAPTER 2

Economic and Social Structure in Perspective

This chapter argues that, although Mozambique is currently among the world's least developed countries as judged by most economic and social indicators, the country has good prospects for sustained and broad-based growth.

Mozambique's excellent natural harbors along the Indian Ocean are among the best in Africa, and they make the country an important provider of transport and services in southern Africa. Moreover, population density (20 people per square kilometer) is quite low (Table 2.1).[1] The population census carried out in 1997 found a population of 15.3 million, compared with the 18.3 million projected from the previous census, which was taken in the 1970s. Severe food insecurity, disease, and migration caused by war and natural disasters (see Chapter 3) account for the difference.

Mozambique's role as a regional transport provider emerged during its colonial days (see Chapter 3 for more detail), and regional transport dominates physical infrastructure and the modern part of the economy. While Mozambique is relatively well connected to its neighbors, domestic transport of people and goods is costly and cumbersome. Road and rail networks have expanded east to west, linking the harbors of Maputo, Beira, and Nacala with the mining and industrial centers of South Africa, Zimbabwe, and Malawi. However, infrastructure for north–south domestic transport and trade is poor: rail links are completely lacking, and permanent roads minimal.

Estimates vary as to how much land in Mozambique is cultivable. The World Bank (1996) records that 46 percent of Mozambique's land area is cultivable, providing on average around 12 to 13 hectares to the country's 3 million farm families. Much of this land is not yet used. Mozambique has ample water resources from rainfall and river systems, especially in the central and northern areas of the country. Major river systems include the Zambezi, Save, and Limpopo rivers. These and other rivers hold the promise of developing intensive irrigated agriculture sometime in the future.

The agricultural sector consists of a large number of dispersed smallholders cultivating 95 percent of all farmland, with the remaining being cultivated by a limited number of large plantations. Food production is dominated by cassava, maize, groundnuts, cowpeas, sorghum, and millet, which account for some 80 percent of food energy intake at the national level. The main

---

This chapter was written by Rasmus Heltberg.

[1]Southern Africa is defined in this report as including Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe.

Table 2.1 Comparative overview

Socioeconomic indicator	Mozambique	Southern Africa	Sub-Saharan Africa	South Asia	Latin America	High income countries	Year
Population density (people per square kilometer)	20	33	24	256	23	29	1994
Population in cities with more than 1 million people (percentage of total population)	14	7	8	10	28	33	1995
GNP per capita, atlas method (U.S. dollars)	80	1,293	490	350	3,320	24,930	1995
Life expectancy at birth, total (years)	46.5	56.0	52.2	61.3	69.1	77.3	1995
Mortality rate, infant (per 1,000 live births)	126	82	n.a.	n.a.	n.a.	n.a.	1995
Mortality rate, under five years (per 1,000 live births)	190	126	n.a.	n.a.	n.a.	n.a.	1995
Safe water (percentage of population with access)	28	56	47	63	80	94	1995
Sanitation (percentage of population with access)	23	46	n.a.	29	68	92	Latest
Population growth	2.37	2.41	2.81	1.97	1.77	0.69	1990–95 mean
Health expenditure, public (percentage of GDP)	4.6	3.0	n.a.	n.a.	n.a.	n.a.	Latest
School enrollment, primary (percentage of gross)	60	108	72	98	110	103	Latest
Illiteracy rate, adult (percentage of people over 15 years)	60	32	n.a.	n.a.	n.a.	n.a.	Latest
Fertilizer use (100 grams per hectare of arable land)	22	311	135	803	647	1,169	1994

Source: Fan, Zhang, and Robinson 2001. They constructed GDPs for the four economic sectors based on various China State Statistical Bureau (SSB) publications.
Note: N.a. means not available.

export crops are cotton and cashews, grown by smallholders. In addition, seafood is a major export product.

Soils in Mozambique are of mixed quality. Prime agricultural land is in the northern and central parts as well as in river valleys throughout the country, where soils are fertile and water-retentive. The principal source of regional variation in cropping practices is rainfall, which declines in quantity and predictability from north to south. The northern and central provinces have relatively ample and reliable rainfall. The southern provinces tend to have sandy, infertile soils, except for river valleys and certain coastal plains; and rainfall is scarcer and more irregular. Much of the southern portion of Mozambique offers good pasture land free from tse-tse fly, but water scarcity can be a problem. Therefore, regular rainfall and fertile soils make for more intensive agriculture in the central and northern portions of the country, while extensive agricultural practices prevail in most of the dry south, which is subject to regular droughts and floods. Variation in rainfall determines the probability of crop failure and is therefore a major cause of food insecurity. In the north, households report one to two months of annual food insecurity whereas, in the south, five months of food insecurity every year is normal.

Mozambique has three main farming systems. The relatively extensive agropastoral practices in the southern areas resemble farming systems in Zimbabwe's dry lands. They are a response to frequent droughts. Cattle stocks were decimated by the war. On the dry lands, farmers operate a substantial number of different *machambas* (plots). In areas along rivers and close to the coast, where soils are good and moisture is plentiful, land is scarce and fallow periods short. The more intensive and diversified northern areas, where agroforestry is common, resembles southern Tanzania. Here, farmers practice strategies of long-fallow shifting cultivation of maize, sorghum, millet, cassava, and other crops. Cashews and cotton are the major cash crops and have

potential for expansion (World Bank 1996). The highlands in the center of the country share features with Malawi and Zimbabwe. Maize, beans, and cassava are the major food crops, and beans and potatoes the cash crops. In the dry season, farmers cultivate plots in valleys; and, in the rainy season, rainfed plots in the uplands are cultivated. In addition, a majority of urban families operate machambas and many towns are surrounded by green belts (MPF/EMU/IFPRI 1998).

The country has substantial potential energy, water, forest, mineral, and marine resources. Except for shrimp, all of these resources are either underexplored or entirely undeveloped. The Tete highlands hold 6 billion tons[2] of known coal reserves. At Panda, large fields of natural gas are now being developed. There might be oil as well. Foreign mining companies are prepared to invest in these resources. In addition, the massive hydroelectricity potential of the Zambezi, which flows 819 kilometers through the country, could make Mozambique a major source of electric power for the region. It is as yet untapped, except for the Cahora Bassa dam, built by the Portuguese and completed just before independence in 1974.

Despite more-or-less uncontrolled collection of fuel wood, Mozambique still has many hardwood forest reserves. Around 25 percent of Mozambique is thought to have capacity for producing hardwood, eucalyptus, and pine timber, and private investors are expressing interest in developing this resource. Mozambique has important reserves of high-quality iron ore and of the rare mineral tantalite, which is used in the electronics and steel industry. It also has some gold. Mozambique's pleasant climate, long beautiful beaches, and Indian Ocean islands—including the United Nations Educational, Scientific, and Cultural Organization (UNESCO) heritage site Mozambique Island—make it a potentially attractive holiday resort.

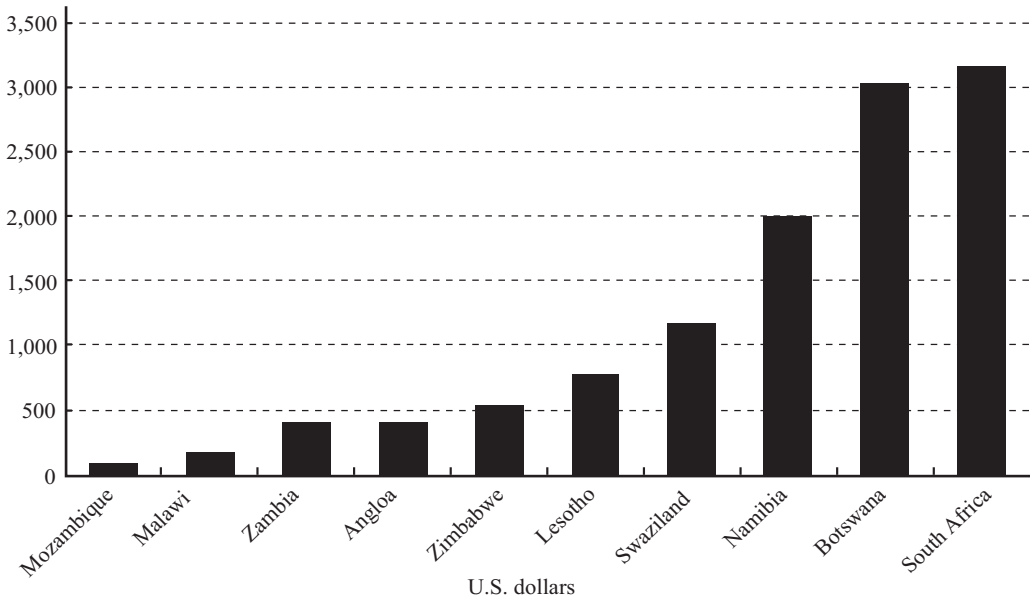
Economic and Social Overview

Throughout the first half of the 1990s, Mozambique had a lower recorded average income than any other country for which World Bank data is available.[3] According to the World Bank's World Development Indicators, Mozambique even held the record as the world's poorest country with a gross national product (GNP) per capita of US$80 in 1995 and 1996. According to the national accounts from the National Institute of Statistics (NIS), which are relied on in subsequent chapters, gross domestic product (GDP) per capita was US$121 and US$146 in 1995 and 1996, respectively. In the WDI tables, Ethiopia, Tanzania, and Zaire follow closely after Mozambique. The huge disparities in GNP per capita in southern Africa are evident (Figure 2.1). The GNP per capita (unweighted means) for southern Africa and for all of Sub-Saharan Africa is much higher, at US$1,293 and US$490, respectively. When income statistics are corrected for differences in purchasing power—GDP adjusted for "purchasing power parity" or PPP, an index used to reflect the purchasing power of currencies by comparing prices among a broader range of goods and services than conventional exchange rates—the differences in nominal income shrink, but Mozambique still remains the poorest country in the region.

[2]Throughout this report, "ton" refers to the metric ton.

[3]The main data source for this section is the World Development Indicators in World Bank (1997b, 1998). The advantage of the WDI data set is that it is comparable across countries and continents. The drawback is that the WDI national accounts figures quoted in this chapter are inconsistent with figures in later chapters. For these reasons, comparisons are made whenever appropriate and feasible.

Figure 2.1 Southern Africa's per capita gross national product, 1995



Source : World Bank 1997b and 1998.

During the 1990s, the economy has gone through a recovery process, analyzed in detail in Chapter 4. Despite a severe drought in 1991, real GDP growth over the period 1990–97 averaged 7 percent per year according to the WDI, and 5.1 percent according to NIS figures. The Mozambican growth rate is high by regional and Sub-Saharan African standards. Growth has been especially good in recent years—including 1997, where it reached 12.5 percent. Growth has been broad-based, with manufacturing, transport, energy, and services showing high levels of change. This has been accompanied by a fall in inflation, which reached a record low of 5.8 percent in 1997, as reported by the International Monetary Fund (IMF 1999).

Foreign aid is very important. According to the WDI, over the period 1990–96 Mozambique received, on average, foreign aid corresponding to 92 percent of GNP. If instead the NIS national account estimates are used, foreign aid was around 46.6 percent of GNP. In any case, Mozambique is one of the most aid-dependent countries in the world. In September 2001, Mozambique reached the completion point under the Heavily Indebted Poor Countries (HIPC) initiative and had its external debt stock reduced by around 75 percent.

In comparing the structure of production in Mozambique to the Sub-Saharan average (Table 2.2), the picture depends again on the data source. According to the WDI, agriculture contributes 32.8 percent of GDP and employs 83 percent of the population. According to NIS figures, agricultural value-added was 25.3 percent of GDP in 1996. As can be seen from Table 2.2, in the average Sub-Saharan African country only 19 percent of GDP comes from agriculture, with 68 percent of the population employed there. The share of industry value-added in GDP (for 1996) was 23.8 percent according to the WDI. According to NIS, it was 20.8 percent. This is below the Sub-Saharan Africa average of 27.2 percent. The service sector produced 39.3 percent of GDP according to WDI, and 51.2 percent according to NIS. This paints the picture of an economy where most of the population survives in subsistence agriculture, where the industrial and manufacturing sectors are lagging

Table 2.2 Structure of production and employment, 1996

Region/Country	Value-added (percentage of GDP)			Agricultural share of labor (percentage)
	Agriculture	Industry	Services	
Sub-Saharan Africa (average)	19.0	27.2	46.6	68.0
Mozambique				
World Development Indicators (WDI) estimate	32.8	23.8	39.3	83.0
National Institute of Statistics (NIS) estimate	25.3	20.8	51.2	n.a.

Source: Fan, Zhang, and Robinson 2001. They constructed GDPs for the four economic sectors based on various China State Statistical Bureau (SSB) publications.
Note: N.a. means not available.

behind, but still having important commercial activities relating to transport services both internally and with neighboring countries.

Social indicators give a gloomy image of human development in Mozambique, even before accounting for the Acquired Immune Deficiency Syndrome (AIDS) pandemic. Life expectancy at birth is low (46.5 years), even by African standards (Table 2.1). Infant and under-five mortality rates are high when compared with neighboring countries. Out of 1,000 children, 126 die before age one and 190 die before they reach the age of five—50 percent more than the average for the region. The proportion of population with access to safe water and sanitation is low, at 28 and 23, respectively, a key reason for poor health. Population is estimated to be growing at a rate of 2.4 percent per year, which is normal in the region but high when compared with any other continent.[4]

Mozambique has made gains in human development. This reflects the priority given by the *Frente de Libertação de Moçambique* (Frelimo) government to expand public health and education services. Public expenditures on health constitute 4.6 percent of GDP in Mozambique, a larger share than in any other southern African country (Table 2.1). Yet, in this kind of comparison, Mozambique's low level of income makes even modest health expenditures in absolute terms look large.

Statistics on education show that the great gains achieved in the immediate post-independence period from a massive education effort have been eroded because of the war, with primary school enrolment standing at 60 percent in 1995, down from 99 percent in 1980. This 1995 level is low compared with neighboring countries, many of which have primary school enrolment rates close to 100 percent, reflecting alphabetization programs that span adult populations. Secondary and tertiary education have shown small improvements in enrolment (up to 7 percent and 0.5 percent, respectively, from only 5 and 0.1 percent in 1980), but remain at very low levels. Not surprising, Mozambique achieves a very low score on the Human Development Index of the United Nations Development Programme—ninth from the bottom.

Structural Transformation

Certain regularities or standard features stand out in development processes. A key regularity is that, as countries grow, they experience sectoral shifts in the

[4]However, with a prevalence of Human Immunodeficiency Virus (HIV) of about 12 percent of the adult population, all human development indicators are set to decline dramatically. For example, NIS projects life expectancy to decline to 35 years by 2010.

composition of output and employment. In their pioneering work, Chenery and Syrquin (1975) studied this transformation process on the basis of cross-sections of countries. They worked with three stages of economic transformation: primary production, industrialization, and the developed economy. They described regularities of each stage—including shifts in the sectoral composition of income, employment, and trade—and analyzed the sources of growth. Chenery, Syrquin, and Robinson (1986) applied and expanded the framework to study a wide range of issues related to growth, structural change, trade patterns, and development strategy.

In this section, Chenery and Syrquin's regression analysis is repeated on a panel data set that is multicountry and up-to-date. The major difference from their work is the use of a different and more recent data set and the use of a GDP measure corrected for differences in purchasing power across countries. The results are used to illustrate where Mozambique stands in the transformation process by comparing the data for Mozambique with an average or standard pattern of transformation derived from the cross-country estimation. Mozambique is also compared with the nine other countries in southern African. The average cross-country pattern estimated from the panel data set is a useful benchmark for comparison. It captures the historical and cross-sectional experience of a large number of countries at different levels of development.

Panel data are cross-country and time-series data that are pooled. The strategy is to include observations on all the countries with available data for the period 1980–96 or a part of the period. The model to be estimated—with a range of endogenous variables describing the processes of resource accumulation, allocation, distribution, and demographic change—is identical to Chenery and Syrquin's model:

$$Z_{it} = \alpha + \beta_1 \ln(Y_{it}) + \beta_2(\ln[Y_{it}])^2 + \beta_3(\ln[N_{it}]) + \beta_4(\ln[N_{it}])^2 + \beta_5 T_1 + \beta_6 T_2 + u_i + \varepsilon_{it}$$

where the endogenous, Z, is expressed as a share (for example, investment share of GDP).

The explanatory variables are per capita income, Y, and population size, N. Subscript i denotes countries, and t, years. Per capita income is a measure of the stage of development of the country. Population size is a proxy for market size and scale economies, taking account of the fact that small and large countries develop differently. The variables T_1 and T_2 are time dummies for the first and second half of the 1980s, respectively. T_1 is equal to 1 for 1980–84 and to 0 in all other years, and T_2 is equal to 1 in 1985–89 and to 0 in other years. The reference period (no dummy defined) is 1990–96. The variable u_i is a country-specific error component estimated with random effects, and ε_{it} is a random error.

Analysis is carried out for the following endogenous variables, chosen among those used by Chenery and Syrquin (1975) and for which information is readily available for Mozambique: investment, saving, private consumption, government consumption, sector value-added (agriculture, industry and services), education expenditures, total imports, total exports, and service exports—all expressed as shares of GDP. In addition, analysis is performed on enrolment in primary school as a portion of the total population in the relevant age group, on the share of labor in agriculture and on the degree of urbanization.

The equation is estimated in quadratic logarithmic form to provide maximum flexibility, as well as to avoid heteroscedasticity. Using ratios on the left-hand side also helps to mitigate problems of heteroscedasticity. Chenery and Syrquin (1975) and Chenery, Syrquin, and Robinson (1986) distinguish among countries according to their size (large and small countries) and export orientation (manufacturers and primary exporters). This is not done here. Instead, focus is limited to one overarching regression (for each of the endogenous variables)

for the entire sample of countries. This is judged to be the best way to provide a simple yet powerful cross-country comparative overview.

Data are taken from World Bank (1998), in which data for 229 countries and territories are listed. After exclusion of missing data, around 150 countries remain with valid data. (The sample size and number of countries vary across equations.) The panel is unbalanced, since a number of countries have valid data for a subset of the sample period only. For income, GDP per capita in constant 1987 U.S. dollars corrected for differences in PPP is used. The advantage of using the PPP measure of national income is that it facilitates comparison across countries, by showing the real purchasing power of per capita GDP. In fact, Chenery and Syrquin had envisaged that use of PPP-adjusted GDP measures would be a means of improving their estimates once such a data series became available.

Table 2.3 lists the results. Generally, the equations fit the data well, and the included explanatory variables explain in a

Table 2.3 Chenery–Syrquin regression results

Dependent variable	Ln Y	$(\text{Ln Y})^2$	Ln N	$(\text{Ln N})^2$	T^1	T^2	Constant	Sample size	Standard deviation	
									e	u
Investment/GDP	39.62	-1.99	-4.6	0.20	1.45	-0.57	-147.78	2,194	5.08	8.45
	(10.0)	(9.1)	(3.6)	(3.4)	(4.8)	(2.0)	(3.1)			
Saving/GDP	29.27	-0.92	-2.56	0.15	2.36	0.80	-154.21	2,250	6.54	12.23
	(4.7)	(2.4)	(0.6)	(1.0)	(6.6)	(2.5)	(3.5)			
Imports/GDP	47.05	-2.97	-24.11	0.52	-3.02	-4.49	109.14	2,258	8.44	20.34
	(4.8)	(4.9)	(2.9)	(1.9)	(5.4)	(8.9)	(1.4)			
Exports/GDP	10.11	-0.20	-14.71	0.32	-2.84	-3.29	121.01	2,257	7.24	19.94
	(1.3)	(0.4)	(1.9)	(1.3)	(6.4)	(8.4)	(1.7)			
Agricultural value-added/GDP	-47.29	2.34	-0.94	0.03	0.30	1.26	251.84	2,053	3.55	8.13
	(15.8)	(12.6)	(0.3)	(0.3)	(1.8)	(8.7)	(9.2)			
Industry value-added/GDP	20.37	-0.65	12.11	-0.31	3.10	0.94	-201.48	1,992	4.28	9.77
	(4.9)	(2.5)	(3.1)	(2.5)	(13.3)	(4.6)	(5.7)			
Service value-added/GDP	26.03	-1.61	-12.88	0.34	-3.34	-2.25	63.51	1,991	4.88	11.34
	(5.5)	(5.5)	(3.1)	(2.5)	(12.7)	(9.7)	(1.7)			
Private consumption/GDP	-39.24	1.45	6.59	-0.23	2.62	1.00	241.13	2,219	6.22	13.56
	(6.9)	(4.1)	(1.4)	(1.5)	(8.2)	(3.5)	(5.4)			
Government consumption/GDP	9.09	-0.57	-4.12	0.08	0.03	0.13	25.64	2,280	3.44	5.48
	(2.9)	(2.9)	(1.7)	(1.1)	(0.2)	(0.8)	(1.1)			
Education spending/GDP	6.83	-0.40	2.33	-0.08	-0.04	-0.09	-40.97	624	0.91	1.75
	(5.2)	(4.9)	(2.8)	(3.0)	(0.4)	(1.1)	(4.9)			
Gross primary enrolment/ Population in relevant age group	64.06	-3.47	-25.4	0.82	-3.08	0.46	2.31	755	7.45	15.91
	(6.1)	(5.4)	(2.9)	(3.0)	(4.0)	(0.62)	(2.3)			
Birth rate	-7.33	0.54	20	-0.72	3.73	2.14	-83.22	1,384	1.92	15.17
	(3.7)	(4.4)	(7.6)	(8.5)	(30.7)	(19.4)	(3.8)			
Mortality rate	-9.29	0.52	5.77	-0.22	0.80	0.28	14.34	1,383	0.93	4.48
	(9.3)	(8.6)	(4.8)	(5.7)	(13.2)	(4.9)	(1.4)			
Agricultural labor share	-6.15	0.17	14.70	-0.66	-2.7	1.07	9.98	1,452	1.57	28.21
	(2.99)	(1.3)	(3.9)	(5.4)	(17.9)	(8.7)	(0.3)			
Urbanization	14.57	-0.72	18.4	-0.38	-3.77	-2.21	-212.86	2,441	2.32	25.68
	(7.09)	(5.68)	(5.8)	(3.6)	(26.1)	(19.6)	(8.4)			

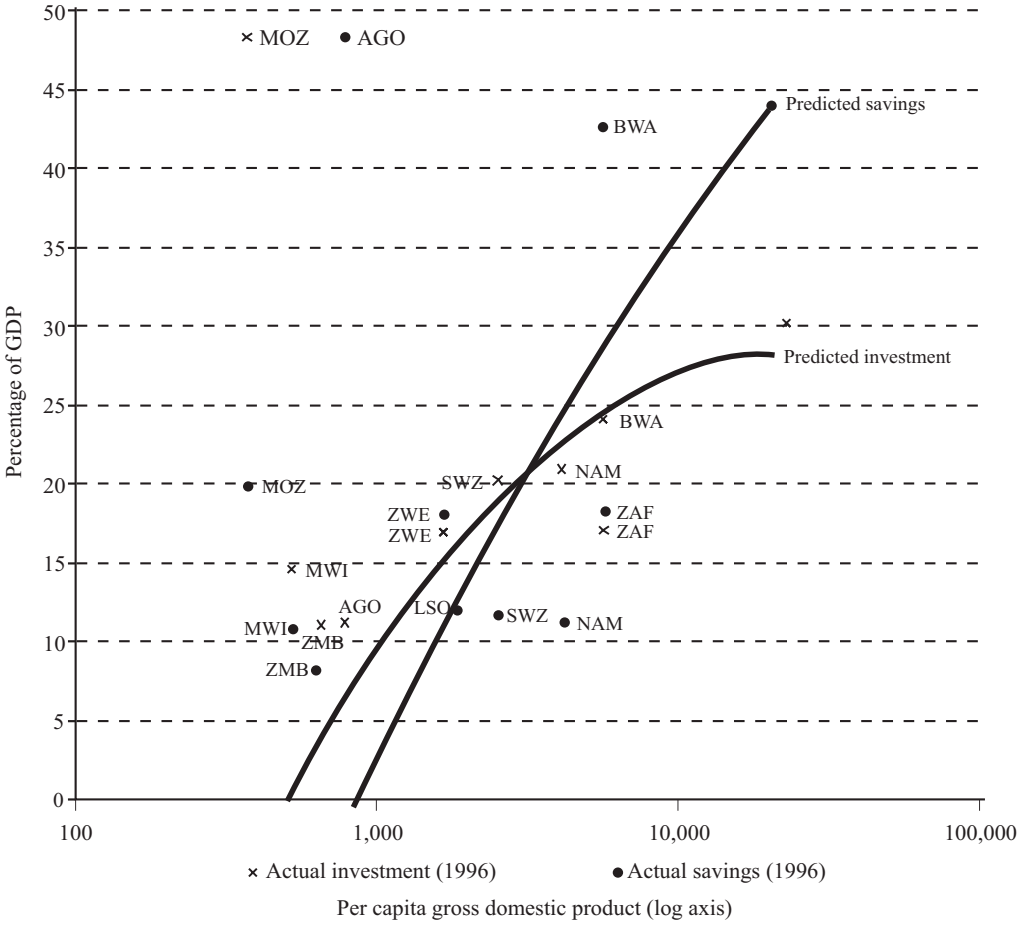
Sources: Authors' calculations based on the adjusted Chenery-Syrquin model and data from World Bank (1998).

Notes: Data indicate random effects estimation of equation 1; t–statistics are shown in parenthesis. ε is a random error term; u is the country-specific error component estimated with random effects.

statistically significant way a substantial part of the observed process of structural change. The R-squared statistic is not a good measure of fit in the random effects model. Instead, the estimated standard errors of u_i and e_{it} are reported.

The estimated functional relationships, normally referred to as Kuznets curves, were plotted (Figures 2.2 through 2.7). The lines in the figures show the regression functions from the random effect models. The data points show the latest available (normally 1996) actual value for 10 southern Africa countries. Note that the marked data points only represent a very small subset of the total data points used to generate the regressions. According to the WDI, Mozambique's PPP-adjusted GDP per capita for 1996 is US$414, the lowest in the region and third lowest worldwide. For ease of exposition and comparability, only the WDI national accounts figures are plotted

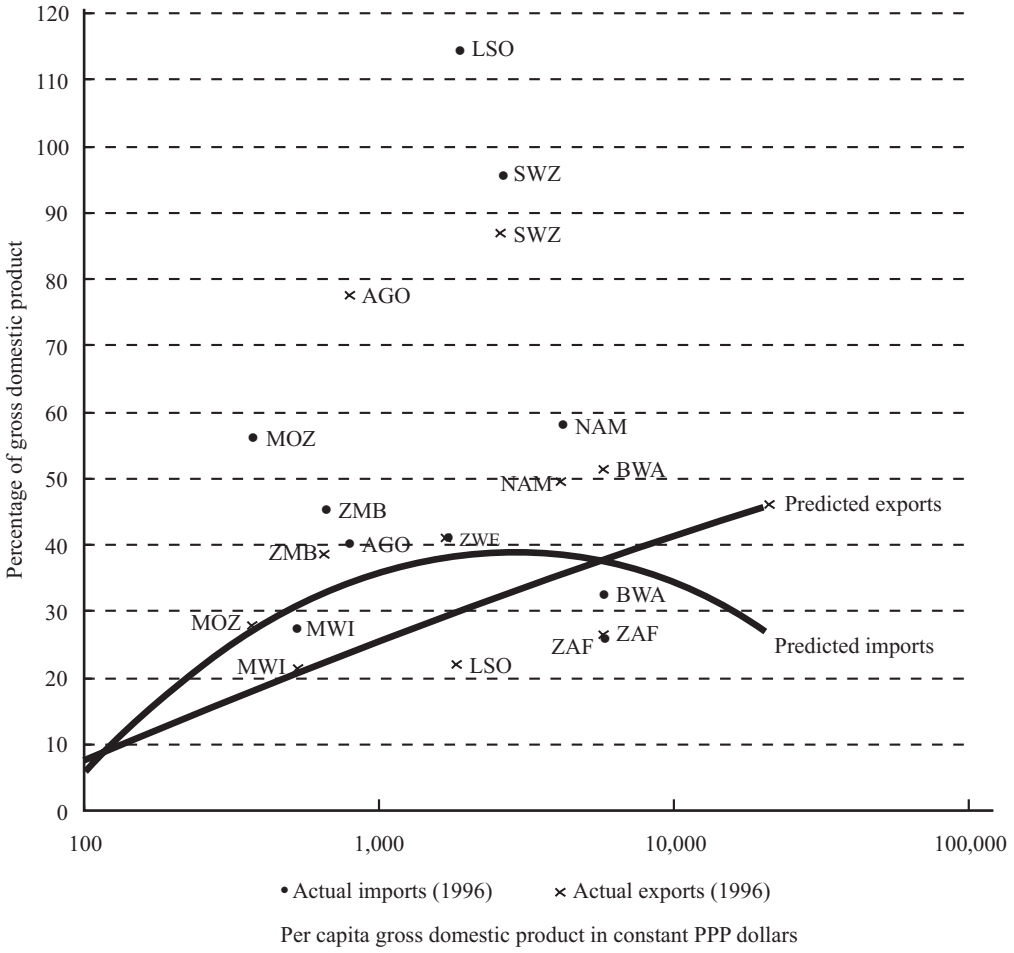
Figure 2.2 Investment and savings regression results



Sources: Authors' calculations based on the adjusted Chenery-Syrquin model and data from World Bank (1998).

Notes: MOZ means Mozambique; AGO means Angola; BWA means Botswana; SWZ means Swaziland; NAM means Namibia; LSO means Lesotho; MWI means Malawi; ZAF means South Africa; and ZMB means Zambia. PPP means purchasing power parity—an index used to reflect the purchasing power of currencies by comparing prices among a broader range of goods and services than conventional exchange rates. Mozambique appears with a PPP-corrected GDP value of 370 1987 U.S. dollars because fixed prices are used.

Figure 2.3 International trade regression results



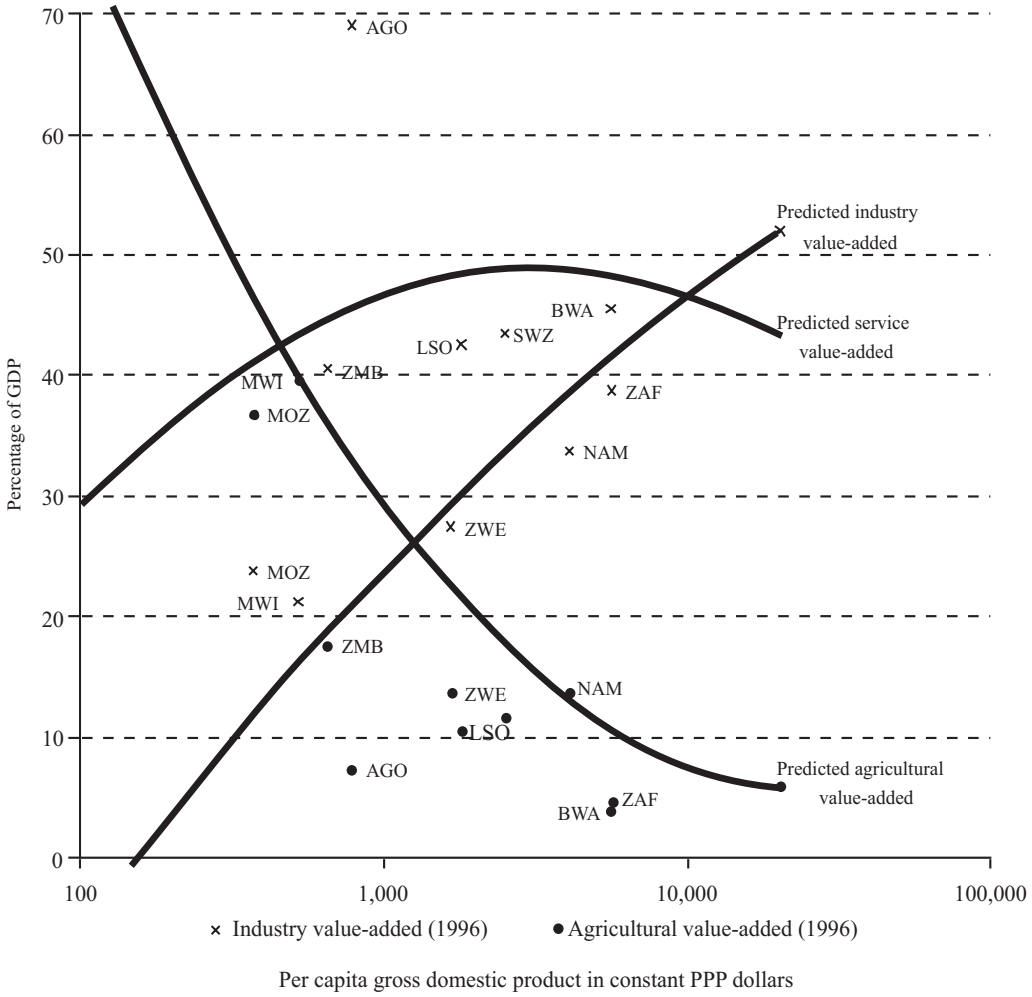
Sources: Authors' calculations based on the adjusted Chenery-Syrquin model and data from World Bank (1998).

Notes: MOZ means Mozambique; AGO means Angola; BWA means Botswana; SWZ means Swaziland; NAM means Namibia; LSO means Lesotho; MWI means Malawi; ZAF means South Africa; and ZMB means Zambia. PPP means purchasing power parity—an index used to reflect the purchasing power of currencies by comparing prices among a broader range of goods and services than conventional exchange rates. Mozambique appears with a PPP-corrected GDP value of 370 1987 U.S. dollars because fixed prices are used.

here (obviously the NIS national account estimates would yield a somewhat different picture).

The Kuznets curves are drawn for a country with a population of 15.3 million to provide comparability with Mozambique. Hence, the vertical distance between the data point for Mozambique and the regression line indicates the extent to which Mozambique is different from the expected or average, given its level of development and population size. Hence, the figures are useful for providing a comparative illustration of Mozambique's current development position both with respect to the "average" long-run transformation process and with respect to its neighbors in the region. For the other countries, caution is necessary when making vertical comparisons between actual country data points and the

Figure 2.4 Structure of production regression results



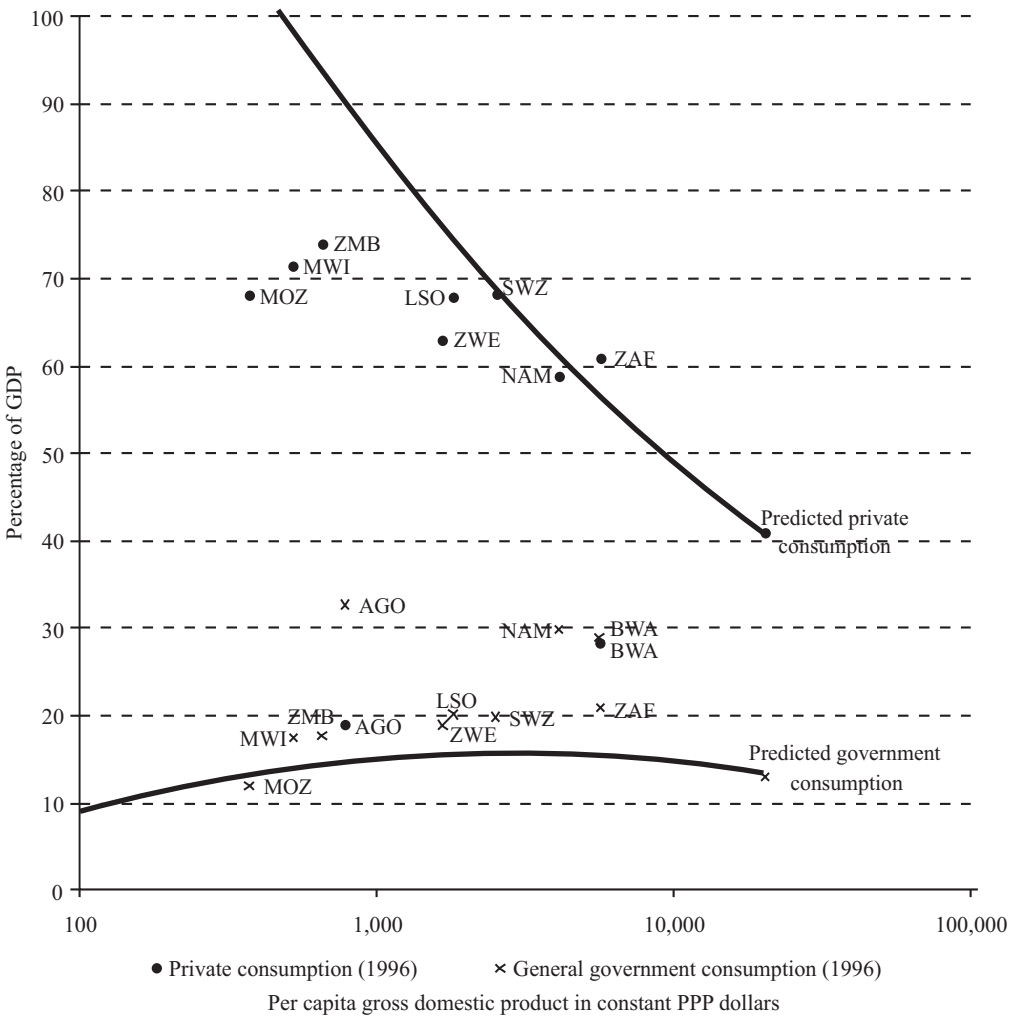
Sources: Authors' calculations based on the adjusted Chenery-Syrquin model and data from World Bank (1998).

Notes: MOZ means Mozambique; AGO means Angola; BWA means Botswana; SWZ means Swaziland; NAM means Namibia; LSO means Lesotho; MWI means Malawi; ZAF means South Africa; and ZMB means Zambia. PPP means purchasing power parity—an index used to reflect the purchasing power of currencies by comparing prices among a broader range of goods and services than conventional exchange rates.

regression lines, since the lines depend on population size and shift up or down according to the population of each country. The shift is largest for countries that are either substantially larger (South Africa) or smaller (Lesotho or Swaziland) than Mozambique. The effect of population size is most pronounced with respect to trade relationships, where the import and export propensities exhibit a strong tendency to decline with size of the country. Most other variables considered here are not very sensitive to population size.

In terms of accumulation of physical capital (Figure 2.2), the savings rate appears to be increasing almost linearly with income, while investment increases in a concave functional form. Countries with low and lower-middle incomes show a strong tendency to have a savings deficit, and

Figure 2.5 Allocation of income regression results



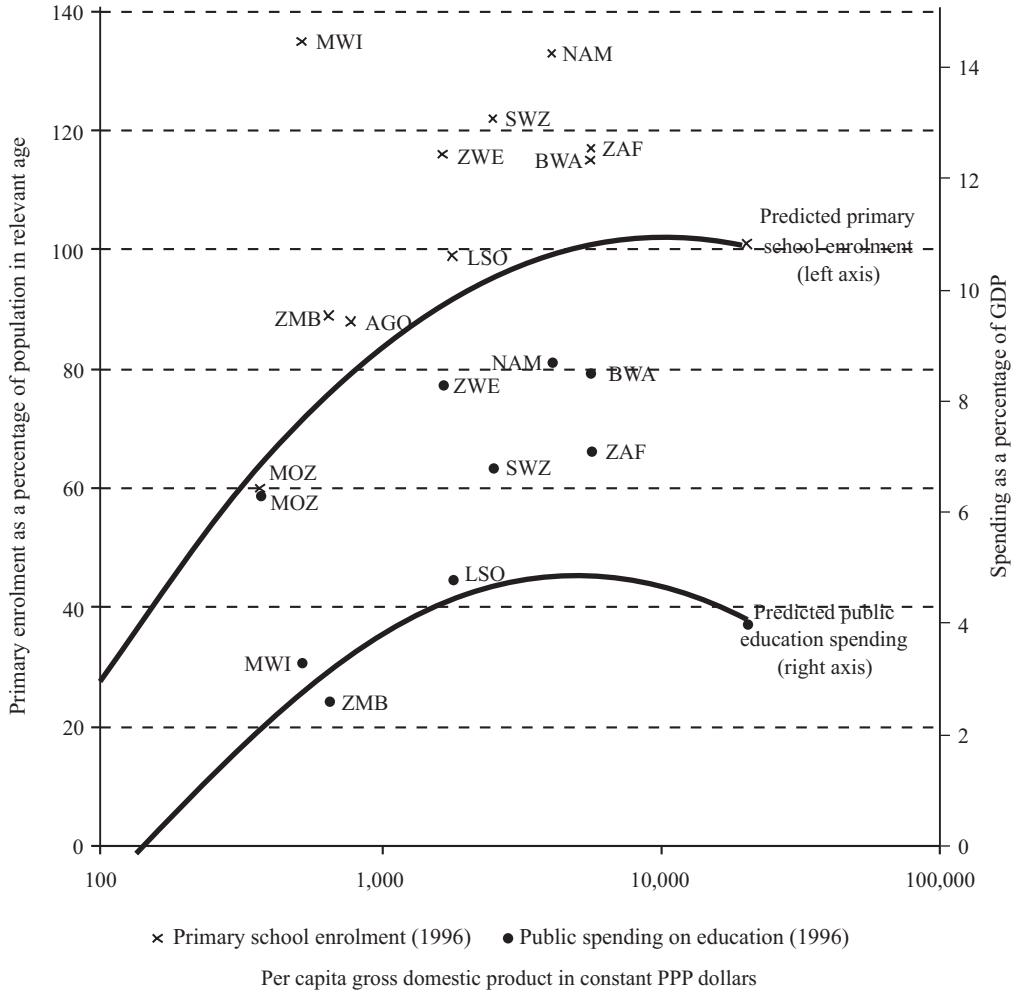
Sources: Authors' calculations based on the adjusted Chenery-Syrquin model and data from World Bank (1998).

Notes: MOZ means Mozambique; AGO means Angola; BWA means Botswana; SWZ means Swaziland; NAM means Namibia; LSO means Lesotho; MWI means Malawi; ZAF means South Africa; and ZMB means Zambia. PPP means purchasing power parity—an index used to reflect the purchasing power of currencies by comparing prices among a broader range of goods and services than conventional exchange rates. Mozambique appears with a PPP-corrected GDP value of 370 1987 U.S. dollars because fixed prices are used.

richer countries have a savings surplus. The actual investment ratios for the southern African countries for 1996 are plotted with a dot; and actual savings, with a cross. It can be seen that Mozambique, which invests 48 percent of its GDP according to WDI, has the largest investment ratio in the region, substantially above the average at its income level. With savings running at 20 percent of GDP, it is clear that this extraordinarily high level of investment is only possible because of aid inflows. Mozambique's large investment rate may in part be a result of aid donor reluctance to finance recurrent government expenditures.

The development pattern of trade (Figure 2.3) shows the import ratio to be first increasing in income and later decreasing,

Figure 2.6 Education regression results

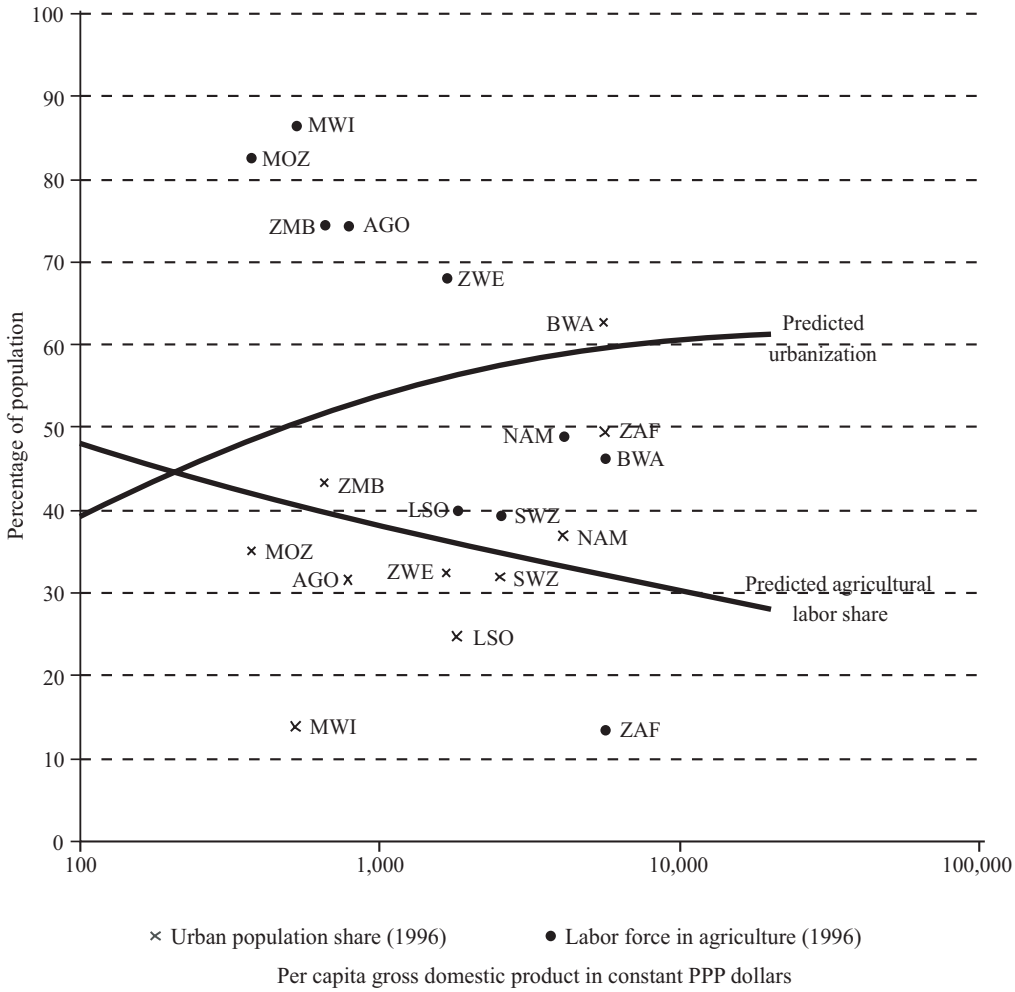


Sources: Authors' calculations based on the adjusted Chenery-Syrquin model and data from World Bank (1998).

Notes: MOZ means Mozambique; AGO means Angola; BWA means Botswana; SWZ means Swaziland; NAM means Namibia; LSO means Lesotho; MWI means Malawi; ZAF means South Africa; and ZMB means Zambia. PPP means purchasing power parity—an index used to reflect the purchasing power of currencies by comparing prices among a broader range of goods and services than conventional exchange rates. Mozambique appears with a PPP-corrected GDP value of 370 1987 U.S. dollars because fixed prices are used.

while the export ratio is increasing in income throughout the relevant range. The result of subtracting the two lines is a pattern of trade balance deficit at low levels of income and surplus at higher levels, which is consistent with the patterns of savings and investment (Figure 2.2). Trade and savings deficits at low levels of income are financed by capital imports, which are, on average, replaced by capital exports at higher levels of per capita GDP. Chenery and Syrquin (1975) reported the same in their data for 1950–70. Mozambique's large aid volume manifests itself as an export share that is somewhat higher than the average, coupled with an import share that is much higher than both its exports and the average import share.

Figure 2.7 Labor by sector: Urbanization and share of labor in agriculture regression results



Sources: Authors' calculations based on the adjusted Chenery-Syrquin model and data from World Bank (1998).

Notes: MOZ means Mozambique; AGO means Angola; BWA means Botswana; SWZ means Swaziland; NAM means Namibia; LSO means Lesotho; MWI means Malawi; ZAF means South Africa; and ZMB means Zambia. PPP means purchasing power parity—an index used to reflect the purchasing power of currencies by comparing prices among a broader range of goods and services than conventional exchange rates. Mozambique appears with a PPP-corrected GDP value of 370 1987 U.S. dollars because fixed prices are used.

Still, it is interesting that Mozambique's export performance appears relatively good when evaluated in a framework like this one. Mozambique exports a higher share of its production than Malawi, Lesotho, and South Africa. The size of the country matters a great deal for trade orientation. For example, the international trade (exports plus imports) of small Swaziland is very high—around 90 percent of its GDP. As already mentioned, for countries much larger or smaller than Mozambique the predicted

relationship is not well represented by the plotted regression line. For South Africa, with a population of 37.6 million, the predicted import share is 32 percent of GDP instead of the 37 percent implied by the plotted relationship based on Mozambique's population size.

In the plotted production structure (Figure 2.4), the Kuznets curves show a familiar pattern. The share of industry value-added strongly increases with income, the agriculture share of value-added decreases equally strongly, while the service sector share of value-added increases at a slower rate and tends to decline again at high levels of income. This pattern is remarkably similar to Chenery and Syrquin's (1975) findings. It appears that, although other aspects of economic structure and policy have changed since their study, the factors driving the sectoral structure of production remain fundamentally the same.

The share of Mozambique's value-added derived from agriculture is 37 percent (according to WDI). This is exceeded only by Malawi within the region, but still is less than expected for a country at its level of development and population. In contrast, and rather surprisingly, the share of industry value-added is actually higher than expected, at 24 percent, although this is low by regional standards, where only Malawi has a lower share of industry value-added. Within the region, Mozambique and Malawi stand out as rather similar, mainly agricultural, producers with relatively little industry. Mozambique's share of service value-added is 39 percent (not shown in Figure 2.4), slightly lower than predicted. This seems odd given the traditional role of Mozambique as a service provider. It may reflect the degraded state of service and tourist infrastructure, which was not yet fully rehabilitated in 1996, the year to which the data refer. However, the share of agricultural value-added was on a downward trend during the economic recovery of the 1990s. The service sector recovered faster than agriculture.

As to the allocation of income between private and government consumption (Figure 2.5), the average panel data pattern shows that government consumption tends to lie within a rising but fairly flat band—roughly between 10 and 20 percent of GDP. This is not very different from the level found by Chenery and Syrquin (1975) for 1950–70. Mozambique's share of government consumption, at 12 percent, is the lowest in its region and close to the expected. If in fact government recurrent spending is being financed by donors over the investment budget, this figure may well understate the actual rate of government consumption. Private consumption is decreasingly tied to income, which correlates to the increasing savings rate (Figure 2.2). Mozambique's rate of private consumption is similar to that of other countries in the region, although below the predicted value.

Another aspect of the accumulation process is education (Figure 2.6). The analysis of education is based on two data series: enrolment in primary school and education spending as a share of GDP. Differences in the quality of education unfortunately are not captured in this type of data. The average pattern is that countries spend an increasing share of their income on education up to a point, after which spending declines somewhat. Mozambique is spending considerably above the level predicted by its GDP, but the high levels of education spending do not as yet show up in the statistics on school enrolment for Mozambique. Not only is the proportion of Mozambican children attending school slightly lower than predicted based on income level (60 percent), it is also the lowest in the region. The poor state of rural infrastructure and the destruction of schools during the war may account for the apparent paradox of high education spending and few children attending schools, although

enrolment rates are on the rise. Predicted primary gross enrolment increases from 66 percent of children at Mozambique's level of income to slightly more than 100 percent at Botswana's and South Africa's levels of income.[5]

The strong education record of many southern African countries is apparent (Figure 2.6). Zimbabwe, Swaziland, Namibia, Botswana, and South Africa all spend more than predicted on education, around 6 to 8 percent of GDP. Malawi and Zambia, in contrast, spend several times less on education and well below their predicted level. Furthermore, with the exception of Mozambique, all countries in the region are above their predicted level for gross enrolment.

It is interesting to compare the predicted relationships in Figure 2.6 with the results of Chenery and Syrquin (1975). On the basis of data from 1950–70, they reported much lower levels of enrolment at all income levels—around 20 to 30 percentage points below the enrolment curve in Figure 2.6. This probably reflects the increased awareness worldwide, during recent decades, of the importance of basic education. Higher enrolment rates do not seem to have translated into markedly higher education spending than what Chenery and Syrquin reported for 1950–70. If anything, education spending in the poorest countries has gone down since that period.

The last Kuznets curve is concerned with demography and the distribution of the labor force. The share of total labor force employed in the primary sector and the degree of urbanization (Figure 2.7) are closely related, but not identical, measures. These data further underscore the well-known fact that the agricultural labor share (Figure 2.4) decreases as development proceeds, although at a decreasing rate. The decline in primary sector employment is far less steep than the decline in the sector's share of value-added. In Mozambique, the primary sector employs 83 percent or more of the workforce (according to 1990 data). This is around 41 percentage points above the predicted share. This again demonstrates the crucial importance of agriculture in employing people in Mozambique. It is interesting to compare expected primary employment with the actual values for the southern African region. With the exception of South Africa, all the countries of the region have higher primary employment shares than predicted by the random effects model—many of them substantially.[6] This may be related to the other finding that all of southern Africa (except Botswana) is less urbanized than predicted and by implication has relatively low shares of employment in industry and services.

The high degree of agricultural employment in southern Africa is striking when comparing labor by sector (Figure 2.7) with structure of production (Figure 2.4), which indicates that most of the countries in the region derive a comparatively low share of total value-added (relative to the expected at that income level) from the primary sector. This finding means that productivity per worker in the primary sector is low in most of the Southern African countries, not only relative to other sectors, but also when compared with the average pattern at similar levels of development. Low productivity in agriculture translates into poverty and chronic food insecurity. Increased

[5]Primary gross enrolment is the proportion of all primary students to all primary school aged childred in the population. Percentages over 100 percent indicate that over-aged children are attending primary school.

[6]The flat line for agricultural employment (Figure 2.7) reflects the choice of estimator. Use of ordinary least squares (OLS) estimation results in a much steeper relationship, more in accordance with Chenery and Syrquin's findings (also based on OLS estimation). The random effects estimator is a weighted average using OLS and estimates from fixed-effect parameters, where the weights applied depend on the number of countries and the variances. In this particular regression, this procedure results in estimates very close to the fixed-effect estimates.

agricultural productivity is a key priority and would help raise incomes, enhance food security, raise foreign exchange earnings and provide momentum to the transformation of the country.

Looking Ahead

Given favorable external and climatic conditions and proper domestic policies, based on the review in this chapter there would seem to be chances for sustained, poverty-alleviating growth—based on natural resources—that could bring Mozambique's economic, social, and poverty indicators on par with or in excess of the average for Sub-Saharan Africa. Thus, a necessary, overall policy objective over the coming years will be to sustainably develop the country's natural resource potential to provide export earnings, employment, and government revenue.

Production of food and cash crops can increase either by expanding cultivated area or by yield growth (production per hectare). In spite of the generally plentiful land resources, land constraints are emerging in certain parts of the country (Tschirley and Weber 1994; Marrule 1998). This underlines the importance of ensuring land tenure rights. Average crop yields in Mozambique are substantially lower than yields in other African countries. By transferring successful varieties and ensuring that fundamental farming practices are improved through extension services it should be technically possible to achieve a substantial yield growth within a short period of time in Mozambique. In addition to better technology, agricultural development requires better marketing channels, as further discussed in Chapters 4, 9, and 10. Cost-effective and competitive means of moving agricultural products from farms to consumers (either nationally or internationally) are needed to integrate subsistence farmers into the cash economy.

If appropriate policy action is backed by sufficient investment from domestic and foreign sources, the future of Mozambique may indeed look bright, as explained in Chapters 4 through 14. First, Chapter 3 places Mozambique's experience in historical context.

CHAPTER 3

The Path to Economic Collapse

Mozambican people of Bantu origin were in contact with Indonesian and Arab traders as early as 300 A.D., and from 700 A.D. Mozambique became fully integrated into the Indian Ocean trade network. From approximately 1100 A.D., trade increased; Mozambican culture still bears distinct evidence of the Arab influence in this activity. Trade in gold, particularly with the Shona kingdoms in present-day Zimbabwe—but also in ivory, other metals, and hides—attracted the Portuguese. From 1505 the Portuguese became established at Sofala and started over the next 125 years to expand inland, especially up the Zambezi.

The early colonial economic system, aside from trade in gold, was based on a so-called *prazo* system whereby Portuguese settlers were granted land and absolute power and authority over the local people. This system was abandoned before 1700, as indigenous resistance toward the Portuguese pushed the colonialists out of rural areas. Yet, the rise in slave trade followed soon after, and a variety of policies to ensure an ample supply of cheap labor were put into place once slavery was officially abolished, around 1850. Portuguese colonialism intensified at the end of the nineteenth century, but Portugal did not have sufficient capital and power to enforce the occupation. This became possible instead through the investment of foreign capital and a variety of British, Rhodesian, and South African companies. These companies were given extensive concessions and administrative rights so that by 1917—when the occupation was complete—Mozambique was to a large extent run by foreign capital.

Forced labor and taxes, which could only be settled in cash, were institutionalized by the Portuguese. This left the rural populations with little alternative but to try to increase their production of marketed crops, such as cashews and cotton, or work as wage labor on plantations, in major investment programs in Mozambique, or in the mines in South Africa. Regarding work wage, the colonial power received payments in gold directly from South Africa, whereas the migrant mine workers, who in some periods amounted to 25 percent of the total active male labor force, were paid in *escudos* at a much lower rate. With Mozambique's unique geographical location, the Portuguese also managed to generate substantial amounts of foreign currency receipts through the provision of transit services.

Soon after the Salazar government came to power in Portugal in the mid-1920s, substantial numbers of Portuguese settlers were sent to Mozambique to work either as farmers or in public and private services, including the marketing system. The presence of the large number of Portuguese settlers led to an increase in imports of consumer goods from Portugal. In addition, some manufacturing industries were established. Yet they were—with the exception

---

This chapter was written by Channing Arndt, Henning Tarp Jensen, and Finn Tarp.

of processing of agricultural export crops—typically based on the manufacture of imported raw materials, geared primarily toward the needs of the Portuguese. Thus, adjacent growth effects benefiting the local population were relatively limited, although their purchasing power and the supply of manufactured goods did increase somewhat. In parallel, a tightening of the labor law system meant that practically all Mozambican men had to work at least six months a year as unskilled wage labor until the abolition of forced labor laws in 1961. Finally, smallholder cash cropping (cashews and cotton in particular) increased, but this was because of pressure to generate funds for tax payments.

Consequently, the traditional food-producing activities in the rural sector (such as cassava and maize) were increasingly left in the hands of women and children. Support services for food crop production were absent, so the potential economic impact of this sector was not developed. Focus in agricultural research, extension, and marketing was instead on export crops (including, in addition to cashews and cotton, crops such as sugar, tea, coconuts, and citrus) and on food crop production undertaken by commercial settlers and in large plantations. Similarly, little credit reached smallholders, who continued to be extremely dispersed.

Even by the standards of colonial administration in Africa, little investment was made in social infrastructure in Mozambique, especially in the rural areas, and jobs requiring even minimal skills were restricted to Europeans. In other words, the economy catered to the needs of the Portuguese, who assumed responsibility for a broad range of functions. Local people were left without access to education and training, except for the teaching carried out by missionaries. Thus, the accumulation of human capital was extremely limited during the colonial period, and black Mozambican literacy remained at less than 10 percent (Green 1991). Secondary and technical education grew after 1960, and a newly established university enrolled up to 1,500 students. Yet, these institutions almost exclusively served the settler community, which had gradually grown to approximately 200,000. As a result, at independence the number of Mozambicans with university training amounted to only approximately 40 according to the Food and Agriculture Organization of the United Nations (FAO 1982).

Regarding physical infrastructure, basic communications were, as discussed in Chapter 2, either lacking or designed to connect the hinterland with the ports on the coast. The north–south links within the country were not developed, and neither were marketing networks to move grain from the surplus-producing areas in the north to traditional food-deficit areas in the south. Instead, the urban areas in the south were in large part fed through imports of wheat, which reached more than 100,000 tons per year before independence. The country was generally self-sufficient in maize and rice, and it appears that the rural population practicing traditional agriculture managed to maintain its self-sufficiency conditions, except in emergency situations or as a consequence of forced cash cropping. Yet, calorie supplies were far below nutritional requirements (FAO 1982).

The last 15 years of colonial rule were characterized by the struggle for independence, particularly in the north; the removal of much of the racially discriminating legislation, such as the labor laws; the continued inflow of Portuguese settlers; and an increase in foreign investments. In addition, Portugal was for the first time transferring substantial financial resources to Mozambique. Consequently, industries oriented toward the internal market—such as food processing, textiles, and machinery and equipment—increased much more than industries geared toward exports. Moreover, the focus in the composition of imports shifted from consumption to capital goods. Hence, this period saw capital accumulation

and growth until 1973, but the boom rested on relatively shaky political and economic foundations. Accordingly, the basic contours of the colonial system outlined above remained unchanged. Thus, the economy depended heavily on imports and rested on agricultural exports, migrant worker remittances, and transit and tourist services. Added to this were widespread administrative controls (reviewed further below) and a phenomenal reliance on Portuguese human capital.

The struggle for liberation from the colonial power gained its modern expression with the formation of the liberation movement, Frelimo, in 1962. The initial outlook was based on the general winds of change, which swept the African continent, and the movement was in essence constitutionalist and nonviolent. However, Frelimo opted for armed battle from 1964, under the leadership of its first president, Eduardo Mondlane, and with military and material support from Eastern Europe and some African countries. The Nordic countries and the Netherlands gave humanitarian assistance, whereas many western countries supported the Portuguese colonial power.

Mondlane was assassinated in 1969, shortly after the Second Congress of the Frelimo party in 1968, and was succeeded by the charismatic Samora Moises Machel. Frelimo effectively controlled a third of the country, mainly in the north, and had penetrated as far south as the Manica and Sofala provinces when the Portuguese Armed Forces overthrew the Portuguese government in April of 1974. An agreement was reached shortly after in Lusaka that Mozambique would become independent on June 25, 1975, under the leadership of Frelimo.

During the 1974–75 transition period and the first year of independence, some 90 percent of the settlers, or an estimated 200,000 people, left Mozambique. This left the country with deserted and damaged capital stock and seriously depleted numbers of skilled and semiskilled workers as well as experienced professionals and administrators. Moreover, external service and tourist receipts started dropping dramatically. South Africa took steps to cut back severely the number of migrant laborers, abolish the gold payments of miners' deferred wages, and divert transit cargo elsewhere. Mozambique also incurred heavy financial losses because of the application of the United Nations Resolution on Sanctions against Southern Rhodesia and Support to the Patriotic Front.

The events described above clearly highlight the vulnerable situation of the Mozambican economy after independence, including the dependence of the balance of payments on migrant labor and transport services to neighbors, which viewed the changes in Mozambique with hostility. In 1975–77, the attention of key—but very inexperienced and, in some cases, rather dogmatic—policymakers focused on trying to come to grips with the management of the economy, including specifically feeding the cities, particularly in the southern part of the country; dealing with the balance of payments squeeze; arresting the economic decline of the years immediately proceeding independence; and planning for the future on the basis of socialist principles. The last was based on the assumption that industry should be a leading sector, with agriculture playing a more passive supporting role.

Thus, the early post-independence years can be described as a period of crisis management. In spite of the enormous difficulties of the hectic transition, these years were also full of idealistic optimism and a sense of national reconstruction and consolidation, fueled by the speed with which Frelimo came to power. Added to this, economic decline immediately before and after 1975 was actually halted (Green 1991), and a recovery started during 1977–81 helped by foreign capital inflows (FAO 1982; World Bank 1996).

Economic Transformation, Socialism, and Central Planning

At independence, a new constitution was introduced with a 230-member People's Assembly as supreme state authority. Yet, effective control of the highly centralized political and executive system of government was vested in the dominant organ of the ruling Frelimo party, the 10-member Standing Political Committee. The drive toward centralized decisionmaking in these years appeared for many—at both national and international levels—to be the only practical way out. The departure of the Portuguese left an administrative vacuum in Mozambique, which had also been tightly governed during colonial times.

Government intervention in agricultural pricing and marketing, for example, was well established in pre-independence Mozambique. The colonial Portuguese government set producer and consumer prices as well as marketing margins for an exhaustive list of products at the various stages of the production and marketing chain. Producer prices were differentiated according to origin (by region) and quality, and profit margins varied by groups of products and marketing agents. Finally, a state marketing board for cereals, which acted as wholesaler and operated a network of warehouses, had been created in the 1960s. The political premium on keeping prices stable in post-independence Mozambique was no doubt considerable. Therefore, it is hardly surprising that Frelimo initially chose to adopt this price-setting and marketing system—although in an expanded, yet simplified form, where panterritorial pricing was applied.

The focus on centralized decisionmaking was also in line with the ideological preferences of the members of the new government. They were obviously influenced by their experiences during the liberation struggle, where the only material support came from Eastern European countries, in combination with a dedication to the promotion of national unity and the elimination of colonial exploitation and domination. Accordingly, the rationale for government intervention started changing, and subsequent policy actions were conceived within the framework of a centrally planned economy. All land, banks, schools, and medical services were nationalized; and administrators were appointed by the state to run the more than 2,000 abandoned commercial farms and industrial companies.

The desirability of these initial steps was strongly reaffirmed by the Third Congress of Frelimo in 1977. On the same occasion, the establishment of a people's democracy and the construction of the material and ideological basis for a socialist society became basic political aims. The Congress also outlined the strategy and policies for a radical transformation of socioeconomic structures (Frelimo 1977). Focus was put squarely on the role of the state in savings, investment, production and trade, and the annual central state plan—the so-called *Plano Estatal Central*—which contained detailed investment and output targets that acquired the status of law. Meeting targets, set by the central planning authorities, became obligatory, with little reference to costs and profits, and state control started permeating almost all commercial activities in the economy. Private companies remained in existence, but as small-scale entities subject to strict regulation.

Four key programs, which were further detailed in the 10-year Indicative Perspective Plan, *Plano Prospectivo Indicativo,* launched in December of 1981 (Government of Mozambique 1981), made up the core of the longer-term development strategy. This strategy comprised creation and development of heavy industry, development of a state agricultural sector, cooperative transformation of the countryside, and massive human resource development. The plan was meant to ensure that the 1980s would be the "decade for the victory over underdevelopment." Annual GDP growth

rates of no less than 17 percent and a fivefold increase in agricultural production by 1990 were hoped for. Accordingly, the investment component of the plan was formidable, and a series of projects that were highly capital-intensive were pursued, including plants to produce iron and steel, aluminum, chemicals, fertilizers, paper, and heavy engineering goods (Economist Intelligence Unit 1996).

In the rural sector, government started to make tenuous efforts at transforming the countryside. The provision of public services to the dispersed rural population was expanded in a remarkable manner in the late 1970s to make a real breakthrough in smallholders' livelihood (Tarp 1984). Numerous communal villages were established to help in this process. Nevertheless, focus in the allocation of investment resources in the agricultural sector remained on the state farms. Safeguarding the infrastructure left behind by the Portuguese appeared a sensible goal to strive to achieve, and further consolidation and expansion was enthusiastically planned with the assistance of large numbers of foreign advisers from Eastern European countries as well as a range of multilateral and bilateral donor agencies (FAO 1977).

The state farms were meant to serve as centers of excellence for the promotion of rural development in their respective areas of influence. They were also expected to provide badly needed employment as well as urban food supplies and export products, underpinning in this way the government's transformation strategy. Yet, Mozambique completely lacked the necessary human and capital resources to achieve growth rates such as those foreseen in the Indicative Perspective Plan. Investments did not yield expected economic returns, and a critical foreign debt burden started accumulating. Moreover, the inability of the government to provide adequate support on a continuous basis for smallholder development gradually started affecting confidence in Frelimo.

With the benefit of hindsight, the overall economic development strategy decided upon at the Third Congress can certainly be assessed as misguided. This was not, however, quite as obvious at the time, given the overall political Cold War climate and the relative macroeconomic stability, which meant that centrally planned, state-led development appeared as an option—which it does not today. Moreover, urban bias as traditionally defined was not characteristic of this period. This is evidenced not only by the investments made in rural development and state farm units already referred to above, but also by the fact that real agricultural producer prices in Mozambique were in 1981 and 1982 significantly above the 1976 level for all crops (Tarp 1990).

The Fourth Congress of Frelimo and the Economic Action Program

Frelimo had already started, during the preparations of the Fourth Congress held in April of 1983, to reassess previous economic policies and the general economic, social and geopolitical situation of the country. The government readily recognized that the course of events was most distressing, and that previous economic policy—which had generated an inefficient use of resources, in particular in the inflationary environment that started to develop after 1981—had to be revised (Frelimo 1982, 1983). Attention was drawn to the neglect of the smallholder farm subsector in the allocation of basic inputs and investment resources. The government identified "giantism" of state farms, excessive centralization of decisionmaking, and the management system's rigidity and inability to adjust quickly to changing needs as the main problems to be resolved. It also recognized that planning as so far practiced, on the basis of a set of material balances, had left the economic system inflexible and extremely vulnerable to exogenous shocks involving sudden decreases in efficiency of

resource use and increases in costs of production. Attention was furthermore called to the need for taking account of overall macroeconomic resource constraints.

Consequently, Frelimo called for a reordering of priorities and the preparation of an economic action program for the 1984–86 period. Mozambique committed itself to initiating a set of reforms, including greater economic flexibility and decentralization as well as reliance on market forces. The country put renewed emphasis on the importance of the smallholder sector. Private initiative was to be promoted in all sectors of the economy, and reforms were instituted in labor legislation and in the regulation of foreign investment. The government also took measures to strengthen public finances, including curtailing the mounting deficits of state farms. A new system for management of foreign currency was introduced that, among other things, made it legal for companies to retain some foreign currency earnings. Moreover, export responsibility was delegated from the central state export company, *Empresa Nacional de Comercialisação Moçambicana* (ENACOMO), to some of the factories or processing companies for crops such as cotton, cashews, and tea.

The government also promoted the role of the private sector in marketing, stressing that the state marketing company Agricom, which purchased around 40 percent of the total amount of crops marketed, should act as a buyer of last resort and not as a monopsonist in the procurement of crops from smallholder farmers. Moreover, nominal consumer and agricultural producer prices were raised significantly; and prices of some crops, such as fruits and vegetables, were liberalized. Producer incentives also came more into focus as an issue and overall objective—exemplified partly through the increasing use of the rural terms of trade as a criterion in price setting, and partly through preoccupation with the availability of consumer items.

Nevertheless, the measures actually taken were not sufficient to reverse the negative economic trend, and the centralized control and structure of the economy remained intact. Hostilities in rural areas escalated, as further discussed below; and the government was forced to rely on direct administrative allocation of resources, as is normally the case in circumstances of war. Thus, despite the pragmatic guidelines emanating from the Fourth Congress and summarized in an action plan, relatively little could in fact be done. In spite of a decisive political move by Samora Machel to stop the war by signing the "Nkomati Accord between the Governments of South Africa and Mozambique" in 1984, South African backing of the rebel movement *Resistencia Nacional de Moçambique* (Renamo) continued unabated.

Economic Collapse

Misguided economic policy was not the only force undermining economic progress after the Third Congress in 1977. Mozambique became a vocal member of the group of frontline states in opposition to the Rhodesian and South African governments, and by the early 1980s Renamo initiated serious efforts to topple the Frelimo government. Renamo had been created by the white regime in Rhodesia in the late 1970s, but was mainly financed and trained by South Africa after Zimbabwe gained independence in 1980. The South African apartheid regime's backing of Renamo formed part of the overall regional strategy to destabilize neighboring countries; and the social, human, and economic impact of the war can only be characterized as disastrous. A 1988 U.S. State Department report (the so-called Gersony report) led U.S. officials to conclude that what happened in Mozambique was one of the most brutal holocausts against ordinary people since the World War II.

The United Nations Children's Fund (UNICEF 1989) estimates were shocking.

More than 1 million people died in Mozambique during the 1980s; close to 5 million were displaced from rural areas inside and outside of Mozambique; and a large part of the country's infrastructure was destroyed, including most of the social and economic investments Frelimo had initiated in the second half of the 1970s. Accordingly, some 1,000 clinics and health posts as well as 3,000 schools were destroyed or closed down, and no less than 400 teachers were killed. Road communications were totally disrupted throughout the country; and the marketing system, which had started to regain momentum during 1977–81, was again seriously affected. Hence, the number of traders, estimated at about 6,000 at independence, continued to drop to fewer than 2,000 in 1990. The traders were mostly concentrated in provincial or district capitals, as their shops and transport means had been destroyed.

Rural smallholder farmers were, in other words, practically cut off from markets for their output, inputs, and essential consumer goods. Marketed production fell drastically, and subsistence agriculture was seriously disrupted also, as most areas were affected by insecurity and killings. Estimates vary, but it is illustrative that direct and indirect 1980–88 economic losses from the war were calculated in the late 1980s at US$15 billion (Green 1991), three times Mozambique's total foreign debt or 20 times what Mozambique received in loans and grants from abroad in 1988. Moreover, defense expenditures by the government surged, leaving little or no room to rehabilitate depleted human and physical capital resources.

As if war and destabilization were not enough, along with other southern African countries, Mozambique suffered from a series of repeated droughts from the late 1970s, and other natural disasters came in the form of floods and typhoons. The droughts in 1982 and 1983 had, for example, a devastating additional negative effect on agricultural output.

By 1986, the events described above caused complete economic collapse. The industrial sector was unable to cope with the large investment projects initiated. Centralized control of prices and distribution, lack of foreign exchange, shortage of inputs, the disruptive effects of war, irregular power supplies, and the world recession in the early 1980s made it impossible to maintain production levels. Thus, industry operated at 20–30 percent capacity only, and by 1986 industrial output was less than half its 1981 level. A similar downward trend occurred in the agricultural sector. The officially marketed production of agricultural products fell by more than 50 percent during the first half of the 1980s, and food aid grew to some 500,000 tons on an annual basis, or more than 85 percent of the total official grain supply. In spite of the food aid inflows, which became an important source of government revenue, per capita food consumption fell by more than one-third from 1979 to 1986.

The government budget deteriorated from a small surplus in 1980 to a 48 percent deficit in 1986, and defense gradually came to account for no less than 30 percent of total outlays. On average, public deficits amounted to 16.6 percent of GDP during this period, while the fiscal deficit—including grants from foreign donors—averaged 11.1 percent of GDP. More than 40 percent of the public deficits, including grants, were financed by expanding the domestic money supply and the rest by foreign loans, as domestic bond financing could not be relied on. Hence, domestic credits tripled from 1981 to 1986.

Meanwhile, the official exchange rate of the metrical (Mt) was kept fixed in relation to the U.S. dollar, and exchange rate adjustments hardly ever occurred. Thus, parallel markets for goods and foreign exchange emerged because of the combination of fixed prices, loss of monetary control, and an increasing excess demand for consumer goods and marketed crops. Prices surged on the parallel markets, and by 1986 the price

of foreign exchange on the black market was 50 times higher than the official rate. The recession and the grossly overvalued exchange rate had, in combination with the war and destabilization, disastrous effects on exports. South African traffic through Maputo harbor had, for example, by 1986 been reduced to only 10 percent of the 1973 level, and by the middle of the 1980s total exports of goods and services were less than 30 percent of the 1980 level.

Imports contracted as well, but the drop was more limited than that of exports. Hence, while total exports covered 50 percent of imports in 1981, they covered less than 25 percent in 1986. Consequently, the country developed a heavy dependence on foreign grants and loans. At the end of 1986, total outstanding international debt amounted to US$3.4 billion compared with US$750 million in the early 1980s. Scheduled debt service reached 275 percent of exports in 1986. Moreover, aid flows accounted for more than half of GDP, and capital expenditures—which remained stagnant in nominal terms during 1981–86—were almost completely donor financed by 1986, leaving little room for the government to maneuver.

In sum, GDP fell at 6 percent per year in real terms from 1981 to 1986, and the accumulated per capita probably amounted to about 45 percent during the same period (Tarp 1990; World Bank 1996). Moreover, internal and external economic balances had by 1986 become close to impossible to manage, while the majority of the smallholder sector was left in an extremely vulnerable situation. The overwhelming share of the population was poor in absolute terms (Green 1991), and social indicators were among the worst in the world. Generalized shortages were endemic, parallel markets grew rapidly, the exchange rate was grossly overvalued, and dependency on donors for financial assistance and food aid excessive.

Hence, by 1986 it was clear that the government was losing effective control of the economy. The nation-building efforts of Frelimo had not succeeded as originally designed, and popular support was dwindling. The social fabric of the country was threatened and crisis management had become the order of the day with little attention to needs in the medium and long term. Economic reforms were clearly required, but even more so was the need for peace. This was repeatedly stressed by Samora Machel, who died in a plane crash in 1986 and was succeeded as president by Joaquim Chissano.

CHAPTER 4

Stabilization and Structural Adjustment

To counteract the widespread economic collapse discussed in Chapter 3, the Government of Mozambique introduced the comprehensive Economic Rehabilitation Program in 1987. Subsequently, the reform effort was renamed Economic and Social Rehabilitation Program (ESRP) in 1989 to put focus on the social dimension of the effort.[7] The stated intention of the program was to lay the foundation for economic growth through a shift to a more market-based economy. ESRP, as originally conceived, was fairly standard in design. It responded to an economy that was failing to maintain monetary control, consuming beyond its means, focusing production excessively on nontraded goods, and relying on inefficient and inflexible microeconomic structures. Moreover, ESRP included a series of standard stabilization measures, such as fiscal adjustment, monetary restraint, and devaluation of the exchange rate. To enhance microeconomic efficiency and the capacity of the economy to withstand external shocks, substantial price and trade liberalization was pursued. Similarly, institutional reforms of the financial sector and a privatization program for state enterprises were included as key components of the program.

External agencies played a major role in the design of ESRP. The IMF and World Bank took the lead in program formulation and implementation. Conditionality was phrased in standard terms, as suggested above, and the policy framework papers in which initiatives to be undertaken were outlined were mainly drafted in Washington, D.C. The ability of the Mozambican government to enter into effective dialogue was severely constrained, and issues of ownership of the program were quickly glossed over. In sum, the IMF and the World Bank exerted massive influence on the policymaking process. In the early years of program implementation, bilateral donors fully supported the line pursued by these agencies and remained largely passive in the macroeconomic policy dialogue. Instead, bilateral donors continued to pursue the implementation of their respective aid programs over which the government had some—but by no means exclusive—control. Gradually the position of the World Bank and IMF began to change, and criticism of the orthodox approach surfaced. The introduction of a social dimension of adjustment in the reform program is an early illustration of this, but during the 1990s the restrictive nature of the fiscal tightness of ESRP also came under fire. Moreover, internal disagreements between the IMF and the World Bank emerged in the second half of the 1990s, and little by little a more unorthodox—and much less monolithic—policy line gained influence. In parallel with this process, the large number of mainly foreign nongovernmental

---

This chapter was written by Channing Arndt, Henning Tarp Jensen, and Finn Tarp.

[7]For simplicity, adjustment programs ongoing since 1987 are collectively referred to in this report as ESRP.

organizations (NGOs)—in some years numbering more than 70—remained largely without influence on macroeconomic policy. Instead, they continued implementing a wide variety of humanitarian, reconstruction, and development projects at field level in a large number of localities throughout Mozambique.

Policy Measures

As a result of the forces referred to above, considerable price liberalization occurred in the three years following the initiation of the reforms. While products with fixed prices accounted for about 70 percent of GDP in 1986, this proportion had fallen to about 30 percent by 1989. Four years later, in July 1993, the government took the substantial step of liberalizing prices for major food products, such as maize meal, cooking oil, and rice. Price liberalization continued such that early in 1996 administered consumer prices were limited to wheat flour, bread, rents, fuels, utilities, and certain transportation fares. By the end of 1996, these few remaining controls had either been removed or a regular update system had been put in place, usually referencing world prices (World Bank/Republic of Mozambique 1996).

However, minimum producer prices for nine agricultural products—including white maize, beans, groundnuts, sunflower, raw cashews, cotton, mafurra, paddy, and tobacco—persisted into 1996 (World Bank 1996). Particular concern was attached to the impacts of minimum prices on maize markets, even though the minimum prices were not generally enforced. Thus, there were reports of selective sanctions against traders purchasing at prices below minimum price levels (Moll 1996). Since risk of sanction works against the development of private trading activities, the World Bank and other donors continued to push for abolition of *de jure* minimum prices. Consequently, the government transformed food crop minimum prices to so-called indicative prices in 1997. In sum, domestic price liberalization was carried out closely meeting ESRP intentions.

Evidence on how producer price liberalization affected consumer prices is scarce and mainly qualitative. Definitive conclusions, therefore, cannot be drawn. Looking at how marketing margins for agricultural goods evolved from 1991, it would appear, however, that margins for traded agricultural products (including maize, raw cashews, and other export crops) have decreased, while margins for several nontraded products (such as cassava and other basic food crops) have increased.[8] Accordingly, for traded agriculture it would appear that falling producer prices have led to even greater decreases in consumer prices. The evidence is less clear in nontraded sectors.

Trade liberalization, including a move from a system of managed trade toward a liberal trade regime with imports subject to *ad valorem* tariffs, has been more gradual. Since 1987, quantitative restrictions on imports and exports have been scrapped, the number and average level of tariff rates substantially reduced, and licensing procedures simplified or rendered automatic. Accordingly, the import tariff structure implemented in November 1996 contained only three rates: 2.5, 7.5, and 35 percent (Ministry of Planning and Finance 1996). Despite the simplified tariff rate structure, it still implies significant effective protection for some agricultural processing industries. For example, the rate applied to wheat is 2.5 percent, while the rate applied to wheat flour is 35 percent. This implies that the effective protection afforded to wheat milling activities is quite high. Also an export tax of 20 percent has been in place for raw

[8]These margins have been calculated based on revised national accounts for 1991–96, discussed later in this chapter

cashews to protect the domestic cashew processing industry.

The area of trade policy that caused the gravest concerns was customs administration. In 1995, the Maputo port authority reported that between 300 and 400 import containers had been sitting at the port for more than 180 days, and that the average time in port was 114 days (Castro 1995). Available evidence suggests, moreover, that traders were able to use illicit means to speed up the importing process, and even avoid import duties. The unsustainable situation in Maputo port gave momentum to ongoing efforts to reform the customs administration.

A key component of ESRP was a comprehensive privatization program initiated in 1989. Progress was slow initially but accelerated in the mid-to-late 1990s, with 125 public firms privatized in 1994 and 261 privatized in 1995 (Sowa 1996). By mid-1999, more than 1,200 firms had been privatized, 87 of these categorized as large enterprises. Relatively few large enterprises, such as the national airline, remain in state hands. It is difficult to assess the efficacy of the program by the usual means—dividing the scheduled number of enterprises to be sold by the specified date by the number actually sold—because the number of firms slated for privatization rapidly grew over the length of the privatization process.

An important nonprice objective in the privatization process was the preference for Mozambican buyers over foreign buyers. The most tangible indicator of this policy was the difference in financing requirements. Typically, foreign investors were required to pay cash, while Mozambican investors were offered installment plans. Figures from early 1996 indicate that Mozambicans played a significant role in purchasing state assets, with the overwhelming majority of firms (many of them very small) purchased by Mozambicans and a slight majority of the amounts agreed to be paid coming from Mozambicans (Sowa 1996). While these differential financing requirements seem to have augmented the level of participation of Mozambican business people, this result came at a considerable cost. Sowa (1996) found that approximately half the installment funds due were in default.

Despite these problems, the privatization program was successful based on how many assets moved from the state into private hands. Even by mid-1996, the World Bank referred to the program as "one of the largest in Africa" (Sowa 1996, 1). Continued rapid privatization since 1996 implies that the vast bulk of economic activity is now in private hands. A joint study by the World Bank and the Government of Mozambique found that enterprises had increased output four times over in the three-year period following privatization (World Bank and Republic of Mozambique 1997). Some cautionary words are in order however. First, this figure refers to firms privatized very early in the process Most firms—particularly large firms—were privatized later, and their performance has yet to be formally assessed. Second, privatization occurred within a generally improving macroeconomic environment, and it is difficult to assess the counterfactual: how well the firms would have done had a credible commitment been made to keep them in state hands.

Another key component of ESRP was the privatization of the commercial financial sector. In 1989, the banking system effectively consisted of two state-owned banks, *Banco de Moçambique* (BM) and *Banco Popular de Desenvolvimento* (BPD). In efforts to gain control over money creation, the commercial banking functions of the BM were extracted in 1992 through the creation of *Banco Commercial de Moçambique* (BCM). Privatization of the BCM was contemplated shortly after, but audits of its accounts for 1992 revealed "substantial losses," mainly because of soft loans to parastatals. Continued poor performance of both the BCM and BPD impaired the

ability of the BM to maintain monetary control; faced with the consequences of slow and partial banking reform, in March 1995 the government decided to proceed as quickly as possible with the privatization of both financial institutions (World Bank 1995a). Subsequently, BCM was privatized in the summer of 1996, while privatization of BPD occurred in late 1997.

The agricultural marketing system is now to a large extent in private hands, and major markets for agricultural output, particularly in the central region, appear to be active. Thus, circuits for treating marketed agricultural production have been developing, while state involvement in purchase, storage, and transport of marketed surplus has been declining, particularly in the southern and central parts of the country. In 1994, the state marketing enterprise, Agricom—which was entrusted with a broad mandate for purchasing, storing, and transporting a wide array of agricultural products—was restructured and renamed *Instituto de Cereais de Moçambique* (ICM).

The reconstructed institution was subsequently given a mandate to act as a buyer of last resort, to manage strategic stocks to ensure food security, and to contribute to the stabilization of producer and consumer prices. Despite the official status, ICM has effectively operated like a private organization given no budgetary allocations, working capital, or donor support have been received (Coulter 1996). Yet, it is still an important player in the procurement of agricultural output, with a storage capacity of approximately 235,000 tons.

Since the cessation of hostilities in 1992, the use of agricultural production inputs has remained rudimentary. It is difficult to determine whether the negligible use of purchased inputs is a result of lack of effective demand or limited supply. An examination of *Sementes de Moçambique* (Semoc), the major seed company of Mozambique, provides some insight into the current state of input markets. As a former state enterprise, Semoc was privatized as part of the privatization program. Since 1994, the company had made substantial efforts to develop a retail network, but retracting donor support for resettlement of displaced people meant that weak sales failed to cover costs. The company survived by downsizing, generating revenue through trading activities, and converting land previously allocated to seed production activities to straight agricultural production. As of the mid-1990s, Semoc estimated that the market for seed would grow slowly and that it would be forced to rely on other income sources for several years before being able to focus exclusively on its core, seed-producing business (Bay 1996).

While substantial infrastructure investments have resulted in a distinctly improved primary and secondary road system, serious problems remain in transporting agricultural surplus from the farm gate to the roads. This difficulty is compounded by a war-induced shortage of animal traction. The fertile northern parts of the country remain poorly integrated with the rest of the country, while distinct improvements have been made in the southern regions. The extent of the road network improvements in the south can be measured in part by a detailed study of maize market integration between Maputo and Chimoio (a major market on the Beira corridor). It suggests that significant price linkages exist between these two markets (Donovan 1996).

The marketing of raw cashews has been the focus of intense policy debate in recent years. Having raised a ban on exports in 1991, the government set and abided by a schedule for eliminating the export tax on raw cashews by 2000. Previous lack of competition in export markets and extraordinary inefficiency in domestic cashew processing permitted the domestic price for raw cashews to fall to 16 percent of the export price or about one-third the level received by farmers in neighboring Tanzania (Castro 1995). More recently, privatized cashew processors have realized efficiency gains. Accordingly, increased competition

between processors and exporters allowed producer prices to increase to 40 percent of the export price in 1996.

Macroeconomic reform efforts in Mozambique formed the core of ESRP program over the past decade. Nevertheless, despite stated intentions from the outset, fiscal adjustment on any significant scale only began more recently. Effects of ESRP are visible on the expenditure side. Initiatives to raise government revenue collection included the privatization of the customs administration and the planned introduction of a value-added tax (VAT). Overall, the key recommendation of the World Bank's first public expenditure review in 1989, to increase government revenues, has so far not been achieved. The persistent inflows of substantial amounts of aid have therefore been essential in financing public expenditure. Efforts toward retrenching the government workforce have not been successful, but the so-called peace dividend did materialize. In combination with strict limits on wages and salaries of civil servants, spending on public administration and defense has been reduced significantly.

On the monetary side, ESRP was very specific in recommending monetary restraint. However, the entanglement of the central and commercial banking functions of the BM was a stumbling block. Thus, while the BM performed central bank functions, it also held more than two-thirds of all commercial loans, with the majority of its portfolio directed toward parastatals. Direct subsidies to these companies, amounting to 12 percent of GDP in 1987, had been substantially reduced by 1992, but indirect subsidies through soft loans from the BM proved difficult to control. A survey of industrial companies in 1993 found that most state-owned companies had nonperforming loans with the banking system (Castro 1995). Privatization of the BCM coincided with the regaining of monetary control in 1996. The annual inflation rate dropped to single-digits, having hovered around 50 percent over most of the previous period. Although adjustment to the new low-inflationary environment was slow, nominal interest rates started to provide market-oriented signals from the mid-1990s as evidenced by real interest rates turning positive after 1995.

Overvaluation of the exchange rate in 1987 was of major concern, and devaluation of the exchange rate was one of the essential building blocks in the structural adjustment program. Between 1987 and 1995, the exchange rate continuously lost value relative to major currencies in nominal terms. Whether these devaluations were large enough to bring the real exchange rate to an equilibrium level is debatable. Parallel markets existed throughout this period; however, parallel and official rates have converged. In 1987, parallel markets traded the metical at 50 times the official rate. By 1995, this differential had narrowed to approximately 10 percent. With the establishment of monetary control in 1996, the exchange rate came into line with the rate on parallel markets. Subsequently, these parallel markets have all but vanished.

Reform efforts have also been directed toward the social sector, in particular the health and education networks. Educational rehabilitation has focused on primary education, where nearly all the school network has been rebuilt after massive war-induced destruction. Rehabilitation of health care has also seen some progress, with the recent initiation of a six-year health program. In line with the general liberalization efforts, private education was reintroduced in 1990, while private health care has been allowed since 1992. A variety of safety net initiatives has also been pursued, but the need for concerted attention to social issues is widely recognized.

Economic Performance

Given the momentous economic and political changes over the past decade, the scope for recuperation and improvement in economic performance has, particularly since

1992, been enormous. However, assessing such change critically depends on the availability of reliable data. The National Institute of Statistics has produced coherent sets of national accounts in accordance with the United Nations System of National Accounts (NIS 1997).[9] The NIS figures differ from the previous official national accounts published by the National Directorate of Planning (NDP). These differences reflect that the NDP data are based on problematic estimation and cross-checking procedures (Johnson 1995). More specifically, the NDP national accounts rely heavily on data from technical ministries and public enterprises, and they do not capture a variety of activities in the services sector. In contrast, the NIS data are based on a variety of surveys,[10] and adjustment is made for items that go unnoticed in the NDP approach, including imputed values for a variety of informal sector activities. Accordingly, the more reliable NIS data is the main data source used in what follows. Yet, because data on balance of payments are compiled in accordance with NDP national accounts only, both data sets are needed for a coherent assessment.

In terms of the evolution of real GDP (Table 4.1), it appears that overall growth of real GDP was respectable in the period 1991–96, according to NIS data. A dramatic drought-induced fall in real GDP in 1992 was reversed the following year, marking the beginning of a period with continuous growth. NIS and NDP growth rate estimates, as expected, paint different pictures of the evolution of GDP. Thus, NIS data imply a significant drop and consequent rebound in 1992–93, and reasonably high and stable growth rates during 1994–96. The official NDP figures, on the other hand, imply that the drought did not affect real GDP significantly, while an unprecedented 19 percent growth rate followed in 1993. After this jump, the NDP recorded more modest growth rates in 1994–95, while the 1996 estimated performance matches that of NIS. In sum, the two sets of data share some similarities, including low growth in the drought-stricken year of 1992, followed by high growth in 1993, a leveling off through 1995, and a resumption of high growth in 1996. Nevertheless, the NIS data tell a story of an economy that has maintained stability and continuity in the adjustment process, while the NDP figures indicate more erratic movements. The NIS data are judged to be a more adequate picture of the post-1992 period.

Changes in the component shares of real value-added indicate that the agricultural

Table 4.1 Real gross domestic product (GDP), 1991–96

	GDP (100 billion metical in 1991 prices)					
Indicator	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Real gross domestic product (NIS)	29.0	26.6	28.9	31.1	32.5	34.8
Growth rate (NIS) (percentage)	…	-8.1	8.4	7.8	4.3	7.1
Growth rate (NDP) (percentage)	…	-0.8	19.3	4.4	1.4	6.4

Source: MPF (1997); *Banco de Moçambique* 1997; and NIS 1997.
Notes: MPF means Ministry of Planning and Finance; NIS means National Institute of Statistics; NDP means National Directorate of Planning; and ellipses (…) mean not applicable.

[9]Officially, the NIS was only established in 1998, superceding the National Directorate of Statistics; for simplicity, however, the acronym NIS is used here to reflect both institutions.

[10]These include demographic, expenditure, and production surveys.

sector share increased from 1994 to contribute almost one-third of total real GDP in 1996 (Table 4.2). The investment-related construction sector and export-oriented transport and communications sector also increased during the period, whereas shares for the commerce, service, and manufacturing sectors (excluding food processing) declined.

The changing structure of nominal value-added (Table 4.3) sharply contrasts the structure of real value-added. By 1996, the nominal share of agricultural value-added declined to 25 percent, while the commerce share increased to 25 percent. Changes in real GDP shares show that the relative movements of value-added across sectors differ significantly. Accordingly, the price of labor-intensive agricultural value-added has decreased relative to other sectors. This is most likely a result of downward pressures on agricultural producer prices given increased production. Thus, repeated depreciation of the exchange rate in Mozambique has been unable to counteract the general downward pressures on agricultural prices. The decline in the price of relative agricultural value-added appears especially steep compared with the price in the capital-intensive commerce sector.

Table 4.2 Sectoral shares of real value-added, 1991–96

	Share of real value-added (percentage)					
Sector	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Agriculture	30.7	26.8	30.4	28.1	31.5	32.6
Fisheries	3.5	3.3	3.3	2.9	2.8	2.8
Agricultural processing	6.5	6.6	5.6	5.5	5.7	7.1
Mining	0.4	0.3	0.3	0.3	0.4	0.3
Manufacturing	2.8	2.7	2.5	1.6	1.7	0.8
Construction	6.5	7.1	6.7	8.1	9.0	9.6
Transport and communication	7.0	9.3	10.3	10.1	10.9	11.3
Commerce	23.3	23.2	19.9	21.4	19.9	18.2
Other services	19.3	20.8	21.1	21.9	18.1	17.3
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: NIS 1997.
Note: The base year for real value-added is 1991.

Table 4.3 Sectoral shares of nominal value-added, 1991–96

	Share of nominal value-added (percentage)					
Sector	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Agriculture	30.7	25.7	28.0	24.2	23.3	25.3
Fisheries	3.5	4.0	3.5	3.0	3.9	3.1
Agricultural processing	6.5	5.7	4.8	5.6	5.7	5.9
Mining	0.4	0.3	0.4	0.4	0.5	0.4
Manufacturing	2.8	2.7	2.1	1.1	1.3	1.3
Construction	6.5	8.3	7.7	11.4	12.5	12.8
Transport and communication	7.0	7.5	8.1	7.5	6.9	6.0
Commerce	23.3	21.9	17.5	22.3	23.9	25.3
Other services	19.3	23.9	27.9	24.4	22.0	19.9
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: NIS 1997.

In the evolution of the expenditure components of real GDP, the share of private marketed consumption declined significantly from almost 75 percent to less than 60 percent of GDP in the period 1991–96 (Table 4.4). Moreover, government consumption declined as a share of real GDP. These developments imply that the overall contribution of consumption toward GDP has decreased significantly.

The mirror image of the large drop in the share of real consumption is a significantly reduced ratio of the negative trade balance to GDP. Thus, the export share increased during 1995–96 to almost 20 percent, while the import share decreased to 34 percent. This reflects a drop in imports of consumer goods, while the share of real investment (which is import heavy) increased in more recent years. It is uncertain whether the increasing share of real investment can be characterized as robust. Nevertheless, data indicate that the share remained at 25 percent in 1997.

Nominal GDP shares (Table 4.5) are only slightly different from real GDP shares (Table 4.4), reflecting that changes in relative prices among the different expenditure components of GDP were minor. Consistent with price movements in the agriculture and commerce sectors, the imputed price of home-consumed production fell relative to marketed consumption. From the real GDP shares, it is clear that this shift in relative prices was accompanied by a shift in the consumption pattern away from marketed consumption toward home-consumed production. It is also clear that the relative price of investment goods rose significantly. This fits well with a similar increase

Table 4.4 Real GDP expenditures, 1991–96

	Real GDP expenditure (percentage)					
GDP component	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Home consumption	23	20	23	22	23	23
Marketed consumption	73	70	64	61	62	59
Government consumption	12	12	14	19	10	9
Gross investment	23	23	22	25	28	25
Exports	12	15	13	14	17	19
Imports	-42	-40	-36	-41	-40	-34
Total	100	100	100	100	100	100

Source: NIS 1997.

Table 4.5 Nominal GDP expenditures, 1991–96

	Nominal GDP expenditure (percentage)					
GDP component	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Home consumption	23	19	22	19	19	19
Marketed consumption	73	73	65	63	65	62
Government consumption	12	14	16	21	10	9
Gross investment	23	27	27	32	36	30
Exports	12	15	13	13	19	19
Imports	-42	-49	-43	-48	-49	-39
Total	100	100	100	100	100	100

Source: NIS 1997.

in the relative price of imports. Nonetheless, real investment expenditures increased over time, indicating that the increased relative prices on imports primarily had a negative effect on imports of consumer goods.

The lack of a discernible trend in the trade balance deficit until 1995 caused much concern. Nevertheless, a significant improvement of the trade balance deficit was recorded in 1996, mainly caused by import compression (Table 4.5), and data suggest that the trade balance as a share of GDP fell to a new low in 1997. The main driver behind the improvement in 1996 was a significant decline in the imports of primary agriculture and agricultural processing, while a smaller contribution came from a fall in imports, unrelated to agriculture. The significant decrease in imports of agriculturally related goods is related in particular to the bumper crop that resulted from the generous weather conditions in 1996. Thus, imports of maize as food aid, reduced significantly in 1995, all but vanished in 1996. The decrease in nonagricultural imports can also be traced to decreases in imports of consumption-related items, while imports of, for example, construction materials and industrial machinery, increased. The increase in exports can be attributed in large measure to processed cashews.

A summary of developments in public finances indicates that the total deficit fell significantly in real terms in 1995 and 1996 (Table 4.6). Moreover, the emphasis on expenditure cutbacks over the adjustment process shifted the recurrent fiscal deficit to a surplus from 1995. Given real government investment also fell, the deficit on the total balance decreased. Nevertheless, falling grants imply that the deficit after grants remained high.

Concerning recurrent expenditures, defense spending made up an overwhelming 34 percent of the recurrent budget in 1992, increasing even further to a staggering 38 percent in 1994. That year was characterized by large, externally funded mine removal and disarmament programs, counteracting the ongoing process of downsizing military capacity. In contrast, defense expenditures were 23 to 24 percent of recurrent expenditures in 1995–96. The cutback in defense spending—that is, the peace dividend—therefore proved to be a major precondition for the recurrent budget surplus and accompanying reduction in the overall budget deficit.

A significant drop in the real value of grants caused 1996 real investment expenditure to fall back to its 1992 level. It is important to note, however, that the investment budget likely contains recurrent expenditure items. For example, all aid-funded spending, including spending on technical assistance, is categorized as investment. Hence, the 1994 investment figure is very likely inflated, so the balance

Table 4.6 Public receipts and expenditures, 1992–96

	Public receipts and expenditures (billion metical in 1992 prices)				
Receipts and expenditures	**1992**	**1993**	**1994**	**1995**	**1996**
Tax receipts	661	768	660	675	669
Current expenditures	765	820	855	612	592
Current balance	-104	-52	-196	62	77
Investment expenditures	694	771	916	801	711
Total balance	-798	-823	-1,111	-738	-633
Grants	690	655	803	584	441
Balance after grants	-108	-168	-309	-154	-193

Source: MPF (various years).

between recurrent spending and investment expenditures should be interpreted with caution.

Turning to revenues, total tax receipts in real terms essentially remained constant throughout 1992–96, indicating a decline in tax receipts by 1996 to a very low 12 percent of GDP. The poor revenue performance is consistent with relatively strong growth in sectors of the economy that do not form part of the tax base. Thus, tax performance supports the observation that real growth was relatively strong in the informal agricultural sector in Mozambique and that major tax reforms have yet to be implemented.

Inflation and money-stock growth rates for the period 1991–96 (Table 4.7) indicate that greater monetary stability emerged in 1996 after a period of being clearly out of control. Inflation surged at the onset of the adjustment period in 1987, resulting from currency devaluation and deregulated prices, which hit rates of around 200 percent per year. However, annual inflation, measured by the GDP deflator, had already been reduced to around 50 percent by the end of 1988, and inflation, measured by the calendar-year change in the Maputo consumer price index (CPI), remained at approximately this level until 1996, when inflation dropped considerably. However, the numbers for money stock, Maputo CPI, and exchange rate growth do not provide a clear picture of the actual speed with which price inflation was brought down. Thus, almost complete price stability was registered between April 1996 and April 1997, with an inflation rate of no more than 4.6 percent.

The monetary authorities did not manage to control the money stock immediately after the initiation of ESRP. Money stock and inflation rates soared until the banking reform in 1995. The narrow money supply (M1) and CPI were closely correlated in this period, becoming even closer during 1996. Thus, the annual growth rates of M1 and CPI were very similar for 1996, and both were significantly down from the previous year. The relationship between M1 and CPI growth rates suggests that, in this period, inflation was to a large extent a monetary problem, although this is a debatable issue. In any case, neither general pressures on wages, expansion of private sector credit, nor growth in government expenditure appear to be plausible causes for the observed inflation rates (Economist Intelligence Unit 1997).

The metical to U.S. dollar exchange rate was devalued several times after the inception of ESRP in 1987 and, following a very large initial jump, moved more or less in line with the domestic inflation rate. Despite an initial depreciation of around 700 percent, the overvaluation at that time is likely to have been much greater. This implies that the depreciation of the metical continuously lagged behind the rate of domestic inflation and, consequently, that Mozambique experienced an overvalued exchange rate during much of the structural adjustment period. This may well have contributed to the impressive return to price

Table 4.7 Money stock, Maputo CPI, and exchange rate, 1991–96

	Growth (percentage)					
Monetary and price indicator	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
M1	35.7	59.3	78.8	57.6	56.2	19.9
CPI	35.2	54.5	43.6	70.1	55.0	16.2
Exchange rate growth	54.4	69.6	53.1	58.9	50.2	25.3

Source: MPF (various years); *Banco de Moçambique* (various years).

Note: The consumer price index is for Maputo city, and the exchange rate is for meticais to U.S. dollars. The growth rates for M1 and CPI refer to calendar year changes measured in December.

stability in 1996 and 1997. Although it is likely that the metical was still overvalued in 1996, it stabilized along with prices. Accordingly, during a six-month stretch in 1996, the metical was depreciated by only 3.6 percent against the U.S. dollar, implying a further real appreciation.[11]

The current account components indicate improved balance of trade, according to official figures[12] (Table 4.8). Moreover, the service balance has improved in recent years because interest payments have stabilized and service account income has increased. Despite these improvements, the current account balance has remained essentially unchanged because of developments of capital transfers. The dollar value of foreign capital transfers decreased by 60 percent from its peak in 1994, and because the majority of these transfers were not returned, this drop represents a major decrease in grant-aid allocations. However, a large part of this decrease can also be related to the completion of aid-financed special programs, as well as to the inflow of food aid related to the 1992 drought. Since these externally financed projects are likely to have been very import-intensive, a large share of the concurrent decrease in imports was probably caused by the discontinuance of these projects. Nevertheless, the picture of a significant decrease in direct transfers of grant aid still remains.

The capital account balance improved significantly in terms of U.S. dollars (Table 4.9). Accordingly, the capital account

Table 4.8 Current account balance, 1991–96

	Current account balance (millions of U.S. dollars)					
Current account item	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Exports	162	139	132	150	174	226
Imports	-899	-855	-955	-1,018	-727	-802
Trade balance	-736	-716	-823	-869	-553	-576
Service balance	-110	-133	-127	-160	-127	-89
Capital transfers	609	609	628	702	339	283
Current account balance	-237	-239	-321	-327	-341	-382

Source: MPF (various years); *Banco de Moçambique* (various years).

Table 4.9 Capital account balance, 1991–96

	Capital account balance (millions of U.S. dollars)					
Capital account item	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
New external loans	144	170	186	260	282	347
Amortization	-354	-350	-324	-317	-270	-196
Direct investment	22	25	32	35	45	72
Capital account	-188	-155	-107	-22	58	224

Source: MPF (various years); *Banco de Moçambique* (various years).

[11]It is likely that part of the currency overvaluation problem was related to "Dutch disease" effects stemming from the substantial inflows of foreign aid, which increased the demand for local currency and therefore exerted upward pressure on the exchange rate.

[12]The trade balance data included in the balance of payments are the official data compiled by the NDP. Accordingly, the current account closely resembles the NDP estimate of the trade balance deficit. Even though the official data are presented in U.S. dollars, they also represent the trends of real domestic currency. Furthermore, they are comparable with the general trends of the NIS national accounts data.

changed from a large deficit in 1993 to a large surplus in 1996. Mozambique was able to attract external loans on an increasing scale since 1993, reaching a level that surpassed capital transfers in 1996. Accordingly, this makes up the lion's share of the big improvement in the capital account balance when combined with the 40 percent decrease in amortization payments. Such payments have been decreasing, stemming from a combination of debt rescheduling and reductions. The direct investment component showed significant progress, reaching a peak in 1996, when it climbed to more than 20 percent of the value of new external loans.

The financing requirement for the balance-of-payments deficit decreased dramatically in 1996, while the current account remained unchanged and the capital account significantly improved (Table 4.10). Despite the fall in the financing requirement, debt relief remained high, making it possible to increase foreign exchange reserves yearly from 1994 to 1996. Furthermore, changes in arrears were an important source of finance in several years.

Social sector rehabilitation shows some progress. From the observations regarding immunization against diphtheria and measles, it is clear that extension of health care improved during 1991–96 (Table 4.11). The infant mortality rate is another indicator of the revitalized health system, which declined after the 1992 ceasefire. Nevertheless, absolute 1996 levels were still among the worst in the world. The reconstruction of the educational system

Table 4.10 Financing the balance of payments, 1991–96

	Balance of payments (billion metical in 1992 prices)					
Balance of payments item	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Change in reserves	-13	-40	46	-53	-60	-158
Debt relief	385	669	212	232	125	310
Change in arrears	86	-222	178	168	191	-61
Financing	458	407	436	347	256	90

Source: MPF (various years); *Banco de Moçambique* (various years).

Table 4.11 Social indicators, 1991–96

Balance of payments item	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Immunization, DPT (percentage of children under 12 months)	46	50	49	55	57	n.a.
Immunization, measles (percentage of children under 12 months)	55	56	62	65	71	n.a.
Mortality rate, infant (per 1,000 live births)	n.a.	134	n.a.	n.a.	126	123
School enrolment, primary (percentage gross)	67	n.a.	n.a.	57	58	60
School enrolment, secondary (percentage gross)	8	n.a.	n.a.	7	7	7
School enrolment, tertiary (percentage gross)	n.a.	n.a.	n.a.	0.4	0.4	0.5
Primary education, teachers	22,236	22,474	22,396	n.a.	24,575	n.a.
Pupil-teacher ratio, primary	54.7	53.4	54.8	n.a.	57.6	n.a.

Source: World Bank 1997b.
Note: N.a. means not available.

made only slow progress over the period, as witnessed by gross school enrolment. Thus, the enrolment rate of the priority sector of primary education only modestly increased, while enrolment rates in secondary and tertiary education remained essentially unchanged. The increasing number of primary school teachers and the concurrent increase in the pupil–teacher ratios show, however, that total enrolment in primary education increased significantly. Thus, the slow progress in the gross enrolment rate can be attributed mainly to a significant increase in the number of school age children.

Future Challenges

The IMF and World Bank singled out major macroeconomic reform issues at the beginning of the adjustment process. Issues included consumption beyond Mozambique's means, production focused excessively on nontradable goods, and lack of monetary and credit control. In addition, the economy was characterized as inefficient and inflexible because of government failures in terms of interventionist measures and outdated legislation. It is clear that action was subsequently taken to address each of these problem areas. Hence, most of the available policy measures that were perceived to be preconditions to achieving economic stability and growth were in fact deployed.

In terms of GDP performance, respectable rates of growth occurred in Mozambique up until the mid-1990s. Moreover, it is clear that established targets of 4–5 percent growth on an annual basis were in general surpassed (Arneberg 1996; World Bank 1997a). Nevertheless, considering the very low initial level of GDP following the collapse in 1986, the virtual standstill of the economy in 1987–91, and the drought in 1992, the recorded growth actually appears less impressive.

Real investment expenditures, which grew quickly from 1992 to 1996, appeared to stabilize thereafter at a reasonable 25 percent of GDP. In the past, concern was expressed over the effectiveness of investment expenditures. One explanation for the apparently low impact of investment was that investment figures were too high because of the common practice of including foreign-funded items of a recurrent nature in the investment budget. This practice has previously given an upward bias to official investment figures.[13] Yet, NIS allocates expenditure between consumption and investment on the basis of expenditure categories. As such, the NIS investment figures are representative of actual investment levels. This implies that statistical considerations are not likely to form part of the explanation as to why growth rates in real GDP per capita stayed low before 1996. Accordingly, it seems that the productivity of past investment undertaken was lower than could reasonably be expected. Nevertheless, with reference to the apparently good 1997 GDP performance, it may be that a turning point had been reached.

During the adjustment period, investment expenditures relied heavily on aid grants for financing, particularly because of the poor performance of government revenue. Advancements in attracting foreign direct investment and foreign loans indicate that Mozambique has taken tentative steps toward lowering its dependence on foreign aid transfers. Moreover, some externally financed, so-called mega projects have been identified by potential investors, in particular including the Caharro Bassa dam, an aluminum smelter, and a reduced-iron plant. Nevertheless, in general, aid transfers will continue to play a big role as a source of investment finance in at least the medium-term. This is underpinned by the critical fact that relative prices of

[13]Official government investment figures amounted to about 45 percent of total investment in 1995, as estimated by NIS.

investment goods rose during the adjustment period.

Regarding consumption, the overly high 1991 private consumption share of GDP, at 96 percent, had been reduced to slightly more than 80 percent in 1996. Since the government consumption share of GDP also fell over this period, reasonable progress was made in reducing the initial consumption to GDP imbalance. This trend was confirmed in preliminary data for 1997. One of the major features of the seemingly stable and continuous economic growth in the mid-1990s was that growth in the informal agricultural sector had been high.

A pertinent issue of macroeconomic stabilization yet to be addressed effectively is fiscal adjustment. Despite improvements in the government budget balances to 1996, the development of the government revenue side remained unsatisfactory. Poor performance in most of the government revenue items meant that, overall, government revenue consistently failed to keep pace with GDP. Data has yet to confirm whether the privatization of the much-criticized customs administration has increased the efficiency and attractiveness of the Maputo port as a provider of transit services to South Africa, but import tariffs should have risen with better custom declarations control. Nevertheless, widespread tax exemptions that in the past detracted substantially from the revenue-generating capability of the important goods related taxes, is a thorny issue. Furthermore, since it is difficult to tax the growing informal sector activities, government clearly needs to pursue further fiscal reforms, including the design of more efficient mechanisms for generating revenue in the growing market-oriented part of the economy.

Given the poor performance of the government revenue side, all of the budget adjustments to 1996 took place on the expenditure side of the budget. A large part of the adjustment was achieved through the so-called peace dividend. However, instead of cutting back on the work force, the government compressed wages and salaries of civil servants as part of the process of returning to a recurrent budget surplus. This led to the double-edged challenge of wage decompression and the need to reduce employee numbers. Furthermore, much attention should be directed toward the modernization of budgetary and financial administrative procedures. Corruption was on the increase both as a consequence of inappropriate legislation and the failure of the legal system to address this issue in the transition from a command-type to a market economy. In sum, while fiscal adjustment took place over the adjustment period, this remains a fragile area of the reform efforts.

Throughout the adjustment period, the balance of payments was strongly affected by developments in debt rescheduling, debt reductions, and aid grants. Foreign debt originally started accumulating in the late 1970s and early 1980s, and the buildup intensified during the war. In the early 1990s all debt indicators reached massive and clearly unsustainable levels, and despite debt relief, new loan financing of the continuing current account deficits meant that in 1995 the debt stock stood at US$5.78 billion, or 16 times export earnings. The debt service obligations related to this huge foreign currency debt continuously strained the balance of payments.

The debt-reduction initiative was made all the more important given decreases in foreign capital transfers in general and aid grants in particular. The sharp negative trend observed in the 1994–96 data can largely be explained by the external funding of special programs in 1994. Nonetheless, an additional downward movement is apparent in aid grants awarded to Mozambique. Increasing loan inflows and reductions in amortization payments led to decreasing grants and increasing investment expenditures. This situation should have improved in recent years; nevertheless, to avoid a recurrence, continued aid inflows at a high level and on grant and concessionary

terms are indispensable in helping to close the financing gap from the current account.

In the past, the large deficit on the foreign trade account, with imports and exports hovering around 50 and 15 percent, respectively, of GDP were a cause of concern to policymakers. More recently, exports have been picking up, and since the import-GDP ratio declined in 1996–97, the ratio of trade balance deficit to GDP was brought down substantially. Encouragingly, import compression was achieved without impairing GDP growth or investment spending. Yet, while some transformation of production took place on the import side, possibilities for relatively easy import substitution and recovery are limited to a few sectors, including grain milling. Moreover, progress on the export side cannot be attributed to a structural shift in the transformation of production. Accordingly, major breakthroughs are needed on the export side to continue the trend of reducing the dependency on net capital transfers—including aid from abroad.

Furthermore, the decreasing consumption share of GDP has not been associated with the necessary shift in consumption patterns toward a better balance between private and public consumption. For example, expenditures need to increase, particularly in the educational sector, where pressure has mounted from a quickly expanding population.

The excessive monetary growth and high inflation rate were two of the problem areas identified by ESRP. Although lack of monetary control was identified as a problem from the outset, progress toward stabilizing monetary growth was made only late in 1996–97, when reconstruction and privatization of the commercial parts of the formerly state-owned financial institutions were carried out. The fact that monetary growth essentially made up for nominal GDP growth means that the velocity of money circulation of M1 remained fairly constant after 1992.

Very high monetary growth rates have generated substantial *seigniorage* revenue over the years. This income corresponds to the amount of real resources appropriated by the government by means of printing money, and it adds up to around 10 percent of GDP per year. This income has, however, been directed mainly to the state enterprise sector through the previously mentioned soft loans. The new low-inflationary environment is likely to be associated with a gradual lowering of inflationary expectations. Accordingly, the velocity of circulation should have begun to fall since the late 1990s, enabling the government to capture some seigniorage revenue without risking a renewed spurt in inflation.

The developments of the sectoral income shares of GDP show that the relative price of value-added across sectors changed significantly during 1992–96. The relative price of value-added in capital-intensive sectors, such as commerce and construction, rose, while prices in agriculture declined. This is a clear indication that capital remained a scarce and constraining factor during the period.

Following the drought of 1992, major emergency packages of food aid flowed into Mozambique from abroad. Good weather conditions thereafter meant that domestic production was increasingly able to substitute for this emergency assistance. Thus, the large decreases in food imports of maize were associated with concurrent increases in the real value of production of 30 to 40 percent, in 1995 and 1996. Following another bumper crop in 1997, Mozambique achieved self-sufficiency in maize, and some progress was even made toward exporting surplus production. However, the potential for relatively easy import substitution as part of the recovery process was expended, requiring the exploration of more fundamental changes in the development constraints faced by agricultural producers.

In this regard, significant efforts and resources were invested in improving primary and secondary roads as well as

rehabilitating the rail networks. These efforts were first steps to promoting Mozambique as an efficient provider of transport services to neighboring countries, and as such they provided Mozambique with possibilities for generating additional foreign exchange earnings. Transit services after 1991 were Mozambique's major export article, surpassing even the critically important fisheries sector.

Nevertheless, extension of infrastructure to underdeveloped rural areas remained inadequate as of 1996. While improvements in infrastructure are likely to boost the livelihood of some smallholders, this is by itself insufficient to reduce poverty on a major scale. The production technology, used in small-scale agricultural production, continues to be very rudimentary. Since little was achieved over the adjustment period in this area, technological improvements thereafter are critical for ongoing agricultural development. Nevertheless, the financial needs associated with improved production methods mean that technological extension on any larger scale must go hand in hand with an extension of the branch network of the financial system to the rural areas. However, this will be likely to materialize only in the longer perspective, and then only in connection with increased marketing opportunities and better enforcement of contract laws. Small-scale agricultural development also depends on a proper solution to the problem of land entitlements, as mentioned in Chapter 2.

Developments in the production of processed food also bear evidence to the poor state of the road network. Overall, grain-milling production remained at roughly the same level during 1993–96, and since the real value of grain milling imports still made up almost 75 percent of domestic production, this sector seems to have potential for domestic expansion and import substitution. However, grain-milling imports consisted mainly of processed rice and wheat flour, while domestic production was mainly maize flour. Following the 1993 price liberalization for maize flour, output increased in 1994 only, so domestic production still hovered around the 1991 level. Moreover, the large effective protection afforded to domestic wheat-flour milling and the 1996 domestic price liberalization had not, based on available data at the time of this study, resulted in any import substitution. Accordingly, the potential for import substitution in processed food production remained untapped.[14]

In summary, one of the primary aims of the reform measures introduced in the adjustment process was to shift the composition of domestic output toward tradable goods. In fact, while the export share of GDP has gone up by about 50 percent, this was in large measure because of one product—cashews. Imported food aid had ceased, so a major component of import substitution occurred as part of the return to more normal conditions, following the severe drought and the cessation of hostilities in 1992. The majority of import substitution possibilities, associated with the recovery of the agricultural sector, have been exploited already, so ongoing development strategies must increasingly focus on the tradability of Mozambican goods.

The microeconomic instruments used to enhance efficiency under ESRP include the privatization of state enterprises and the liberalization of prices. During the period of socialist rule, all banks and the vast majority of companies had been nationalized, and the efficiency of production declined. Thus, great potential existed for efficiency gains at the outset of the privatization program. Coming from a slow start, privatization of the important larger state companies accelerated in 1995 and essentially progressed to

[14]In reaction to the improved incentives, a lot of investment in large-scale milling capacity was undertaken in the major cities during 1997–99.

completion. While the goal of moving assets from state into private hands was largely attained, an authoritative assessment of the impacts of privatization remains to be done. Nevertheless, it is fair to conclude that the privatization of the commercial parts of the formerly state-owned banks, together with the entrance of new banks, helped to increase competition in the financial sector. In addition, the stated goals regarding domestic price liberalization was essentially met, and domestic price liberalization is no longer a major policy issue.

By the end of the adjustment period, rehabilitation of the social sector still presented major challenges for the government. Revitalization of the health care system was reflected in a decreasing child mortality rate, but a lot remained to be done. Improvements to the devastated educational system had also taken place. Hence, the school network, which was closed down because of the civil war, was close to fully reconstructed; and the number of primary school teachers had increased. These improvements were not, however, able to meet the increasing requirements of a country experiencing rapidly growing population from significant numbers of returning refugees and other displaced people. Thus, significant budgetary reallocation toward social sectors was an essential priority.

Conclusions

More than a decade after the start of the stabilization and structural adjustment program, and after five years of peace, macroeconomic stabilization was achieved in Mozambique by 1997. Indicators for that time show that monetary control was effective and inflation was low. Furthermore, stable growth was reached in the second half of the 1990s leaving few policy-induced distortions in its wake. As such, key recommendations of the liberal reform program were achieved. While some see the results as wholly satisfactory, it is also clear that much of the progress realized in the mid-1990s can be attributed to economic recovery from an extraordinarily suppressive environment. In any case, it is evident that the long climb toward greater prosperity has only just begun. Many basic requirements for economic growth, such as physical infrastructure, functioning government administration, and human capital still suffered from prolonged neglect and underdevelopment by 1997. In addition, structural imbalances, including severe aid dependency, continued to be endemic and the vulnerability to exogenous shocks remained as large as ever. This was demonstrated vividly in early 2000 when massive flooding caused a catastrophe in southern Mozambique.

Progress from 1992 to 1997 included reducing the excessive consumption share of GDP and improving the foreign trade position. Yet, the composition of private consumption remained highly focused on home consumption of own production. Moreover, it was clear that fiscal and administrative changes were critically needed. The turnaround in the trade balance in particular was achieved through a decrease in the imports of consumer goods. The actual import substitution that occurred over the period had in large measure been related to the recovery of the agricultural sector, following the 1992 drought and the cessation of hostilities. Some possibilities for import substitution remain, for example, in grain-milling activities. Nevertheless, the ongoing need for imports of investment and essential consumer goods to underpin development strictly limits the effectiveness of additional import compression. This highlights the need to improve the tradability of Mozambican products and their competitiveness in domestic and international markets.

In sum, the successful stabilization of inflation and monetary growth as well as the high and stable investment level reported in this chapter are cause for optimism. Many distorting policy-induced interventions were also removed during the

adjustment phase. Nevertheless, natural recovery from the damages of war and dislocation was a significant contributor to the turnaround. The underlying real development constraints remained much the same by 1997, and while market forces had been set free, the government was left with little capacity or ability to act. The alleviation of widespread poverty remained an elusive goal without institutional requirements—such as an effective regulatory framework and the promotion of agricultural production and food security beyond mere market liberalization—being given top priority, and, hence, difficult development challenges remain.

CHAPTER 5

Linkage and Multiplier Analysis Based on the Social Accounting Matrix

The 1995 social accounting matrix for Mozambique—called MOZAM for short—was developed under the project *Macroeconomic Reforms and Regional Integration in Southern Africa*.[15] No up-to-date SAM for Mozambique was previously available. The methodological approach used relies partly on a descriptive analysis grounded in MOZAM and its aggregate macroeconomic version, MACSAM (for Mozambique Macro-SAM). This SAM confirms the critical importance of high marketing costs, the sizeable share of agricultural production consumed on-farm, and the severe capital constraint, which inhibits marketed agricultural production particularly.

A series of multipliers is also derived from MOZAM, and a structural decomposition of these is undertaken following the structural path procedure introduced by Defourny and Thorbecke (1984). Finally, a novel interpretation of the multiplier for value-added by capital (referred to as the "capital multiplier") is developed as part of the analysis to reach conclusions about development strategy and the allocation of scarce capital.

SAM Construction

In 1991 the NIS started producing coherent sets of national accounts in accordance with the United Nations System of National Accounts. The NIS figures differ substantially from the official national accounts published by the National Directorate of Planning (Table 5.1). As already pointed out in Chapter 4, these differences reflect that the NDP data have been based on dubious estimation procedures and poor cross-checking (Johnson 1995). More specifically, the NDP national accounts rely heavily on data from technical ministries and public enterprises. They do not, for example, capture the importance of home consumption of own production in the subsistence sector and a variety of activities in the services sector. In addition, the NDP data are not representative of economic activity in the formal private sector following the economic reforms undertaken since 1987 in the context of the Economic Rehabilitation Program. In contrast, the NIS data are based on a variety of surveys,[16] and they have been

---

This chapter was written by Channing Arndt, Henning Tarp Jensen, and Finn Tarp.

[15]Comprehensive documentation of the construction of the new 1995 Mozambican SAM is available in Arndt et al. (1998), and can be accessed through IFPRI's homepage, http://www.cgiar.org/ifpri/index1.htm.

[16]These include surveys of demographic features as well as expenditure and production patterns, which have been used to estimate the dimensions of consumption of own production. Moreover, the careful accounting of marketing margins, reflected in this chapter, was based on price differentials between producer and consumer prices.

Table 5.1 Comparison of 1994 data sources

Macroeconomic indicators	Data source (100 billion metical)		
	Planning (NDP)	Statistics (NIS)	Percentage difference (NIS as base)
GDP	86.5	108.4	-20.2
Investment	60.1	33.0	128.6
Exports	20.2	14.9	35.4
Imports	68.4	55.7	22.6
Trade balance	-48.2	-40.9	-18.0

Source: Compiled by authors.
Note: NIS means National Institute of Statistics; NDP means National Directorate of Planning.

adjusted for items unnoticed in the NDP approach. Finally, the new NIS accounts provide GDP from the expenditure as well as the income side.

MOZAM incorporates a complete and coherent data set, based on NIS information, which is amenable to in-depth economic analysis. Furthermore, MOZAM contains a reasonable amount of detail on the production side, covering 40 activities. With 13 agriculture and 2 agricultural processing activities, the agricultural sector is particularly well represented.[17] There are also 40 commodities, 3 factors of production (agricultural and nonagricultural labor, and capital),[18] and 2 household types (urban and rural).[19] In addition, government expenditure is divided into 2 separate accounts: recurrent government and government investment. The division of government expenditure highlights the role of aid inflows for the financing of investment for reconstruction purposes, and it also facilitates the examination of recurrent expenditures relative to tax revenue. An NGO account captures transactions related to NGOs, while a capital account reflects the private sector savings–investment balance.

MOZAM includes a number of innovative features, reflected in MACSAM labels (Table 5.2). In household demand, home consumption of own production is distinguished from private consumption of marketed commodities. Home consumption avoids trade and transport margins, which can represent 50 percent or more of the marketed price. Thus, MOZAM captures prevailing incentives for households to avoid markets and function more as autonomous production and consumption units. Marketing margins are in focus in relation to decisions about production for export and domestic consumption. However, transaction costs are also important for imported commodities. Domestic, export, and import marketing margins are therefore explicitly broken out for each activity in MOZAM.

[17]Agricultural and agriculturally related activities include maize, rice, other grains, cassava, beans, other basic crops, raw cashews, raw cotton, other export crops, other crops, livestock, forestry, and fisheries along with grain milling and other food processing. These activities correspond one-to-one with the commodity specification in MOZAM. The only exception is that an additional commodity, wheat, has no domestic activity because it is only imported.

[18]Land is relatively abundant in Mozambique, and data on returns to land are nonexistent. Some work (Ministry of Agriculture 1992) does indicate that these returns are not zero, as often assumed but the cost share of land is surely small and is therefore lumped into the returns to capital in MOZAM.

[19]A large national household survey carried out in 1996–97 facilitates further disaggregation and allows more in-depth analyses of distributional issues.

Table 5.2 Labels of the macroeconomic social accounting matrix (MACSAM)

Receipts		Expenditures											
		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12
		Activities	Commodities	Factors	Enterprises	Households	Recurrent government	Indirect taxes	Government investment	NGO	Capital	Rest of the world	Total
1.	Activities		Marketed production			Home consumption							Total sales
2.	Commodities	Intermediate consumption				Private consumption of marketed commodities	Government consumption	Export subsidies	Government investment	NGO consumption	Non-government investment	Exports (FOB)	Total marketed commodities
3.	Factors	Value-added at factor cost											Value-added at factor cost
4.	Enterprises			Gross profits			Subsidies						Enterprise income
5.	Households			Wages including mixed income	Distributed profits		Social security					Net transfers by workers	Household income
6.	Recurrent government	Consumption taxes		Factor taxes	Enterprise taxes	Income taxes		Indirect tax revenue to government					Government recurrent receipts
7.	Indirect taxes	Import tariffs	Output taxes										Tariffs plus output taxes
8.	Government investment											Aid in government budget	Government aid receipts
9.	NGO											Aid in NGO budget	NGO aid receipts
10.	Capital				Retained earnings	Household savings	Government savings 1		Government savings 2			Net capital inflow[a]	Total savings
11.	Rest of the world	Imports (CIF)											Imports
12.	Total	Total commodity supply	Total payments	Value-added at factor cost	Enterprise expenditure	Household income allocated	Tax financed government expenditure	Indirect tax receipts less export subsidies	Government investment	NGO consumption	Non-government investment	Foreign exchange available	

Source: Authors' 1995 macro-SAM for Mozambique (MACSAM).

Notes: NGO means nongovernmental organization; FOB means free on board; CIF means cost, insurance, and freight.

[a]Amounting, in principle, to the sum of the balance of payments entries not appearing elsewhere in row or column 11.

Finally, to obtain the balanced MACSAM, as well as the disaggregated MOZAM, the minimum cross-entropy estimation procedure proposed by Golan, Judge, and Miller (1996) was used (Table 5.3). This method takes all the consistency requirements of the SAM into account, and the aggregate macroeconomic totals of MOZAM were in all cases within 1 percent of the previously balanced MACSAM. Since entries were disaggregated on the basis of different, not fully compatible data sources, adjustments to individual cells of MOZAM were necessary. Differences from the original data (the estimation "prior") were generally small—that is, less than 1 percent—and seldom more than 20 percent (in such cases from a small base).

Macroeconomic Characteristics and Constraints

A coherent 1995 macroeconomic profile of the Mozambican economy can be derived from MACSAM, which confirms that Mozambique is indeed a very poor country, even when exact GDP estimates differ. Using an exchange rate of 8,890 meticals per U.S. dollar and an estimated population of 16 million, per capita income amounted to only US$121 in 1995 market prices. MACSAM also documents that home consumption accounts for almost 19 percent of total GDP, and private consumption of marketed commodities makes up 62 percent. Since home consumption avoids marketing margins, this item actually accounts for a much higher proportion of "real" household demand than is reflected in MACSAM, an issue that is further pursued in "Sectoral Characteristics and Economic Linkages," later in this chapter.

Turning to the external balance, imports add up to some 49 percent of GDP, while exports are 19 percent. This sizeable foreign trade deficit is financed by an inflow of foreign capital, mainly in the form of aid. External capital inflows to the government and NGO budgets in MACSAM can be directly attributed to foreign donors. Moreover, a major share of net capital inflows to the capital account, derived on a residual basis, is in fact related to foreign aid, as commercial borrowing from abroad is very limited. Mozambique is therefore one of the most aid-dependent countries in the world, and the sustainability of these aid flows is a matter of serious concern.

Private and government investment account for 19 percent and 17 percent of GDP, respectively. The productivity of investment gives rise to concern, as growth of per capita GDP was around 4 to 6 percent per year from 1992 to 1996. A balanced assessment must, nevertheless, take into account that some donor-funded investment may be recurrent in practice. In any case, given the need to reconstruct Mozambique after a long and vicious war, the country must maintain investment at a high level in the years to come. When it comes to investment financing, dependence on external sources is daunting. Total domestic enterprise, household, and recurrent government savings account for 11 percent of GDP, equivalent to a mere 31 percent of total savings. Hence, more than two-thirds of total savings come from external sources. Maintaining a high and efficient level of investment and lowering aid dependency is a challenging task, given the imperative of increasing the absolute level of consumption of the Mozambican population.

In relative terms, private consumption, including consumption of home-produced goods and marketed goods, makes up some 81 percent of GDP. Government and NGO consumption amounts to almost 13 percent of GDP. While consumption should rise in absolute terms because of widespread poverty, consumption in the longer term will have to fall to a much lower relative level, unless donors are willing to maintain the extraordinarily high level of aid.

Aid inflows registered in the government budget make up more than 40 percent of total revenue. Aid is therefore the largest

Table 5.3 Balanced 1995 macroeconomic social accounting matrix for Mozambique

Receipts	Expenditures (100 billion metical)											
	1. Activities	2. Commodities	3. Factors	4. Enterprises	5. Households	6. Recurrent government	7. Indirect taxes	8. Government investment	9. NGO	10. Capital	11. Rest of the world	12 Total
1. Activities		244.3			32.4							276.6
2. Commodities	121.2				107.0	16.7	0.0	28.6	5.5	33.5	32.4	344.9
3. Factors	155.8											155.8
4. Enterprises			62.9									62.9
5. Households			91.7	59.0		1.3					3.4	155.4
6. Recurrent government		10.9	1.3	2.4	2.5		5.5					22.5
7. Indirect taxes	-0.3	5.9										5.5
8. Government investment											17.6	17.6
9. NGO											5.5	5.5
10. Capital				1.5	13.6	4.5		-11.0			25.0	33.5
11. Rest of the world		83.9										83.9
12. Total	276.6	344.9	155.8	62.9	155.4	22.5	5.5	17.6	5.5	33.5	83.9	

Source: Authors' calculations and the 1995 macro-SAM for Mozambique (MACSAM).
Note: Rows and columns do not always sum to totals because of rounding.

single revenue item. Other important sources of revenue are consumption taxes and import tariffs, accounting for 27 percent and 15 percent of the total, respectively, while income taxes yield 6 percent only. The composition of revenue clearly reflects both the dramatic aid dependence of the Mozambican government and the low level of development. Trade taxes have so far been one of the few administratively feasible ways of mobilizing revenue from domestic sources. Since they have been decreasing in line with the reform efforts, there is now a pressing need for reforming the income tax system. Yet, it will take time before such changes can have any major impact.[20]

Government recurrent consumption amounts to less than 10 percent of GDP.[21] This is low given the critically important role of the state in further development in Mozambique. Hence, in line with the implementation of public sector reforms to improve government effectiveness and good governance, this share should increase. Finally, total government revenue and expenditure (including investment) imply a financing requirement of 3 percent of GDP. This is not by itself a critical figure. It is, nevertheless, high in light of the low domestic household and enterprise savings, amounting to less than 9 percent of GDP—putting the vulnerable, aid-dependent nature of the Mozambican government into perspective.

Sectoral Characteristics and Economic Linkages

The disaggregated nature of MOZAM makes it possible to extend the brief macroeconomic analysis based on MACSAM to a sectoral level. More in-depth analytical insights regarding the agricultural sector are pursued in this section as SAM multipliers are derived and decomposed. A full version of MOZAM is available, as already noted, in Arndt et al. (1998). Highlights only are provided in the following discussion.

MOZAM

The activity columns of MOZAM indicate that value-added at factor cost amounts to 56 percent of total production costs in Mozambique (Table 5.4). The share of value-added is particularly high in agriculture, where intermediate inputs account for less than 16 percent of total sectoral costs. The limited intermediate input use in agriculture reflects the rudimentary nature of technology used in this labor-intensive

Table 5.4 Sectoral production costs

	Production costs (100 billion metical)				
Cost item	**Agriculture**	**Industry**	**Services**	**Commerce**	**All sectors**
Intermediate inputs	8.8	49.5	47.4	15.4	121.1
Labor (wages)	41.9	13.4	25.7	10.9	92.0
Capital (profits)	5.1	16.6	18.9	23.2	63.8
Output taxes	-0.2	-0.1	0.0	0.0	-0.3
Total sectoral costs	55.6	79.5	92.0	49.4	276.5
Share in total costs (percentage)	20.1	28.7	33.3	17.9	100.0

Source: Authors' disaggregated (micro-) SAM for Mozambique (MOZAM).

[20]Ongoing reforms include the introduction of value-added taxes and revisions of the income tax system.

[21]If the recurrent items in government investment expenditures were taken into account, this share would be somewhat higher.

sector. In fact, almost 90 percent of value-added in agriculture represent labor wages. A more detailed analysis of agricultural sector costs of production show that—except for raw cotton, other export crops, and fisheries—the low share of value-added by capital is, indeed, a general sectoral characteristic.[22] In contrast, the share of value-added by labor is 45 percent in industry and 32 percent in commerce. Hence, under the rate of return assumption already referred to, the intensity of capital is relatively high in the production of commerce activities.

In the activity rows of MOZAM, production is transformed into home-consumed and marketed production. The second group corresponds to 88 percent of the value of total domestic production (Table 5.5). Yet, in agriculture, marketed production accounts for only 45 percent of domestic production, valued at producer prices (that is, excluding marketing margins and consumption taxes). This is a startling feature of the underdeveloped Mozambican economy, since roughly 75 percent of the Mozambican population depends on agriculture for their livelihoods. It also follows from the sectoral domestic production data that home consumption is mainly a rural phenomenon (Table 5.5).

Total commodity supply in the columns of MOZAM does not include the supply of goods for home consumption in the activity rows. Consequently, agriculture's share of total marketed supply is very low (Table 5.6). Industry plays a significant role in formal sector sales, and it is also the sector in which imports make up an overwhelming

Table 5.5 Sectoral domestic production

	Domestic production (100 billion metical)				
Production item	**Agriculture**	**Industry**	**Services**	**Commerce**	**All sectors**
Urban home consumption	3.0	0.0	0.6	0	3.6
Rural home consumption	27.4	0.2	1.3	0	29.0
Marketed production	25.2	79.2	90.1	49.4	243.9
Total sectoral production	55.6	79.5	92.0	49.4	276.5
Share in total production (percentage)	20.1	28.7	33.3	17.9	100.0

Source: Authors' disaggregated (micro-) SAM for Mozambique (MOZAM).

Table 5.6 Composition of sectoral supplies

	Sectoral supplies (100 billion metical)			
Supply item	**Agriculture**	**Industry**	**Services**	**All sectors**
Domestic production	25.1	79.2	90.1	194.4
Marketing margins	12.5	37.0	0.0	49.4
Consumption taxes	0.9	7.6	2.2	10.8
Import tariffs	0.2	5.6	0.0	5.9
Imports	5.0	64.7	14.2	83.9
Total sectoral supply	43.8	194.1	106.6	344.5
Share of total supply (percentage)	12.7	56.3	30.9	100.0

Source: Authors' disaggregated (micro-) SAM for Mozambique (MOZAM).

[22]Assuming that the rate of return to capital is the same across all sectors of the economy, the implication is that capital stocks (and the implied capital intensities in production) are relatively small in the majority of the agricultural subsectors.

share of supply. Thus, industry is the sector in which government has, at least in the timeframe of this study, relatively easy access to revenue in the form of consumption taxes and import tariffs.

The data on composition of sectoral supplies confirm that commercial margins are particularly important in agriculture (Table 5.6). In fact, they account for 29 percent of the total value of the supply of marketed agricultural products. In industry, the corresponding share is 19 percent, whereas the service sector has, by definition, no marketing costs. The high share of commercial margins in marketed agriculture explains why home consumption of agricultural products is so widespread. Moreover, it illustrates that heavily home-consumed subsectors, such as cassava and other basic crops, are burdened with average domestic marketing costs of 80 percent of the market prices. In contrast, maize faces more modest margins of around 25 percent.

The demand side of the Mozambican economy, in the commodity rows of MOZAM, is dominated by private consumption, but the two investment accounts also make up a considerable share of final demand (Table 5.7). Moreover, the export share of the industrial sector is small. This sector therefore runs a large trade deficit. In contrast, both the marketed agriculture and service sectors run trade surpluses with export shares of around 20 percent. Within agriculture, more than two-thirds of exports come from fisheries.

The disaggregation of factor and household accounts in MOZAM indicates that 80 percent of capital income is paid to urban households, whereas 60 percent of wage income goes to rural households. Given that the large majority of Mozambicans are rural, this depicts an unequal distribution of income between rural and urban areas. Poverty, though certainly acute for some urban people, is mainly a rural phenomenon. While urban dwellers save 12.5 percent of their income, the equivalent savings rate is only 3.8 percent in rural areas.

Finally, MOZAM implies that while agriculture is crucial for the subsistence and employment of the large majority of the Mozambican population, agricultural GDP amounts to only 28 percent of total GDP, including marketed production at market prices as well as home consumption at producer prices. On the other hand, services, industry, and commerce account for 27 percent, 25 percent, and 20 percent of GDP, respectively.

Multiplier and Structural Path Analyses

SAM-based multiplier models belong to the class of general-equilibrium models that use fixed prices in assessing the economic effects of exogenous changes in income and

Table 5.7 Composition of sectoral demand

	Sectoral demand (100 billion metical)			
Demand item	**Agriculture**	**Industry**	**Services**	**All sectors**
Intermediate consumption	15.0	57.7	48.4	121.1
Private consumption	20.1	70.9	15.8	106.8
Government consumption	0.0	0.0	16.8	16.8
NGO consumption	0.0	0.0	5.5	5.5
Private investment	0.1	30.8	2.3	33.1
Government investment	0.0	27.6	0.8	28.4
Exports	8.6	7.1	17.0	32.7
Total sectoral demand	43.8	194.1	106.6	344.5
Share of total demand (percentage)	12.7	56.3	30.9	100.0

Source: Authors' disaggregated (micro-) SAM for Mozambique (MOZAM).

demand. The common distinguishing features of these models include three basic sets of assumptions. First, prices are fixed. Accordingly, conclusions about quantities are drawn on the basis of values. Second, functional relationships are taken as linear in the SAM columns. This implies, among other things, that Leontief production functions are relied on in the activity columns, and there is no substitution between imports and domestic production in the commodity columns.[23] Third, multiplier models are demand driven. Accordingly, there are no supply-side constraints on economic activity.[24]

In the MOZAM-multiplier application, activities, commodities, factors, enterprises, and households are specified as endogenous accounts, whereas government recurrent, indirect taxes, government investment, NGOs, capital, and the rest of the world are kept exogenous. Thus, only two kinds of shocks are possible, working through the commodity and the household accounts, respectively.[25] In the analyses, reference is made to individual as well as total and sectoral multipliers. The total multiplier for domestic activity output following from a shock to a commodity is defined as the sum of the multipliers (down the column of the multiplier matrix) for all of the affected activity accounts. For example, a one-unit increase in the demand for maize generates an increase in total domestic production of 2.10 units (Table 5.9). Other total multipliers can be defined with respect to total supply, value-added, enterprise income, and household income.[26] Accordingly, the total multiplier for household income following from a shock to the cassava commodity account, for example, is defined as the sum of the individual household income multipliers with respect to cassava. The sectoral commodity multiplier is, in turn, defined as the weighted average of the total multipliers belonging to a given set of commodity accounts where the weights reflect 1995 shares in total sectoral supply.[27]

In the analysis, particular attention is also paid to the capital multipliers.[28] Capital is—from an overall point of view—the critically scarce factor of production in Mozambique. Nevertheless, some limited capital is available for economic expansion. As such, capital should be considered, from an analytical point of view, as freely available when marginal expansion in specific sectors of production is considered. This is

[23]Leontief production functions are characterized by constant returns to scale as well as no substitution in factors or intermediate inputs. Moreover, consumption shares of the households in the relevant columns of the SAM are constant.

[24]SAM multiplier analysis is a static analysis that cannot capture the full dynamic returns to investments.

[25]A more traditional input–output multiplier analysis would have to be used if home consumption were to be made an exogenous demand component. This is not pursued here.

[26]Linkages to enterprise income closely match linkages to capital. This is because the MOZAM framework allocates all of the capital income to the enterprise account, which in turn distributes most of this income to the household accounts. It is only because of small-enterprise taxes and retained earnings that the multipliers are not perfectly identical. Consequently, the interpretation of the linkages to the enterprise account is the same as the interpretation of the linkages to capital. Hence reference is not made to enterprise income multipliers in what follows.

[27]The total multipliers for agricultural commodities with respect to domestic production are, for example, averaged to arrive at what is termed the sectoral commodity multiplier for agriculture. In other words, this sectoral multiplier reflects the increase in domestic production that would ensue with an increase in the demand for the "average" agricultural commodity.

[28]In what follows, "capital multiplier" is used as shorthand for "value-added by capital multiplier." Note that, since the prices of capital (the rates of return) are assumed constant, the capital multipliers actually measure the additional physical capital needed to sustain the multiplier process.

Table 5.8 Agricultural commodity multipliers

Measure	Maize	Rice	Wheat	Other grains	Cassava	Beans	Other basic crops	Raw cashews	Raw cotton	Other export crops	Other crops	Livestock	Forestry	Fisheries
Activities and commodities														
Noncommerce activities	1.54	2.99	0.00	2.30	1.92	1.59	1.99	2.48	2.47	2.01	1.09	2.50	2.71	2.33
Domestic commerce	0.29	0.30	0.00	0.73	0.95	0.39	0.70	0.54	0.22	0.29	0.43	0.47	0.37	0.29
Export commerce	0.02	0.03	0.00	0.03	0.02	0.02	0.03	0.05	0.04	0.23	0.02	0.03	0.05	0.02
Import commerce	0.25	0.25	0.00	0.22	0.20	0.31	0.27	0.22	0.30	0.29	0.16	0.23	0.22	0.21
Total activities	2.10	3.58	0.00	3.28	3.09	2.31	2.99	3.29	3.03	2.81	1.70	3.22	3.35	2.86
Total commodities	2.58	3.62	1.00	3.49	3.41	2.77	3.29	3.48	3.41	3.22	2.32	3.45	3.54	3.35
Factors and enterprises														
Agricultural labor	0.77	1.69	0.00	1.06	0.69	0.70	0.85	1.20	0.89	0.72	0.43	1.19	1.28	0.58
Nonagricultural labor	0.25	0.32	0.00	0.42	0.47	0.30	0.41	0.38	0.30	0.34	0.25	0.34	0.35	0.31
Capital	0.42	0.50	0.00	0.70	0.82	0.51	0.71	0.64	0.56	0.64	0.43	0.57	0.58	0.61
Total factors	1.44	2.51	0.00	2.18	1.98	1.52	1.97	2.22	1.74	1.71	1.10	2.11	2.22	1.50
Total enterprises	0.41	0.49	0.00	0.69	0.81	0.51	0.70	0.63	0.55	0.63	0.42	0.56	0.58	0.60
Households														
Urban households	0.58	0.84	0.00	0.94	1.00	0.67	0.91	0.90	0.74	0.79	0.53	0.82	0.85	0.73
Rural households	0.82	1.62	0.00	1.18	0.92	0.80	1.01	1.27	0.96	0.86	0.54	1.24	1.31	0.73
Total households	1.41	2.47	0.00	2.12	1.91	1.48	1.91	2.17	1.70	1.66	1.07	2.06	2.17	1.45

Source: Authors' calculations and the disaggregated (micro-) SAM for Mozambique (MOZAM).

exactly the assumption underlying standard SAM-multiplier analysis, in which capital is treated as a fully unconstrained, endogenous factor. It is evident, however, that the relative scarcity of capital at the macroeconomic level has a fundamental impact on how the multiplier results should be interpreted. Normally, large multipliers in target sectors are welcome. They signal big effects on the economy. However, capital multipliers also measure the additional number of capital units needed to sustain the multiplier process. Thus, under conditions of generalized capital scarcity, maximizing the overall production and income effects presumes that capital use is minimized. Assuming that the rates of return to capital are the same across sectors, it follows that it is the ratio between the multiplier in focus in the target sector and the capital multiplier, rather than the target multipliers per se, that is the proper measure to focus on.[29]

This approach is adopted in the following discussion. While it is methodologically different, it is similar in spirit to the constrained multiplier analysis proposed by Parikh and Thorbecke (1996). Their starting point is that well-defined, but limited, excess capacities exist in certain production sectors. On this basis, in addition to the unconstrained multipliers, they derive so-called mixed multipliers, which come into effect as capacity constraints are reached. The final multipliers put forward by Parikh and Thorbecke (1996) are defined as the sum of the unconstrained and mixed multipliers. However, this route is not appropriate here. First, detailed data are not available on the amount of excess capital in Mozambique. Second, a major objective of this report is to identify the sectors in which expansion should originate, with a view to allocating available capital most effectively. Hence, the multiplier methodology must allow capital to adjust endogenously in the multiplier analysis.[30]

Finally, path-multiplier decompositions, as described in Defourny and Thorbecke (1984), are relied on to investigate the importance of capital-intensive marketing services in the transformation of domestic production into home-consumed and marketed goods. Structural path analysis is designed to provide a more detailed picture of the effects of shocks to exogenous accounts. The SAM multipliers measure the cumulative effects from a shock, while the path analysis decomposes the multiplier into direct and indirect components. The effect on domestic marketing margins following a shock to the demand for a given commodity can therefore be divided into effects related to the marketing of the final domestic product and the marketing of intermediate inputs, respectively. Thus, the structural path decomposition is useful in this context in understanding the nature and strength of linkages that work through the commerce sector, which is the focus of the discussion of incentives to consume on-farm rather than supplying to the market.[31]

---

[29]The implicit assumption of a uniform rate of return to capital across sectors is relied on in the sectoral ranking in this report. Ranking according to changes in the returns to capital (that is, the capital multiplier) as done in what follows is only consistent with the desired ranking according to changes in the stock of capital (that is, capital used in the multiplier process) when the rate of return to capital is uniform.

[30]Subramanian and Sadoulet (1990) suggest the use of yet another analytical framework in which supply constraints are binding right from the outset, with Lewis and Thorbecke (1992) being an illustrative application. Since the focus of the present report is on the magnitude of traditional multipliers and on the allocation of scarce capital among the various production sectors, capital is not seen as binding for individual sectors. This is why the constrained multiplier approach was not adopted here.

[31]A complete structural path analysis has been carried out as part of the research reported here. Tables with the full set of total influences (in the notation of Defourny and Thorbecke) can be obtained from the authors. For reasons of space, only selected results are given here given the focus on decomposition related to marketing.

Concerning linkages from commodity demand, it is clear that the agriculture and services sectors have large linkages to domestic production, total supply, value-added, and household income. However, industry has in general rather small linkages (Table 5.9). It also appears that the sectoral commodity multiplier of services with respect to domestic production, amounting to 2.56, is lower than that of agriculture (2.75). Since the linkage from services to the capital-intensive activity of domestic commerce is relatively small (0.19), it might seem that an increase in services could expand production without significant strain on scarce capital. Yet, this is an incomplete assessment, as only capital used in marketing services is considered. Account must also be taken of the capital used in actual "physical" service production, reflected in a capital multiplier of 0.60. On this basis, it can be concluded that an increase in overall domestic production is most effectively arrived at in terms of capital used by expanding the agriculture sector. This is reflected in the fact that the ratio between the output and capital multipliers (that is, 2.75/0.59 = 4.66) is largest in domestic agricultural production.[32]

Agriculture has the largest sectoral multipliers when it comes to factor and household income. A one-unit expansion in the demand for the "average" agricultural good will create additional factor returns of 1.72 units. Furthermore, since the ratio between value-added and the individual capital multiplier is largest for agriculture, this sector stimulates valued-added through a more effective use of capital than is the case for the other two sectors. Similarly, a unit expansion of agriculture will increase household income by 1.67 units. This is more (both absolutely and relative to the capital multiplier) than what would result from stimulating the services and industry sectors. Finally, the increase in income following

Table 5.9 Sectoral commodity multipliers

Measure	Agriculture	Industry	Services
Activities and commodities			
Noncommerce	2.03	1.34	2.17
Domestic commerce	0.45	0.21	0.19
Export commerce	0.03	0.03	0.02
Import commerce	0.23	0.24	0.18
Total activities	2.75	1.81	2.56
Total commodities	3.14	2.47	3.08
Factors and enterprises			
Agricultural labor	0.79	0.25	0.34
Nonagricultural labor	0.33	0.29	0.51
Capital	0.59	0.47	0.60
Total factors	1.72	1.01	1.44
Total enterprises	0.58	0.46	0.59
Households			
Urban households	0.76	0.56	0.79
Rural households	0.91	0.42	0.60
Total households	1.67	0.97	1.39

Source: Authors' calculations and the disaggregated (micro-) SAM for Mozambique (MOZAM).

[32]Assuming a rate of return to capital of 10 percent, the additional domestic production per unit of capital used in the multiplier process can be calculated as 2.75/(0.59/0.10) = 0.47. Assuming—as previously mentioned—a uniform rate of return to capital across sectors, it follows that ranking based on the capital multiplier is the same as ranking based on capital used in the multiplier process.

from a demand shock to the agriculture sector are directed relatively more toward rural areas.

Turning to the multipliers, following shocks to the demand for specific agricultural commodities, they span a broad spectrum of combinations of linkages (Table 5.8).[33] The commodities can be grouped into categories with markedly different characteristics as regards their potential for furthering domestic production, value-added, and household income, including a more equal distribution of income. These characteristics are, in turn, largely determined by the size of the total multipliers. The amount of capital necessary to fuel the multiplier process does, however, also play a role in ranking the commodities, especially in the case of maize.

Rice is the crop with the highest linkages. It faces reasonably low domestic marketing costs, reflected in a multiplier of 0.30. In addition, capital costs for rice that are associated with the multiplier process are relatively low.[34] In addition, the total value-added to the capital multiplier ratio (2.51/0.50 = 5.02) is very high, and the same goes for the relative domestic activity and household multipliers. Thus, MOZAM implies that expanding rice production appears attractive. Yet, current rice production cannot expand much in reality because of existing land and water constraints, which would eventually be felt.

Maize is the second-largest individual crop in MOZAM when both marketed and home-consumed production are taken into account, and the production of marketed maize has relatively small overall linkages (Table 5.8). Yet, the multiplier process following an expansion of this crop also faces relatively low domestic marketing and capital constraints. The path multiplier analysis shows that 52 percent of the marketing costs pertain to the marketing of the final domestic product, and that 48 percent can be attributed to the multiplier process associated with the marketing of intermediate inputs. It follows that the total structural path influence associated with the marketing of the final domestic product is 0.15 (0.29 * 0.52). This is relatively low compared with other commodities, such as cassava and other basic food crops, where the share of home-consumed production is also high. Thus, the potential to transform home-consumed maize into marketed maize appears promising relative to other agricultural products.

Maize is also characterized by high ratios between the different total multipliers and the capital multiplier (Table 5.8), implying that an expansion of this crop might be an attractive policy option in formulating agricultural development strategies. This is particularly so since maize has significant natural potential for expansion. Furthermore, the high linkage to agricultural labor income, relative to nonagricultural labor (0.77/0.25 = 3.08) and capital (0.77/0.42 = 1.83) means that it is the rural population that benefits most from expanding maize production. Nevertheless, given the limitations of the multiplier analysis, it should be

[33]Official government investment figures amounted to about 45 percent of total investment in 1995, as estimated by NIS. For reasons of space, comments are not included on other grains (mainly sorghum), beans, other export crops (citrus fruits, copra, and sugar crops), and other crops (various minor crops, sunflower, and mafurra). These commodities represent crops that have either low multipliers (beans and other crops) or high capital multipliers (other grains and other export crops). Their importance is clear from the main text. The two agricultural processing commodities—flour milling and other food processing—have multipliers similar to those of industry. Textiles, often considered of interest because they use raw cotton as an input, do not perform better than the other industrial commodities in terms of multipliers.

[34]Terms such as "marketing costs" or "use of capital" include both the direct costs related to the expansion of a particular commodity that is shocked and the derived use of marketing services and capital in the multiplier process.

noted that the possibility of relatively easy import substitution has essentially been exhausted. Further growth in production will most likely have to be accompanied by expansion of investments in small- and large-scale milling, or expansion of exports, which would require developing export-oriented institutions. In Chapter 6, the capacity of export institutions, measured by an elasticity of transformation between exports and domestically marketed maize, is estimated to be quite low, implying that exports must be accompanied by development of export institutions.

Livestock and forestry are characterized by high linkages to noncommerce domestic production, while the domestic marketing and capital multipliers are of intermediate size. The path multiplier analysis reveals that the influence associated with the marketing of the final domestic products is around 0.13, which is rather low. Increasing the share of marketed production of these goods (including particularly activities such as small ruminants and firewood collection) is therefore a promising option. Furthermore, livestock and forestry have very high multiplier ratios relative to the capital multipliers, and high linkages to agricultural labor mean that an expansion of these marketed commodities will benefit rural over urban households. Thus, livestock and forestry are sectors of considerable interest in future agricultural development in Mozambique, particularly since they are associated with considerable potential for expansion. This last observation reflects both the natural-resource endowment of Mozambique and the elimination of livestock herds during the war period.

Raw cashews show high linkages to noncommerce domestic production, but this sector is also associated with relatively high domestic marketing and capital multipliers. The result is that value-added and household-income multipliers relative to the capital multiplier are lower than that of livestock and forestry, but still relatively high and—in this respect—comparable with maize. Yet, the path analysis shows that the marketing costs of the final domestic product are high (0.34). Thus, the potential for shifting the balance between home-consumed and marketed raw cashews is not very promising in contrast to, for example, maize. Nevertheless, a caveat to the multiplier analysis is that the cashew processing sector is relatively inefficient, as it stands in the data set. Accordingly, a more efficient processing sector could possibly spur structural changes and raise the creation of value-added in the primary production sector.

Home consumption as a share of domestic production ranges between 38 and 80 percent for the 5 agricultural products singled out above.[35] However, despite these shares of home-consumed production, the associated marketing constraints are not particularly large, with the possible exception of raw cashews. It follows that the share of home, consumed production could, and should, decline. This is not true for cassava and other basic crops (largely vegetables), which face very high domestic marketing constraints. Furthermore, the excessive marketing costs are the main reason for the high capital multipliers since these crops are certainly among the least capital-intensive in production. The path analysis shows that the influences associated with the marketing of final domestic production of cassava and other basic crops are 0.89 and 0.60, respectively. Consequently, these commodities have very limited potential for market development. Low ratios of total-to-capital multipliers are also characteristic. Nevertheless, insurance, or safety-first,

[35]The shares of home consumption in total production valued at producer prices are rice, 80 percent; maize, 63 percent; livestock, 50 percent; forestry, 48 percent; and raw cashews, 38 percent. In comparison, home-consumed cassava and other basic crops make up 92 percent and 62 percent of total production, respectively.

considerations, which are not captured in the SAM multiplier analysis, are particularly important for cassava production, as further discussed in Chapter 10.

The fisheries sector[36] has high linkages to noncommerce domestic production and is associated with a low domestic marketing multiplier. However, both the dependence on intermediate inputs and the high share of capital in total value-added imply that the capital multiplier ends up quite high. This lowers the ratio between the total multipliers and the capital multiplier considerably. Expansion of fisheries does therefore not appear particularly attractive in a situation where capital is scarce and natural resources are constrained. This result is further underlined by the fact that a low ratio between rural and urban household multipliers for fisheries implies that an overall expansion of this sector does not seem to carry attractive equity and poverty alleviation effects.

Finally, raw cotton has some attractive characteristics, such as a low capital multiplier, because of its role as a direct input into the textile industry. As such, raw cotton has relatively high total multipliers per unit of capital. Thus, it comes out as a borderline case between fisheries on the one hand and livestock and forestry on the other. Yet, the multiplier process associated with an expansion of the textile sector, which drives the demand for raw cotton, is not attractive according to the 1995 MOZAM. Again, a caveat to the multiplier analysis is that a more efficient processing sector could possibly raise the creation of value-added in the primary production sector, or that the development of trade links could allow the raw cotton production sector to tap into export markets.[37]

Table 5.10 Household multipliers

Measure	Urban households	Rural households
Activities and commodities		
Noncommerce activities	1.44	2.03
Domestic commerce	0.26	0.32
Export commerce	0.03	0.03
Import commerce	0.21	0.25
Total activities	1.94	2.63
Total commodities	2.36	2.55
Factors and enterprises		
Agricultural labor	0.38	0.86
Nonagricultural labor	0.30	0.33
Capital	0.45	0.51
Total factors	1.13	1.70
Total enterprises	0.44	0.50
Households		
Urban households	1.57	0.71
Rural households	0.52	1.95
Total households	2.09	2.66

Source: Authors' calculations and the disaggregated (micro-) SAM for Mozambique (MOZAM).

[36]The activity "fisheries" is treated here as an aggregate, and subsectors such as small-scale fisheries, which have substantially different characteristics in terms of imported intermediates, are not accounted for separately. Furthermore, if the generation of exports was the exclusive focus, it is relevant to recall that both raw cotton and fisheries are important. Yet expanding them will, in the Mozambican situation of scarce capital, take place at a substantial cost to other sectors. Moreover, exports are exogenous in the SAM framework applied here. They are therefore set at a level provided by the analyst rather than being an endogenous response, as in a fully specified CGE model.

[37]While no raw cotton was exported in 1995, exports rose considerably in later years.

The second category of exogenous shocks that can initiate a MOZAM multiplier process—that is, shocks to household income—can be implemented either by increasing social security transfers from government or transfers from abroad (Table 5.10). Such shocks have uniformly higher multipliers when they work through rural rather than urban households. People in rural areas demand more agricultural products, and the feedback mechanism for expenditures and income has fewer leakages because of the lower rural savings rate. In addition, value-added and household-income multipliers are in all cases higher relative to capital multipliers when rural rather than urban income expands.

Conclusions

The macroeconomic situation of Mozambique leaves much to be desired, as discussed above. Poverty is widespread, and the room for income redistribution is nonexistent. Thus, growth must form the core of any future development strategy to increase consumption in absolute terms. Yet, investment is only being maintained at a reasonable level because of the influx of aid. It follows that mobilizing savings and changing the consumption-investment balance, as well as making the best of capital investments actually undertaken, are critical macroeconomic challenges in promoting longer-term growth in Mozambique. Moreover, government revenue needs to increase. To overcome these problems, the economic reform program must shift its focus from the macroeconomic stabilization achieved in the 1990s, to addressing the fundamental need for structural change and development.

The sectoral GDP figures, especially the low share of agriculture, are unusual given the low level of development of the Mozambican economy. They are, however, a reflection of geography, poor infrastructure, and the role of Mozambique as a provider of services to neighboring countries. In any case, agricultural development is currently the only way of providing a livelihood for the vast majority of the population. It is also a particularly effective way of increasing the extremely low rural savings rate and might enable the government to diversify revenue sources away from the present excessive dependence on import related consumption taxes and import tariffs.

The critical importance of agriculture also clearly emerges from the multiplier and structural path analysis discussed above. Agriculture has much larger sectoral linkages than industry, and agriculture is more effective than either industry or services in generating additional value-added under the conditions of scarce capital. In addition, the sectoral commodity multipliers confirm that agricultural expansion is the most appropriate way of reducing the inequality in the rural-urban income distribution. Growth strategies for reducing poverty must focus on the agricultural sector. This observation is further reinforced by the fact that exogenous income transfers have, in the case of Mozambique, higher multiplier effects when they are channeled through rural people.

While agriculture has high average multipliers, the specific agricultural commodity multipliers and path analyses demonstrate large intrasectoral differences. For example, agricultural development in Mozambique cannot rely in any significant way—from a strictly economic perspective—on expanding or shifting the balance between home-consumed and marketed production of cassava and other basic crops. Similarly, the raw cotton and fisheries sectors do not appear to be very promising, while livestock and forestry present reasonably well, particularly in terms of smallholder production. In addition, as demonstrated here, maize and to a lesser degree rice must form part of the very core of any short-to medium-term Mozambican development strategy. Cassava is added to this list in Chapter 10 because of its particular insurance characteristics.

CHAPTER 6

A CGE Model for Mozambique

As previously discussed, a computable general-equilibrium model was developed for Mozambique. A complete list of the equations of the model are in Appendix A.[38] In many ways, the Mozambican model employed for the simulations described in Chapters 7–11 is standard; however, it also exhibits a number of important departures from standard neoclassical CGE models. These departures include taking explicit account of the costs associated with marketing goods.

The large costs associated with marketing agricultural production imply that much of the rural population consumes a large part of their own produce. The explicit inclusion of home consumption of own production represents another departure from standard neoclassical models. This feature is important because it enables poor rural households to avoid the marketing costs associated with marketed agricultural products. The combined modeling of home consumption and marketing costs is important because it represents two sides of the same coin. Other nonstandard features of the Mozambican CGE model include imperfect mobility of labor between agricultural and nonagricultural occupations and minimum production levels for certain agricultural crops given safety-first considerations. The discussion of the Mozambican CGE model in this chapter focuses on these special characteristics.

The empirical foundations for the departures from more standard models vary in strength. Those departures thought to have the strongest empirical basis are incorporated into a base CGE model developed from the 1995 base-year SAM presented in Chapter 5. This model is then subjected to a novel and rigorous empirical testing procedure (see "Validation and Estimation," below; and also Arndt, Robinson, and Tarp 2002). The procedure essentially addresses two questions. First, can the model reproduce recent historical economic performance in Mozambique? Second, for which values of behavioral parameters, chosen from an acceptable prior distribution, does the model best reproduce the historical record?

In sum, this chapter presents an empirical and theoretical hypothesis concerning the structure of the Mozambican economy in the form of a CGE model, tests this hypothesis against the historical record, and estimates acceptable parameter values that best fit the historical record. This exercise provides both a basis on which to judge the capacity of the model to track economic events and an empirical foundation for behavioral relationships. The validation and

---

This chapter was written by Channing Arndt, Henning Tarp Jensen, and Finn Tarp.

[38]The model presented here was developed under the project *Macroeconomic Reforms and Regional Integration in Southern Africa*, and applied for the first time by Arndt et al. (2000) in the study underlying Chapter 9. Subsequently, many of the new features—including marketing margins and home consumption—were included in the so-called standard IFPRI CGE model (Lofgren, Harris, and Robinson 2001).

estimation procedure used here for a macroeconomic model is in the spirit of Hansen and Heckman (1996). They argue that the distinction between calibration (estimation) and verification (validation) is often contrived and that what is needed is a clearly stated criterion for picking the parameters of a model and assessing the quality of that selection. The procedure presented below provides both.

It is asserted, on the basis of the results from the estimation and validation procedure, that the model adequately reproduces the historical record. Consequently, the estimated vector of behavioral parameters is accepted, and the implications of these parameter-value estimates are discussed. Finally, the basic model structure, parameterized with the estimated vector, is deemed suitable for policy analysis.

Model Characteristics

The standard neoclassical CGE model assumes (1) perfect competition, profit, and utility maximization by firms and consumers, respectively; (2) no transactions costs; and (3) perfect mobility of factors of production (land excepted). This model is used regularly as benchmark in economic modeling. From this basic structure, a large number of models with differing characteristics can be developed (see Dervis, de Melo, and Robinson 1982).

In the Mozambican economy, cross-hauling involving two-way trade of the same commodity can be found in many sectors, examples being food processing and other services. Cross-hauling is efficiently dealt with in the context of the 1-2-3 model by Devarajan et al. (1997). This model is at the core of the Mozambican CGE model. Imperfect substitution between domestic and foreign commodities are dealt with through an Armington constant elasticity of substitution (CES) function on the import side and a constant elasticity of transformation (CET) function on the export side.

Furthermore, the core 1-2-3 model can be extended easily to reflect conditions in the economy that contradict the assumptions underlying the standard neoclassical model. For example, unemployment can be modeled easily by assuming a fixed nominal wage and a variable supply of labor, as opposed to the standard case of a variable wage and a fixed, fully employed supply of labor. In addition, the model can be altered relatively easily to accommodate fixed factors of production or factors of production that move sluggishly between being employed in various activities.

The choice of macroclosure imposed on the model often receives considerable scrutiny. Since the model is a closed system, it must satisfy Walras' law. Walras' law states that if all but one equation in a closed system are satisfied, the final equation must be satisfied as well. In addition, basic macroeconomic balances imply that private savings + government savings + foreign savings = aggregate investment. One of these elements must be allowed to adjust, unencumbered by any behavioral equation, if the model is to simultaneously satisfy this identity and Walras' law.

Theoretical perspectives on the operation of the macroeconomy also play a key role. The "neoclassical" closure views investment as endogenous and determined by available savings. This is the most commonly employed closure. Since aid flows are such a dominant driver of investment in Mozambique, this is the closure employed for most of the simulations in this report as well as for the estimation and validation exercise. However, alternative choices of macroclosure exist. One alternative is a "Keynesian" closure, which views investment as exogenous. In this specification, total savings must adjust to attain the specified level of investment. An adapted

version of this closure is used for parts of the trade policy analyses in Chapter 8.[39]

Here, the primary concern is with elucidating key elements in the structure of the Mozambican economy and fashioning a CGE model that reflects these elements. Extensions to the core 1-2-3 model are presented below. The departures from the standard neoclassical model are present in some (but not all) of the models employed for analysis in Chapters 7–11. The importance of these features follows directly from the structure of the Mozambican economy (Table 6.1) and the discussion in Chapter 5. As mentioned, Appendix A contains the full set of equations.

Table 6.1 Production structure of the economy

	Activity (percentage)					
Sector/Category	**Value-added**	**Exports**	**Imports**	**Export share of output**	**Import share of absorption**	**Domestic margin**
Grain	5.7	0.2	4.0	0.8	42.4	27.4
Cassava	6.1	0.0	0.0	0.0	0.0	302.5
Raw cashews	0.7	0.2	0.0	5.7	0.0	44.2
Raw cotton	0.3	0.0	0.0	0.0	0.0	0.0
Other export crops	0.6	2.4	0.1	54.8	8.2	52.3
Basic food crops	6.8	0.3	1.6	0.9	10.9	111.2
Livestock	2.4	0.1	0.2	0.4	7.4	13.6
Forestry	3.3	1.7	0.0	9.3	0.2	14.9
Fisheries	4.3	21.3	0.0	71.5	0.0	44.3
Mining	0.5	2.6	0.3	77.6	41.1	8.9
Food processing	2.8	8.6	18.8	13.7	26.9	58.7
Textiles and leather	1.0	6.8	2.8	67.8	39.5	36.2
Wood	0.5	1.2	0.6	21.7	19.9	26.0
Paper and packaging	0.1	0.0	1.4	1.2	40.7	37.4
Fuels and chemicals	0.5	1.1	18.5	15.4	54.2	46.7
Nonmetals	0.3	0.0	3.1	0.7	39.9	31.6
Metals	0.2	0.7	1.4	41.3	56.2	23.4
Machinery and equipment	0.2	0.6	28.7	17.5	76.2	14.0
Electricity and water	0.6	0.0	1.4	0.0	21.0	0.0
Construction	12.6	0.0	0.0	0.0	0.0	0.0
Transport and communication	6.8	23.9	4.8	21.7	12.3	0.0
Banking and insurance	7.2	0.9	0.2	2.2	1.2	0.0
Dwellings	1.1	0.0	0.0	0.0	0.0	0.0
Public administration	3.7	0.0	0.0	0.0	0.0	0.0
Education	1.7	0.0	0.0	0.0	0.0	0.0
Health	0.6	0.0	0.0	0.0	0.0	0.0
Other services	7.5	27.3	12.0	39.5	40.0	0.0
Commerce	21.9	0.0	0.0	0.0	…	…
Total	100.0	100.0	100.0	…	…	…
Average	…	…	…	12.5	26.9	11.9

Source: Authors' calculations and the disaggregated (micro-) SAM for Mozambique (MOZAM).
Note: An ellipsis (…) means not applicable.

[39]Much literature exists on the implications of alternative macroeconomic closures. Refer to, for example, Taylor (1990) and Sen (1963). The choice of external closure is mainly driven by the policy environment. It depends in particular on whether the country pursues a fixed or a flexible exchange rate regime. The choice of macroeconomic closure affects model behavior and results.

Four significant departures from the standard neoclassical model stand out: marketing margins, home consumption, agricultural versus nonagricultural labor, and agricultural household behavior. These are discussed below; their implications are pursued in subsequent chapters.

Marketing Margins

Marketing margins reflect storage and transportation costs, as well as risk associated with trading activities and limited opportunities for diversification. Since the CGE model is created with a medium-term focus, it is assumed that marketing technologies remain fixed over the experiment horizon. The marketing margins are introduced into the static CGE model by assuming that each unit of a given production good requires a fixed amount of marketing services to reach the market. Since the current model framework treats imported and exported goods as inherently different from domestically consumed production, marketing margins related to exports, imports, and domestic goods were accounted for separately. The commercial services needed for marketing purposes are all produced domestically and considered to be similar in nature, that is, the same trucks and storage facilities were considered to be used for marketing each of the three different types of goods. Accordingly, a single production activity provides the commercial services associated with the marketing of commodities. Transaction costs vary among sectors, as emphasized in Chapter 5. They are zero in service sectors, by definition, while they are nonzero and can become very large in other goods sectors. The data indicate that the cost of delivering certain agricultural crops to domestic consumers surpasses the cost of the product at the farm or factory gate (Table 6.1).

All versions of the model are extended to include marketing margins. Marketing costs vary depending on whether the product is imported, exported, or domestically produced and marketed. Different margin rates are therefore specified for imports, exports, and domestically marketed production. As shown in Appendix A, marketing margins enter equations (A1) through (A3), which determine domestic market prices for imports, exports, and domestically marketed production. The parameters MRM_{im}, MRE_{ie}, and MRD_i (where the last is tabulated in percentage terms in Table 6.1) denote the quantity of commercial services required to market one unit of imported, exported, and domestically produced commodities, respectively. These fixed quantities of commercial services are multiplied by their price, PQA_{imr}, to obtain nominal wedges between border and factory or farm-gate prices, on the one hand; and to obtain domestic prices for imports, exports and domestically marketed commodities, on the other. In relation to domestically marketed production, this implies that commercial services are treated as another intermediate input. Production of commercial services is capital intensive. As a result, a strong relationship exists between returns to capital and the commercial service price.

Home Consumption

Almost all Mozambican households have some money income, either from goods sales or from factor remunerations. This income is used for purchases of essential goods that cannot be produced by the households themselves. Nevertheless, the possibility of home consumption enables households to bypass the market in so far as they can produce consumption goods themselves. The presence of high marketing margins implies the existence of significant wedges between farmgate sales prices and market prices. Rather than sell at a low price and purchase at a high price, households—particularly rural agricultural households—can opt to consume at least some of what they produce. In this way, explicit modeling of the interaction between marketing costs and home consumption

becomes essential for assessing important aspects of the economy, such as poverty alleviation and welfare improvements for the poorest households.

Home-consumed and marketed consumption of all commodities are captured in a linear expenditure system (LES) formulation. This is illustrated in equations (A42) through (A43) of Appendix A. The parameters $gammah_{i,hh}$ and $gammam_{i,hh}$ indicate minimum consumption levels for home-consumed and marketed commodities, respectively. Supernumerary income—defined as household income less savings, taxes, and the cost of minimum consumption levels—is allocated across commodities through the share parameters $betah_{i,hh}$ and $betam_{i,hh}$, Elasticities of substitution between home-consumed and marketed commodities are determined by the minimum consumption parameters $gammah_{i,hh}$ and $gammam_{i,hh}$, If these minimum consumption parameters are set at zero, cross-price elasticities are of the Cobb-Douglas type and equal to one. The price equation (A3) indicates that the home-consumed price, $PDCH_i$ is not laden with marketing margins. In contrast, the marketed consumption price, PC_i is laden with both marketing margins and consumption taxes. In this way, the model fully captures the avoidance of marketing-related costs through home consumption.

Finally, the estimated parameters of the utility function (the estimation procedure is outlined in the next section) set the quantity of home consumption to be relatively insensitive to changes in price through relatively high values on $gammah_{i,hh}$, especially for rural households. This implies that marketed production of agricultural commodities would tend to be more variable than total production volume, as rural households sell more in good years and retain a greater share of harvest to meet family needs in poor years.[40]

Agricultural Versus Nonagricultural Labor

Existing evidence suggests that generally substitution between agricultural and nonagricultural labor is imperfect in developing countries. This is even more the case in Mozambique, where agricultural labor consists mainly of smallholder farmers living in rural areas (Naeraa-Nicolajsen 1998). Accordingly, the skill levels of these farmers are so different from what is required in nonagricultural production that any changeover to nonagricultural activities is highly unlikely over the medium term.

In spite of the fact that the majority of the rural population has no means of working in a nonagricultural production activity, it is clear that urban households are also supplying some agricultural labor to the factor market. This labor supply is mainly associated with the maintenance of the so-called Machambas. Since agricultural production from these small plots is already maintained as a side occupation in most cases, this part of the supply of agricultural labor is not likely to substitute for nonagricultural labor either, at least over the medium term. Changeover from the nonagricultural to the agricultural labor category is not likely either, since the flow of people away from refugee camps and urban zones back to the countryside following the end of

[40]The presence of a significant share of home consumption potentially has profound implications for the response of home-consuming households to exogenous shocks. If a household avoids markets for at least one commodity, household decisionmaking becomes nonseparable in the sense that production decisions are linked to the household's utility-maximization problem rather than being the solution to a pure profit-maximization problem. Production decisions for subsistence goods depend on shadow values rather than on market prices. As a result, shifts in policy variables that affect market prices for subsistence goods, such as import tariffs, might have no effect on the household's optimal production levels (Sadoulet and de Janvry 1995). An attempt to model nonseparable household behavior within the framework of a 1-2-3 model can be found in Lofgren and Robinson (1999).

the civil war has ended by now. Overall, the most representative specification of labor mobility over the medium term is to set the substitution elasticity between agricultural and nonagricultural labor to zero, thereby fixing labor supplies inside each of the two categories. This implies, among other things, that wage rates are allowed to diverge between agricultural and nonagricultural labor.

Nevertheless, the possibility for some (imperfect) labor mobility was introduced into the model through a constant elasticity of transformation function between agricultural and nonagricultural labor. The CET function and its first-order condition for income maximization are illustrated in equations (A15) through (A16). The CET specification differs from migration models in the Harris–Todaro tradition. In these models, urban labor is often assumed to be substantially more productive than rural labor. Urban migration can, as a consequence, increase average labor productivity and thus welfare.

If imperfect substitution between agricultural and nonagricultural labor is permitted, a pertinent general-equilibrium question is to which households does the income generated by those units of labor—which have moved category—accrue? Little empirical data exist on migration patterns and remittances, although remittances are regarded as important in some regions (Naeraa-Nicolajsen 1998). In the SAM, income generated by agricultural labor accrues primarily, but not exclusively, to the rural household, while income generated by nonagricultural labor accrues primarily, but not exclusively, to the urban household. For the sake of simplicity, rural and urban households can be assumed to receive constant shares (those shares implied by the SAM) of income generated by agricultural and nonagricultural labor. This implies equally proportioned shifts in labor between categories across households. Thus, if the agricultural labor force declines by 1 percent, causing a 2 percent rise in the nonagricultural labor force, these same percentage changes are assumed to apply to the labor endowment of each type in each household.

It is a relatively simple matter to drop the equations relating to the CET specification and fix labor supplies in agriculture and nonagriculture. As noted above, all model versions used this factor market closure in the end. In the validation and estimation exercise, quantities of labor were fixed in agriculture and nonagriculture on the basis of rural and urban population data. As a result, the substitution parameter, *f*, was not estimated either.

Agricultural Household Behavior

Two perceptions of agricultural household behavior merit investigation, and they both appear to have strong potential general-equilibrium effects. First, there is evidence suggesting differing sex roles in agricultural production (NDR 1992; Ministry of Agriculture and Fisheries/Michigan State University 1997; Liberman 1989; Pehrsson 1993; Pitcher 1996; Waterhouse 1997; ZADP 1997). While there are wide variations across regions as well as some contradictory results from separate studies carried out in the same regions, the general story runs as follows: Men clear land and tend livestock. In addition, they are more involved in production of cash crops than food crops. Women perform household chores, tend the food crops, and are responsible for a substantial share of cash crop production. Second, safety-first considerations are likely to play an important role in relation to agricultural production. The modeling of safety-first considerations can, as further discussed in Chapter 10, be implemented through the parameter $RISK_j$, which enters equations (A12) and (A25).

Ample evidence exists to support the first three departures from the standard neoclassical model. However, it should be emphasized that the deviations from the

standard neoclassical model listed under the agricultural household behavior rubric are of a more stylized nature. It should also be emphasized that all of these deviations from the standard neoclassical model, including the deviations listed under the agricultural household behavior rubric, are potentially applicable to numerous regions across the African continent.

Validation and Estimation

Despite their popularity, CGE models are frequently criticized for resting on weak empirical foundations (McKitrick 1998; de Maio, Stewart, and van der Hoeven 1999). Criticism focuses, in particular, on weak empirical foundations for estimates for behavioral parameters. The problem is not confined to CGE models but has been recognized for complex simulation models in general (Schmalensee, Stoker, and Judson 1998).

For developed countries, major microeconometric exercises have been undertaken to estimate behavioral parameters, notably trade parameters. These include efforts by the IMPACT project, the U.S. International Trade Commission, and the U.S. Central Intelligence Agency (Alaouze 1976, 1977; Alaouze, Marsden, and Zeitsch 1977; Shiells, Stern, and Deardorff 1989; Shiells 1991; Shiells and Reinert 1991; Shiells, Roland-Holst, and Reinert 1993; and Goodman 1973). Despite these and other efforts, the microeconometrics literature is widely viewed as providing only spotty coverage of the parameters of interest (Hansen and Heckman 1996; McKitrick 1998). In addition, it is far from clear that results from microeconometric studies can be applied appropriately to the more aggregate sectoral and household representations usually present in CGE models. For developing countries, the lack of an empirical basis for behavioral parameters is even more severe. As a result, debate over appropriate values for behavioral parameters remains highly contentious. This is particularly true for trade parameters in CGE models employing Armington-type trade assumptions, such as the one employed in this study.

The dearth of estimates of behavioral parameters has generally led analysts to specify functional relationships that require relatively few behavioral parameters. Hence, the ubiquity of the CES functional form in applied general-equilibrium analysis. This parsimony with respect to the number of behavioral parameters comes at a cost in terms of flexibility in representing technology or preferences (Jorgenson 1984; Uzawa 1962; McFadden 1963).

Direct econometric approaches to estimating CGE models have been used (Jorgenson 1984; Jorgenson and Slesnick 1997; McKitrick 1998). However, lack of data, computational and conceptual difficulties in estimation, and uncertainty concerning the validity of resulting estimates have been formidable barriers to application of the econometric approach. Existing applications reflect these difficulties. First, econometric estimates are almost always obtained using annual data. The elasticities obtained are thus short run. However, many CGE analyses consider a significantly longer adjustment timeframe, often three to five years. Short-run elasticities are likely to understate the response capacity of agents over this longer time frame. Second, given the large number of parameters to be estimated, long-time series data for numerous variables are required to provide sufficient degrees of freedom for estimation. In many cases, the economy is likely to have undergone structural changes over the period, which may or may not be reflected appropriately in the estimation procedure.

Finally, even those econometric estimates designed specifically to feed parameter estimates to CGE models undertake estimation without imposition of the full set of general-equilibrium constraints. While the estimated parameters might provide a highly plausible description of historical production and consumption data sets, the

estimated values will not be fully compatible with the general-equilibrium system they are designed to represent. For example, predicted values from separate econometric production and consumption systems have the potential to grossly violate product balance conditions for some years of historical data.

As an alternative to the econometric approach, some CGE researchers employ a simple "validation" procedure by which they run a model forward over a historical period and compare results for some variables. The results can provide a basis for revising estimates of some important parameters, recalibrating the model in a kind of informal Bayesian estimation procedure. Examples of this approach include Gehlhar (1994); Kehoe, Polo, and Sancho (1995); and Dixon, Parmenter, and Rimmer (1997). Unlike econometric approaches, this approach makes limited use of the historical record and provides no statistical basis for judging the robustness of estimated parameters.

In this study, a maximum-entropy approach was employed to estimation of behavioral parameters for a CGE model. This approach is similar to the econometric approach of Jorgenson (1984) in that the full historical record can be employed, and statistical tests for estimated parameter values are available. It is similar to the multiperiod validation and calibration approach in that the full model tracks the historical record of exogenous variables, and the maximum-entropy approach can be applied in the absence of copious data. This approach enables researchers to use all available data, take into account all relevant constraints, employ prior information about parameter values, and apply variable weights to alternative historical targets. Available information does not need to be complete or even internally consistent. The philosophy of the maximum-entropy approach is to use all available information and to avoid assuming any information not available (such as strong assumptions about the distribution of error terms).

Maximum-Entropy Estimation for a CGE Model

The maximum-entropy approach is motivated by "information theory" and the work of Shannon (1948), who defined a function to measure the uncertainty, or entropy, of a collection of events. The approach is now widely used to estimate and make inferences when information is incomplete, highly scattered, or inconsistent (Kapur and Kesavan 1992). Golan, Judge, and Miller (1996) bring the general regression model into the entropy and information framework by specifying an error term for each equation, without assuming any specific form for the error distribution. In addition, the framework allows specification of a prior distribution for the parameters to be estimated. The result is a flexible estimation framework that supports the use of information in many forms and with varying degrees of confidence. The power of the framework stems from its efficient use of scarce information.

In the entropy estimation formulation applied here, the static CGE model attempts to track the historical record over a series of time periods. Historical statistics are divided into three groups. The first group contains exogenous variables (variables whose values are determined outside of the model) observable from historical data. This group would typically contain historical data on tax rates, employment, world prices, and government spending. The second group contains exogenous variables not observable from historical data. Rates of technical change by industry are prominent members of this group for most developing countries, including Mozambique. The third group contains endogenous variables (variables whose values are determined by the model) observable from the historical record. This group would typically contain

information on items such as GDP, exports, imports, and household consumption.

If the known exogenous variables and arbitrary values for the unknown exogenous variables and behavioral parameters (such as Armington substitution elasticities) are imposed on a CGE model, the model generates a "prediction" for a large number of endogenous variables whose actual values are also available from the historical record. The values predicted by the model can then be compared with the historical record. The maximum-entropy approach provides a framework for formally comparing a diverse set of model-predicted values with their corresponding historical values for a series of time periods. The entropy criterion can then be used to choose parameter values, such as Armington substitution parameters and rates of technical change, that permit the model to best track the historical record. In addition, economic theory, empirical experience with CGE models, and the econometric literature provide some guidance on likely values and acceptable ranges for parameter estimates. This information can be imposed in the form of prior distributions. When prior distributions are imposed, the maximum entropy approach strikes a balance between tracking the historical record and respecting the prior distributions.

An Application to Mozambique

Data and estimation. The primary data source employed for estimation is the NIS national accounts data for the period 1991–96. Product balance statements for 184 commodities are available for the period and provide information on imports, exports, tariff revenue, total production, marketing margins, intermediate consumption, and household consumption (split between the rural and urban sectors as well as home versus marketed consumption). Value-added and additional tax information is also available for 26 sectors. These data are supplemented by data from the Mozambique *Anuário Estatístico* (MPF various years). This source provides information on exchange rates, government expenditure (broken between recurrent and investment), government tax revenues, remittances, and aid in the government budget.

In the model to be estimated, the data are aggregated to 6 commodities (food, cash crops, processed food, seafood, manufactures, and services) and 7 activities, which correspond one-to-one to the commodities plus the commerce activity. The base year for the model is 1995, which corresponds to the base year for the SAM. In 1991, war was ongoing and data quality is thought to be exceedingly poor. As a result, this year is excluded from the analysis. The data set thus comprises five years (1992–96), including the base year. The paucity of time-series data implies that annual observations must be employed in estimation. The estimated elasticities apply to this relatively short time frame.

The GDP deflator is used to convert all data to real 1995 values. The following historical data series from the observed exogenous variables vector are imposed on the model: the exchange rate (metical to U.S. dollars),[41] total nongovernmental organization activity, total government expenditure and government investment, subsidies to enterprises, social security payments, net-remittances, tariff rates by commodity, and world price changes for exports and imports by commodity. Indices of world prices for imports and exports are derived from

[41]Even though Mozambique conducts very little direct trade with the United States, the exchange rate of metical to U.S. dollars was chosen. Three reasons underpin this choice. First, the value of aid flows, which are extremely important, and remittances, which are somewhat important, are recorded in U.S. dollars. Second, many international transactions are denominated in dollars even if the United States plays no part in the transaction. Third, the metical-U.S. dollar exchange rate behaved similarly to a trade-weighted exchange-rate index over the estimation period.

national accounts data presented in Chapter 4. The indices exhibit considerable price variation for most commodities, which bodes well for identifying trade parameters.

Data are not available on the evolution of the stock of labor and capital. Agricultural and nonagricultural labor stocks are assumed to vary proportionately with rural and urban population respectively. Rural and urban population estimates are derived from Bardalez (1997). Estimates for the capital stock were obtained using a variant of the perpetual inventory method of Nehru and Dhareshwar (1993). They describe the evolution of the capital stock as follows:

$$K_t = (1-\varphi)^t K_0 + \sum_{i=0}^{t-1} I_{t-i}(1-\varphi)^i \qquad (1)$$

where K_0 is the initial capital stock, I_t is investment in period t, and ϕ is the rate of geometric decay.

Unfortunately, neither a long series of investment data nor an estimate of an initial capital stock is available. An estimate of the capital stock in 1995, the base year, was obtained by dividing total payments to capital, derived from national accounts data, by an assumed rate of return to capital. An annual rate of return of 0.17 was assumed, which accords with the high rates of return to capital experienced over the period and simple growth accounting equations. Remaining capital stocks can then be determined by applying the evolution equation for capital stock under an assumed rate of decay. Nehru and Dhareshwar (1993) apply a rate of decay of 0.04 to all countries in their sample. However, they admit that developing countries are likely to have higher rates of decay. For Mozambique, rapid rates of decay can be expected for road investment, which claims a relatively high share of total investment. A rate of decay of 0.075 was applied.

Finally, some exogenous parameters, derived from the 1995 SAM, are held constant throughout the estimation period. These include input-output coefficients; income, enterprise, factor, and consumption tax rates; most output tax rates; household and enterprise savings rates; commodity cost shares in government consumption and investment; and commodity cost shares in private investment. In these cases, either time-series data on these coefficients are unavailable or the coefficients are small and have remained relatively constant throughout the period.

Eight sets of variables are targeted. An error term measures the difference between values predicted by the model and the value of the historical targets. Historical target variables include GDP (*a*), total sales by activity (*b*), the value of imports by commodity (*c*), value of exports by commodity (*d*), consumption tax revenue (*e*), value of total private investment (*f*), the value of home consumption by commodity and household type (*g*), and value of marketed consumption by commodity and household type (*h*). For example, the relationship between actual and predicted GDP determines the value of the error term associated with GDP as follows:

$$GDP_t^a = GDP_t^p + e_t \quad \forall t \in T \qquad (2)$$

Table 6.2 Support set end points on predicted values for imports

Year	Low (percentage of actual values)	High (percentage of actual values)
1996	42	158
1994	42	158
1993	28	172
1992	14	186

Sources: Authors' calculations and the disaggregated (micro-) SAM for Mozambique (MOZAM).
Note: Predicted values in 1995 always equal actual values because 1995 is the base year.

where GDP_t^a is actual GDP in period t and GDP_t^p is predicted GDP in period t.

In the entropy estimation formulation, support sets on error terms set the maximum divergence of the predicted value from the historical target. The upper and lower support points for predicted values of imports are represented by commodity as a percentage of historical targets (Table 6.2). These support sets are typical of those employed for almost all target variables excepting GDP.[42] Support sets are relatively wide. In addition, because data quality is believed to be poorer for 1992 and 1993 than for subsequent periods, support sets are widened for these periods. The support sets on the error for GDP are significantly tighter—the error in predicting GDP can be no larger than 15 percent of actual GDP for all periods. All support sets, on error terms, are symmetric three-point (lower, upper, and zero) prior distributions.

Prior distributions for parameters were set wide to contain all possible parameter values. For trade parameters associated with the CES aggregator functions, three-point prior distributions (Table 6.3) were set on elasticities, with the lower point set at 0.3, the central point set at 1.5, and the upper point set at 9.0. The central point, which corresponds to the prior, was given a weight of 0.5. Weights on the upper and lower points were set such that the expected value of the prior distribution was 1.5.[43] The support set is the same for the CET excepting the upper point, which is set at five rather than nine to reflect the limited export capacity of the economy.

On the consumption side, estimation focused on minimum consumption levels in the linear expenditure system. Other

Table 6.3 Trade parameter support sets and estimates

	Export elasticity				Import elasticity			
Activity	**Estimate**	**Prior value**	**High**	**Low**	**Estimate**	**Prior value**	**High**	**Low**
Food	0.72	1.50 (0.500)	5.00 (0.128)	0.30 (0.372)	5.54	1.50 (0.500)	9.00 (0.069)	0.30 (0.431)
Cash crops	2.20	1.50 (0.500)	5.00 (0.128)	0.30 (0.372)	0.69	1.50 (0.500)	9.00 (0.069)	0.30 (0.431)
Fish	0.74	1.50 (0.500)	5.00 (0.128)	0.30 (0.372)	n.a.	n.a.	n.a.	n.a.
Processed food	0.33	1.50 (0.500)	5.00 (0.128)	0.30 (0.372)	0.57	1.50 (0.500)	9.00 (0.069)	0.30 (0.431)
Manufacturing	0.56	1.50 (0.500)	5.00 (0.128)	0.30 (0.372)	0.87	1.50 (0.500)	9.00 (0.069)	0.30 (0.431)
Services	2.84	1.50 (0.500)	5.00 (0.128)	0.30 (0.372)	1.85	1.50 (0.500)	9.00 (0.069)	0.30 (0.431)

Sources: Authors' calculations and the disaggregated (micro-) SAM for Mozambique (MOZAM).
Notes: Prior weights for each point in the support sets are shown in parentheses below each point. N.a. means not available.

[42]For some very small flows, support points are set very wide, such as with small but positive imports of cash crops, which occur in each year.

[43]The CES import aggregator function is not defined numerically for an elasticity of one. To permit estimation, the import elasticities were bounded initially to be greater than one. If an elasticity estimate struck its bound, the bounds were shifted to the elasticity range less than one. This process continued until an interior solution (no import elasticities on bounds) was found. Prior distributions remained the same for all solutions.

parameters of the linear expenditure system are implied by choice of minimum consumption levels and base-year data. Equally weighted three-point prior distributions for minimum home and marketed consumption levels were centered on one-third and one-fifth of base-year consumption levels, respectively, for all households and commodities. Lower and upper limits on the prior distributions were set at 50 percent and 150 percent of these central levels.

Equally weighted two-point support sets for prior distributions were set on parameters for technical change. Rates of Hick's neutral technical change over the estimation period were calculated for manufactures and services–the two activities where weather or other external factors do not play a major role in determining productivity levels. These support sets were set quite wide, with the lower point set at –20 percent per year and the upper point set at 24 percent per year, implying a prior mean value on technical progress of 2 percent per year. For agricultural activities (food and cash crops) and for the fishing activity in 1993, technology parameter support sets were specified for each year, reflecting significant variation in climatic conditions over the estimation period.[44] Lower and upper points on technology parameters were set at 25 percent and 250 percent, respectively, of the level observed in 1995. Weights on support set points were chosen so that the prior value for the technology parameter was exactly the 1995 level.

Finally, some elements of the unobserved exogenous variables vector were estimated without any prior distributions. In particular, levels for output subsidies to food processing and manufacturing activities were set as free variables with no prior levels for the years 1992–94. This choice reflects subsidies in the form of soft loans from state-run banks (or the central bank itself) directed toward these activities over this period.[45] The soft loans permitted selected firms in manufacturing and food processing to pocket the inflation-induced increase in product price over the period (if they repaid the loan, which they often did not). Since inflation rates hovered around 50 percent over the period, easy access to low-cost credit represented a large subsidy at that time. This subsidy appears to have manifested itself in the national accounts in the form of reduced input costs. Failure to account for implicit state subsidies to manufacturing and food-processing industries implies rapid technological regress over the estimation period—a highly implausible result.

Allowing net capital inflows to adjust endogenously closes the model. The exchange rate is fixed to the historical target. Thus, net capital inflows expand or contract depending on the gap between domestic savings and nongovernment investment.[46]

Measures of fit. This section examines some measures of goodness of fit between actual and predicted values. This study follows Kehoe, Polo, and Sancho (1995) in employing simple correlations and pseudo R-squared measures to determine goodness of fit.[47] Movement of macroeconomic aggregates over the estimation period

[44]Use of data on climatic conditions (for example, rainfall) as instrumental variables in estimation of agricultural technology parameters would be an interesting extension.

[45]To the extent that subsidization of certain industries through the banking system continued into 1995, this subsidization is inadequately captured in the available social accounting matrix. However, by 1995, it had become clear that the banking system had been a conduit for subsidies to state enterprises, and steps had been taken to minimize the flow (Castro 1995).

[46]This is also the only feasible closure. Credible data on capital inflows is nonexistent. Official capital inflow data correspond with a different (and lower-quality) set of national accounts, as discussed in Chapter 4. The two sets of national accounts differ substantially in levels for almost all aggregates of importance—such as GDP, export, imports, and the trade balance—as well as trends in these aggregates.

correlates nicely with the historical data (Table 6.4). Values for the pseudo R-squared tend to be substantially lower than the correlations. Unlike linear regression, which forces the sum of the error terms to equal zero, predicted values in this maximum entropy procedure can consistently diverge from actual values by either a positive or negative amount. All of the predicted values for the aggregates studied, excepting total imports, exhibit a tendency toward either positive or negative consistent divergence from the actual value.

As to goodness of fit for exports and imports (Table 6.5), performance in terms of correlation and R-squared varies substantially from more than 0.9 to negative values. For the major import commodity (manufactures with a 53 percent share) and export commodity (services with a 52 percent share), predicted values track historical values quite closely. Small flows, such as exports of food and imports of cash crops, tend to be predicted with a lesser degree of accuracy. This result is intuitive. General-equilibrium models perform best in

Table 6.4 Correlations and pseudo R–squared for macroaggregates

Indicator	Correlation	R-squared[a]
GDP	0.99	0.81
Private investment	0.92	0.83
Value of intermediate consumption	0.97	0.84
Total sales	0.97	0.55
Total exports	0.80	0.62
Total imports	0.62	0.65

Sources: Authors' calculations and the disaggregated (micro-) SAM for Mozambique (MOZAM).
[a]The pseudo R-squared measure employed is simply ESS/TSS, where ESS is the error sum of squares and TSS is the total sum of squares.

Table 6.5 Measures of fit for exports and imports

Measure	Food	Cash crops	Fish	Processed food	Manufactures	Services	Weighted average[a]
Exports							
Share in 1995	0.01	0.04	0.21	0.17	0.05	0.52	n.a.
Correlation	0.35	0.91	0.14	-0.48	0.60	0.91	0.50
R-squared[b]	0.10	0.96	-2.03	-0.66	0.39	0.76	0.46
Imports							
Share in 1995	0.06	0.00	0.00	0.22	0.53	0.18	n.a.
Correlation	0.87	-0.60	n.a.	0.51	0.90	0.89	0.81
R-squared[b]	0.79	-0.08	n.a.	0.43	0.92	0.63	0.75

Sources: Authors' calculations and the disaggregated (micro-) SAM for Mozambique (MOZAM).
[a]For the cases of negative R-squared in the export row, these values were set to zero for the purposes of the weighted R-squared calculation, with the weights corresponding to 1995 export or import shares as appropriate.
[b]The pseudo R-squared measure employed is simply 1 – ESS/TSS, where ESS is the error sum of squares and TSS is the total sum of squares.

[47]The pseudo R-squared measure employed is simply 1 – ESS/TSS, where ESS is the error sum of squares, and TSS is the total sum of squares. The use of ordinary least squares imposes conditions on error term estimates that imply various properties for R-squared. These properties are not present in the maximum-entropy estimator. For example, estimation by ordinary least squares implies that RSS/TSS = 1 – ESS/TSS, where RSS is regression sum of squares. The maximum-entropy procedure employed does not impose this relationship.

analyzing issues where general-equilibrium feedbacks matter. As a result, the model should be more adept at predicting larger flows.

Two prominent exceptions to this rule of thumb are exports of seafood and processed food. Each commodity's share of total exports is significant; nevertheless, correlations are small or negative and R-squared is negative for each commodity. These poor performances probably indicate that exogenous factors, operating outside of the model, had a stronger impact on exports of seafood and processed food than the factors contained within the model. In the case of seafood, exports are materially affected by weather and ocean conditions, particularly for shrimp. Regarding processed food, exports of this commodity are composed primarily of sugar, cashews, and cotton fiber. As discussed in Chapter 4, each of these constituent industries operated in a complex and rapidly evolving regulatory environment over the estimation period. These policy constraints and shifts are impossible to incorporate into the model at this level of aggregation, but they have clearly affected export performance for cashews and sugar and quite likely have affected export behavior for cotton fiber.

Under this criterion, model predictions of import behavior perform well with a weighted correlation of 0.81 and a weighted R-squared of 0.75 (Table 6.5). Model predictions of export behavior are less favorable, with a weighted correlation of 0.50 and a weighted R-squared of 0.46 (with the truncation of R-squared measures at zero). In sum, the model is capable of explaining many salient aspects of the performance of the Mozambican economy in the period following the civil war. This is remarkable given the tumultuous changes that characterized the period and the relative paucity of good information on economic performance. The fit of the model was deemed to be adequate enough to proceed to estimating behavioral parameters.

Trade parameter estimates. Estimated export elasticities for four commodities (food, seafood, processed food, and manufactures) are low. For services and cash crops, estimated export elasticities move substantially above the prior levels. Since services made up more than half of exports in value terms in 1995, the elastic transformation estimate is interesting. A statistical test was conducted by the authors to determine if the prior elasticity of 1.5 is consistent with the data.[48] The χ^2_1 statistic (not shown in Table 6.3) was 2.2 and fails to reject the null hypothesis.[49] The basic story emerging from the estimates is that Mozambique is an economy with little capacity to shift production between domestic and export markets for many export commodities. The loss of contact with export markets that occurred during the civil war period appears to have restricted the capacity of firms to access export markets. In addition, the structural changes brought about by the economic reform program have harmed some traditional exporters, such as cashew processors, and opened export opportunities in other sectors, such as food. For example, Mozambique has begun exporting small quantities of maize. However, a lack of well-established export institutions hinders export capacity in maize and other commodities (World Bank 1996). The export elasticity estimates indicate that, for most commodities, similar difficulties exist in tapping export markets.

While economic collapse and war profoundly affected export volumes, import volumes remained substantial thanks to large influxes of foreign aid. As a result, importing institutions functioned throughout

[48]Full details are available from the authors.

[49]Imposing an export elasticity of 1 for services results in failure of the routine to find a feasible solution with the optimal solution as starting values.

the estimation period. In the circumstances of Mozambique, calamities strike regularly. This causes substitution of food aid imports for domestic production, reflected in high substitution elasticities between domestic and imported food. Substitution elasticities between domestic and imported nonfood items appear to be smaller.

Yellow maize contributed a substantial portion of food imports, particularly in the early postwar period. For example, in 1993 maize constituted approximately 60 percent of food imports, with the vast bulk of maize imports coming in the form of yellow maize as food aid (NIS 1997; Donovan 1996). Even though Mozambican consumers express a clear preference for white maize, substitution possibilities (in times of crisis) appear to be strong. A test of the null hypothesis, of an import elasticity on food of three, was rejected by the data at the 95 percent confidence level (χ^2_1 statistic of 5.9).

This result agrees with available microeconomic evidence. The Ministry of Agriculture and Michigan State University (1994) conducted a study of white versus yellow maize consumption. They found that, with equal prices, consumers overwhelmingly favor white maize. However, when presented with a hypothetical game of maize purchasing, consumers indicated that they would switch rapidly to yellow maize if its price fell relative to white maize. Low-income consumers, who make up the bulk of the population, indicated the greatest degree of price sensitivity.

Manufactures represent a second interesting case. (Note that, as previously mentioned, this category does not include food processing, which is a separate industry.) Manufactures claimed by far the largest import share in 1995 (Table 6.5). In addition, domestic manufactures production is small, accounting for less than 2 percent of value-added at factor cost in 1995. On the basis of volume alone, domestic manufactures cannot substitute substantially for imported manufactures. However, this does not necessarily imply that the degree of substitutability between existing domestic manufactures and imported manufactures is small. Estimation results indicate an elasticity that is slightly lower than one. This is within the range of values frequently employed in the context of developing country. However, a statistical test fails to reject the null hypothesis of an elasticity of 2. The χ^2_1 statistic is only 0.1, indicating reasonable consistency of the data with a wide range of possible values for the import elasticity for manufactures.

Conclusions

The Mozambican CGE model presented here accounts for imperfect substitution between imports and domestically marketed production and imperfect transformation of production into exports. The 1-2-3 core model is extended to take account of marketing margins and home consumption of own production. These features are essential to capture Mozambican characteristics, such as vast distances and an underdeveloped economic infrastructure. Other extensions to the standard model include the possibility of allowing for imperfect labor mobility between agriculture and nonagriculture and allowing for special household characteristics, such as safety-first considerations and differing sex roles in agricultural production.

The extended 1-2-3 model has also been subjected to an estimation and validation procedure. The reasonable fit between values predicted by the CGE model and actual values strengthen confidence in the model for policy simulation purposes. The estimated trade parameters for Mozambique point strongly to the need for development efforts to aid in the transformation of domestic products into export products. It also indicates that substitution elasticities between imported and domestically produced goods are relatively high. This is especially so for food crops after times of natural disasters.

CHAPTER 7

Aid Dependence

Mozambique remains, as demonstrated in Chapter 5, dependent on the goodwill of bilateral and multilateral donor agencies to make aid transfers on a large scale; and the analyses in this chapter further illustrate the critical support that foreign capital inflows in general and aid transfers in particular provide to the Mozambican economy. The analyses are based on simulations using the CGE model in Chapter 6. Special characteristics and specifications necessary for the analysis of aid dependence are discussed below. Although this chapter includes a discussion of the overall importance of foreign capital inflows, the focus is on the impact of reducing Mozambican aid dependence. The experiments are designed to reflect a gradual lowering of total net foreign capital inflows through a gradual uniform lowering of the different items of foreign capital inflow. The decision to lower all capital inflows simultaneously and uniformly was based on a desire to maintain comparability across experiments. It is, however, not essential to the analysis that the items are lowered uniformly.

The fact that most aid inflows are channeled through government accounts is reflected in the specification of the CGE model, where aid inflows are accounted for on the revenue side of the government investment budget. In contrast, foreign savings inflows are accounted for on the revenue side of the capital account.[50] Since government investment expenditures are determined from the macroclosure as discussed below, the government investment budget will not balance in general. The deficit is financed by drawing on the capital account. It follows that foreign savings inflows act as a source of financing for government investment, in the same way as foreign aid inflows. This implies that foreign savings and aid inflows are indistinguishable in this model as far as the impact on the rest of the economy is concerned.

The fact that foreign savings and aid enter the model indistinguishably implies that the initial decline in foreign capital inflows can be interpreted as reflecting the impact of a pure reduction in foreign aid inflows. Such an interpretation is reasonable because foreign savings and aid constitute the main components of foreign capital inflows. Yet, this point of departure implies that the design of the experiments and the macroclosure must accord with this characteristic. A basic feature of any attempt at reducing aid dependence in Mozambique is that

---

This chapter was written by Henning Tarp Jensen, and Finn Tarp.

[50]The remaining foreign capital inflows in the form of remittances and aid funding of the NGO budgets are of minor importance, since they account for less than 20 percent of total transfers in the 1995 base year. Aid inflows into the government investment budget account for more than a third, while foreign savings inflows into the capital account amount to almost half of total transfers in 1995.

overall foreign capital inflows are going to decline. Although some small recent progress has been made, Mozambique still faces large problems in tapping into international capital markets. Access to foreign borrowing is far from being sufficient to finance the imports of essential physical productive resources. It follows that increasing the foreign savings inflow cannot be expected to be automatically forthcoming in response to declining aid transfers. The aid dependence experiments are therefore based on the presumption that reductions in aid inflows lead to significant reductions in total net capital inflows.

The design of the macroclosure used in the experiments here reflects the authors' assessment of the government's reaction in relation to the erosion of a significant source of revenue. The macroclosure ensures that private and government investment expenditures vary in proportion to each other. As such, the macroclosure reflects the view that adjustment following a decline in foreign aid inflows will affect both investment components. While government investment expenditures are financed mainly by foreign aid inflows, private investment is financed by regular foreign savings. Accordingly, the specification of the macroclosure for the investment items is based on the presumption that "crowding-out" of private investment occurs when aid inflows are reduced.

The macroclosure also specifies recurrent government expenditures as a fixed proportion of absorption. This reflects the maintained assumption that administration expenditures are more difficult to reduce than investment expenditures. Overall, the macroclosure is designed to support the interpretation of the initial decline in foreign capital inflows as reflecting the impact of reductions in foreign aid inflows.

The factor market closure is based on a presumption that current levels of factor employment will be maintained after a reduction in aid inflows. This implies that increased unemployment is not allowed to be part of the adjustment to decreases in capital inflows. One argument for choosing this factor market closure is that the alternative closure is hard to justify. Allowing for unemployment would require specifying nominal wages exogenously. Such a fixed-wage specification would be ad hoc and would contrast with the medium-term perspective of the experiments. It was therefore decided to retain the full-employment factor market closure. Another argument for maintaining full employment is that the employees associated with aid-financed projects are likely to be relatively well qualified. Decreasing aid-financed expenditures on domestic investment will mainly affect the formal industry sector, where skills are relatively high and employees are relatively well equipped to find employment elsewhere. Decreasing aid inflows supposedly do not have any major impact on the employment status of the agricultural sector, where subsistence farming is widespread. The distinction between the agricultural and nonagricultural labor categories is therefore maintained, and substitution between the two labor types is not provided for in the simulations.

A set of experiments was conducted on the basis of the model closure described above (Table 7.1). Given that total aid inflows amounted to around 40 percent of total capital inflows in 1995, it follows that the first experiment can be given two different interpretations: a full elimination of aid inflows combined with a significant increase in net foreign borrowing, or a (large) partial elimination of aid inflows combined with some small increase in foreign borrowing. Given that Mozambique has low access to overseas financial markets, the latter interpretation is used here. Moreover, the second experiment, which includes a 40 percent reduction in net foreign capital inflows, is interpreted as the full elimination of all aid inflows. The remaining experiments, 3 through 5, which are based on the same model closure consideration discussed above, are included to complete the

Table 7.1 Experiment descriptions for aid dependence simulations

Simulation	Description
Base run	Base run
Experiment 1	20 percent reduction in foreign capital inflows
Experiment 2	40 percent reduction in foreign capital inflows
Experiment 3	60 percent reduction in foreign capital inflows
Experiment 4	80 percent reduction in foreign capital inflows
Experiment 5	100 percent reduction in foreign capital inflows

Source: Authors' static CGE-model experiment design.

general picture of the importance of capital inflows.[51]

Reducing net foreign capital inflows has significant repercussions on key macroeconomic indicators (Table 7.2). Each consecutive 20 percent reduction in net foreign capital inflows leads to an average decrease in nominal absorption of approximately 5 percent. Nevertheless, the marginal welfare cost of reducing foreign capital inflows increases as the level of capital inflows decreases. Accordingly, the first and last 20 percent declines in foreign capital inflows imply 4.8 and 5.8 percent drops, respectively, in nominal absorption. It follows that changing price incentives and reallocation of productive resources provide some insulation from the initial impact of reducing capital inflows, but the effect gradually weakens. Overall, it can be concluded that, while the structure of the economy does provide for some insulation against the adverse effects of declining aid inflows, the associated loss of welfare remains substantial.

Eliminating all foreign capital inflows has a large negative effect on real GDP. Accordingly, the results of experiment 5 indicate that the full elimination of foreign capital inflows leads to a 5.2 percent decrease in real GDP. The sequence of experiments shows that gradually decreasing foreign capital inflows has an increasingly negative impact on real value-added. This implies that changing relative prices and reallocation of productive resources are also important in ameliorating the negative impact on value-added. The results of experiment 1 show that this effect is particularly strong in the initial phase, indicating that a partial elimination of aid inflows will not have a major impact on real GDP. Assuming that the net result of the full elimination of aid inflows is a 40 percent reduction in total net foreign capital inflows, experiment 2

Table 7.2 Macroeconomic indicators for aid dependence simulatons

Indicator	Base run (100 billion metical)	Change from base run (percentage)				
		Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
Real GDP	172.1	-0.5	-1.3	-2.3	-3.6	-5.2
Nominal GDP	172.1	-1.8	-3.1	-4.0	-4.6	-4.9
Nominal absorption	223.3	-4.8	-9.9	-15.3	-20.9	-26.7

Source: Authors' static CGE-model simulations.

[51]Given that the use and impact of net foreign borrowing and aid inflows differ, the macroclosure should in principle be reconsidered when analyzing reductions in net foreign borrowing. This is not done here.

indicates that the termination of aid receipts will result in a mere 1.3 percent decline in real GDP.[52]

Experiment 5 leads to a 4.9 percent decrease in nominal GDP, implying that the GDP deflator is almost unaffected by a total elimination of foreign capital inflows. However, while a gradual elimination of capital inflows has a decreasing negative marginal effect on nominal value-added, it has an increasing negative marginal impact on real value-added. It follows that the GDP deflator suffers a strong initial decline that is only gradually reversed. Comparing nominal GDP and absorption, it appears that import substitution and export transformation combined with full employment of factors ensure that the impact on value-added is relatively modest.

Overall, it can be concluded that significant welfare costs are associated with a total elimination of foreign capital inflows in Mozambique. These welfare costs come about through the forced reduction in the trade balance deficit. The combination of decreasing imports and increasing transformation of domestic production into exports reduces the quantity of goods available for domestic absorption. Nevertheless, the increasing export transformation of production ensures that real GDP declines only modestly. A partial reduction in foreign aid inflows reduces real value-added only slightly. The effect on welfare in terms of nominal absorption is also going to be dampened by significant changes in price incentives, but the negative impact is nonetheless significant. Overall, the full elimination of aid inflows is likely to yield a decrease in welfare of around 10 percent.

The real GDP components confirm that significant reallocation among the final demand components would occur following a complete elimination of foreign capital inflows (Table 7.3). Since net foreign capital inflows add up to the trade balance deficit, it follows that eliminating net foreign capital inflows is tantamount to eliminating the trade balance deficit. The sequence of experiments implies that exports and imports contribute equally to the elimination of the trade balance deficit. Since services have a

Table 7.3 Real GDP components for aid dependence simulations

GDP component	Base run (100 billion metical)	Change from base run (percentage)				
		Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
Exports	32.7	14.9	31.0	48.0	65.9	84.4
Imports	83.9	-6.4	-12.3	-17.9	-23.1	-28.1
Home consumption	32.6	-1.5	-2.7	-3.7	-4.5	-5.3
Marketed consumption	106.8	-2.3	-4.0	-5.3	-6.2	-6.8
Recurrent government	16.8	-3.7	-8.1	-13.2	-18.7	-24.5
Nongovernmental organizations	5.5	-14.1	-31.0	-50.9	-73.8	-100.0
Investment	61.5	-11.0	-23.5	-37.1	-51.9	-67.4
Real GDP	172.1	-0.5	-1.3	-2.3	-3.6	-5.2

Source: Authors' static CGE-model simulations.

[52]Alternative experiments with unemployment indicate that the macroeconomic impact of a full elimination of capital inflows will only be moderately stronger. However, the alternative experiments also indicate that the ameliorating impact of initial changes in capital inflows is significantly moderated. Reductions in aid inflows in particular are likely to have a stronger real macroeconomic impact when unemployment appears.

large export share and a relatively high elasticity of transformation, service exports expand considerably. Accordingly, the service sector accounts for the main part of the expansion of exports. In contrast, the main part of the decrease in imports is directly related to the demand effects of declining foreign capital inflows. It follows that around two-thirds of the decline is accounted for by declining imports of investment-related transport and machinery equipment.

The macroclosure has important implications for the impact of changing capital inflows on the composition of final demand. The choice of a savings-driven investment closure in the current experiments implies that the total elimination of net foreign capital inflows leads to a reduction in real investment by more than two-thirds. Moreover, real recurrent government expenditure declines by 25 percent, in line with the significant decline in absorption expenditure. Since economic activity in general and imports in particular remain at reasonable nominal levels, it follows that government domestic revenue remains reasonably stable. Taken together, the development of government revenue and recurrent expenditure implies that the government will be able to increase its own financing of investment expenditures. This is particularly important when foreign aid inflows into the government investment budget are eliminated. Nevertheless, the chosen macroclosure implies that the government will continue to run an overall budget deficit. This is consistent with the notion that both government and private investment are squeezed.

Since the significant expansion of exports ensures that aggregate real value-added does not respond too strongly to declining capital inflows, aggregate household income and consumption decline only moderately. Moreover, import prices increase significantly because of the strong nominal exchange rate depreciation, implying that market prices increase faster than producer prices. Combined with the fixed budget shares of the household consumption patterns, this explains in part why real marketed consumption declines slightly faster than real home-consumed production. Another part of the explanation is that the decline in rural household income (and home consumption) is more moderate than the decline in urban household income. Overall, the experiments imply that the relative share of informal sector production in household consumption is going to increase as a response to decreasing capital inflows. However, because of increased activity in the tradable goods sectors, the informal sector is going to remain constant as a share of total value-added. Finally, the externally financed NGO sector vanishes with the disappearance of capital inflows.[53]

Looking at the gradual elimination of net foreign capital inflows, several regularities in the impact on the composition of final demand can be observed. All final demand components are declining continuously except exports, which increase steadily. Among the domestic demand components some differences in the rates of decline can be observed. While the rate of decline for government consumption and overall investment has a tendency to increase with the reductions in foreign capital inflows, the rates of decline for the private consumption components are decreasing. The increasing rate of decline for overall investment is related to the declining rate of depreciation of the exchange rate. The exchange rate depreciation insulates the domestic currency revenues of foreign capital

[53]The 100 percent decline of real NGO demand in Experiment 5 is because all NGO revenues come from abroad. When all capital inflows are eliminated, the NGO sector, by definition, disappears. Accordingly, the 100 percent decline reflects the elimination of the NGO sector from the model in Experiment 5, not that a lower bound has been struck.

inflows somewhat, but the decreasing rate of depreciation implies that the domestic currency value of foreign currency inflows is decreasing at an increasing rate. Since foreign capital inflows constitute a significant source of finance for investment expenditures, this explains the increasing rate of decline for real investment.

The falling rate of decline for real household consumption reflects the decrease in nominal GDP.[54] While overall household consumption decreases in line with nominal GDP, the two individual components of household consumption decline at different rates. The marginal impact on marketed consumption declines rapidly from a high initial level, whereas the marginal effect on home consumption declines more slowly from a smaller initial level. This implies that the informal sector share of household consumption is increasing at a decreasing rate. In fact, the last 20 percent reduction of capital inflows in experiment 5 has a stronger negative effect on home consumption than on marketed consumption, implying that the informal sector share of household consumption decreases slightly. The increasing rate of decline for government consumption follows the pattern of nominal absorption.

The above observations on the gradual elimination of capital inflows have implications for the impact of reductions in aid inflows. A partial reduction in aid inflows represented by experiment 1 leads to declining imports and increasing exports. While the absolute impact on real exports of a full elimination of capital inflows is larger than on real imports, the opposite is true for a partial elimination of aid inflows—exports increase significantly in relative terms, but changes to real imports are more important in absolute terms. Accordingly, experiment 1 indicates that import substitution and outright reductions in demand for imported goods are going to be more important than increased export transformation in the adjustment to declining aid inflows. Reduction in the demand for investment goods is going to be especially important, but also reductions in demand for imported services are going to be large. Some small import substitution is going to occur in agriculture and related sectors.

As indicated above, a reduction in capital inflows will have a particularly strong effect on investment. Accordingly, a partial reduction in aid inflows reduces real investment expenditures by 11 percent. This significant reduction in investment affects not only the level of imports but also the level of domestic activity. Accordingly, the decline in expenditures on construction reduces value-added in this sector by approximately 0.9 percent of total economywide GDP. The reduction in real value-added by the construction sector is therefore larger than the 0.5 percent overall decline in real GDP. It follows that the impact on the construction sector represents the main transmission mechanism between reductions in aid inflows and the domestic economy. It can also be noted that the marginal impact on real investment is increasing with the level of reduction in aid inflows, and this spills over into the impact on real GDP. Hence, the full elimination of aid inflows leads to a reduction in value-added by construction amounting to 2.0 percent of total real GDP, implying a 1.3 percent overall decline in real GDP. It follows that continuing reductions in aid dependence will entail increasingly negative repercussions on the domestic economy through the construction-investment channel.

[54]Changes in real household consumption reflect changes in nominal GDP, since the closure specifies the consumer price index as numeraire.

Reductions in aid inflows will also have noticeable negative effects on rural and urban household consumption.[55] The different impacts on the two consumption items are partly related to the different developments of producer and consumer prices and partly to the fact that home consumption is mainly associated with rural households. Farmers actually increase value-added by agricultural production marginally because of slightly increasing agricultural import substitution and export transformation. Consequently, rural household income does not decrease as much as urban household income. It follows that home consumption is somewhat insulated from decreases in foreign aid inflows. In contrast, marketed consumption by urban households is decreasing markedly, particularly because of the loss of income from the construction sector. This indicates that reductions in aid inflows will hurt the formal urban sector more than it will hurt the informal rural sector. A complete elimination of aid inflows will, however, markedly reduce consumption in both rural and urban areas.

Declining real government consumption in relation to a partial reduction in aid inflows is dictated by the model closure. The 4.8 percent decline in nominal government consumption is consistent with the marked decline in nominal absorption. Nevertheless, real government consumption declines by only 3.7 percent, since the declining aid inflows lead to declining domestic prices in all service sectors. While real imports decline by 6.4 percent, the partial reduction in aid inflows leads to a much smaller 0.7 percent reduction in nominal import expenditures. This implies that the main loss of government revenue is related to other indirect taxes on goods, such as consumption and circulation taxes. Important revenue losses also follow from small, direct tax components, including factor and enterprise taxes. They suffer from declining capital income. Overall, the 1.5 percent decrease in government revenues implies an increase in the recurrent budget surplus. However, the increasing recurrent budget surplus is not large enough to finance the significantly increasing deficit on the government investment budget. This is consistent with the notion underlying the model closure—that reduction in aid inflows is going to result in "crowding-out" of private investment.

The impact of the elimination of foreign capital inflows on agricultural terms of trade were evaluated at different points in the price mechanism (Table 7.4). While relative agricultural export, producer, and value-added prices increases, relative agricultural import and consumer prices decrease. Overall, agricultural producers are gaining in relative terms because of higher relative prices on agricultural goods, while rural consumers of agricultural goods are gaining in relative terms from lower relative market prices. The increases in relative agricultural producer prices are a result of the markedly declining demand for construction, while the demand for primary agricultural goods is maintained. Moreover, service sector producer and consumer prices are competitively lowered. The declining commercial-service price puts downward pressure on agricultural and industry sector market prices. Since services do not face any marketing costs, by definition, it follows that the downward pressure on service sector market prices is transmitted directly to service sector producer prices.

[55]The interpretation of experiments 1 and 2 as proper reflections of reductions in aid inflows has to be qualified somewhat in relation to the two household consumption items. Since the reductions in capital inflows include reductions in remittances to households, this will overstate the negative impact as compared with pure reductions in aid inflows. Nevertheless, the total effect of a full elimination of remittances amounts to less than 0.5 percent of household consumption. The results can therefore be taken to properly reflect reductions in aid inflows in a qualitative sense.

Table 7.4 Price indices and agricultural terms of trade for aid dependence simulations

Prices	Base run	Change from base run (percentage)				
		Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
Import						
Agricultural terms of trade	100	-0.3	-0.6	-0.8	-1.0	-1.1
Agricultural prices	100	3.9	7.5	10.6	13.3	15.6
Nonagricultural prices	100	4.3	8.1	11.5	14.5	16.9
Export						
Agricultural terms of trade	100	2.8	5.0	6.8	8.1	9.1
Agricultural prices	100	9.8	18.5	26.1	32.6	37.9
Nonagricultural prices	100	6.8	12.8	18.2	22.7	26.4
Retail						
Agricultural terms of trade	100	-0.4	-0.6	-0.7	-0.7	-0.4
Agricultural prices	100	-0.1	-0.1	-0.1	0.0	0.3
Nonagricultural prices	100	0.3	0.5	0.7	0.7	0.7
Producer						
Agricultural terms of trade	100	1.1	2.2	3.2	4.2	5.2
Agricultural prices	100	0.4	1.0	1.7	2.5	3.3
Nonagricultural prices	100	-0.7	-1.2	-1.5	-1.7	-1.8
Value-added						
Agricultural terms of trade	100	2.7	5.1	7.1	8.7	10.1
Agricultural prices	100	0.4	0.9	1.6	2.5	3.4
Nonagricultural prices	100	-2.3	-4.0	-5.1	-5.8	-6.1
Exchange rate	100	6.1	11.6	16.4	20.5	23.9
Commercial service price	100	-2.9	-5.3	-7.3	-8.9	-10.1

Source: Authors' static CGE-model simulations.

The drastic decline in demand for construction also lowers the demand for nonagricultural labor and capital in this sector markedly. This releases large productive resources that are subsequently reallocated to other productive sectors. Some of the released resources flow into primary agriculture and agricultural processing. Demand for primary agricultural goods is maintained because of increasing intermediate input demands from agricultural processing industries and some limited scope for import substitution. The demand for agricultural processing is in turn supported by increasing incentives for export transformation.[56] Finally, it is important to note that demand for agricultural goods is supported by important feedback effects stemming from the link between agricultural labor income and the high agricultural budget shares that characterize rural households. It follows that the overall impact of an elimination of foreign capital inflows on price incentives is unequivocally positive for the rural agricultural sector.

From the sequence of experiments, it appears that the initial reductions in capital inflows have strong effects on relative agricultural prices. This observation underpins the argument that changes in price incentives are more important than quantitative adjustments in relation to initial reductions in capital inflows. All agricultural terms of trade related to the production side respond positively to reductions in aid receipts. The impact on relative agricultural value-added

[56] Export transformation provides little support to demand for primary agriculture because of low export shares.

prices is particularly strong in relation to a partial or total elimination of aid inflows. Accordingly, experiment 2 shows that relative agricultural value-added prices increase by more than 5 percent when all aid inflows are eliminated. The increasing agricultural terms of trade follow from declining nonagricultural, as well as increasing agricultural, value-added prices. The increasing agricultural value-added prices are driven mainly by the strong increases in domestic agricultural export prices, which again follow from significant reductions in the price of marketing services and a strongly depreciating exchange rate.[57] As for agricultural terms of trade related to the consumption side, it appears that all indices decline. Overall, the impact of reductions in aid inflows on price incentives appears unequivocally positive for the rural agricultural sector.

Conclusions

The analyses of the experiments in this chapter clearly indicate that reductions in aid inflows have significant welfare implications. A partial reduction or total elimination of foreign aid inflows would represent a substantial reduction in overall foreign capital inflows. Mozambique is facing large problems in tapping into international capital markets, and access to foreign borrowing is far from being sufficient to finance the imports of essential physical productive resources.

Declining aid inflows lead to a decline in the trade balance deficit because of a lack of alternative financing. The adjustment includes both reduced imports and increased exports, underpinned by a significant depreciation in the real exchange rate. The trade balance adjustment mirrors the characteristics of the initial Mozambican trade pattern, as it includes a significant expansion of service sector exports and a strong contraction of imports of investment-related transport and machinery equipment. In addition, some small import substitution is going to occur in agriculture and related sectors. While the expansion of exports is supply driven and underpinned by changing producer price incentives, the decrease in imports of investment goods is mainly related to the demand-side effects of declining aid inflows. Consequently, the termination of all aid inflows leads to a reduction in real investment by almost 25 percent.

Crowding-out of private investment is likely to occur when aid financing of government investment declines. Overall, the expenditures on construction for investment purposes will be the main transmission channel between declining aid transfers and the domestic economy. Continuing reductions in aid dependence will entail increasingly negative repercussions on the domestic economy through the construction-investment channel. Moreover, the unavoidably negative future impact on the capital stock is likely to add significantly to the decline in future domestic economic activity.

The composition of the government budget will also have to change when aid inflows are reduced. While government recurrent expenditures are likely to decline with the general level of absorption, domestic revenues are likely to remain reasonably stable, since nominal imports decline only slightly. While the increasing surplus over the recurrent budget leads to an important increase in the government's own financing of investment expenditures, it is not large enough to finance the significantly increasing deficit from the government investment

[57] The lower marketing costs and exchange rate depreciation also benefit nonagricultural value-added prices. However, the producer prices of the declining construction and service sector dominate the impact on nonagricultural producer prices. Moreover, relatively large intermediate input-cost shares imply that the decline in producer prices has a strong negative impact on value-added prices in the nonagricultural sector. Input price increases induced by exchange rates also add to the decline in the nonagricultural value-added prices.

budget. The government will continue to run overall budget deficits, and some private investment will be crowded out.

The composition of household consumption will change in favor of home-consumed production because of relative price changes and changes in the distribution of household income. Accordingly, the overall household budget share of informal sector production is going to increase, implying that home consumption is somewhat insulated from decreases in foreign aid inflows. In contrast, marketed consumption by urban households is going to decrease markedly because of a loss of income from the construction sector. While the elimination of aid inflows will reduce consumption for all households, it will hurt the formal urban sector more than it will affect the informal rural sector.

Reductions in aid inflows have strong effects particularly on relative agricultural producer prices. Changes in price incentives alter the allocation of productive resources and ensure that the macroeconomic impact of reductions in aid inflows is somewhat ameliorated. Demand for primary agricultural goods is maintained in the face of reduced aid inflows because of increasing intermediate input demands from agricultural processing industries and some limited scope for import substitution. It follows that relative agricultural export, producer, and value-added prices increase, while relative agricultural import and consumer prices decrease. Overall, agricultural producers are gaining in relative terms because of higher relative prices on agricultural goods, while rural consumers of agricultural goods gain in relative terms from lower relative consumer prices. The overall impact of an elimination of foreign aid inflows on price incentives is unequivocally positive for the rural agricultural sector.

CHAPTER 8

The Agricultural Bias Revisited

The World Bank carried out a large-scale inquiry into the actual level of agricultural bias associated with import-substituting policies in the late 1980s (Krueger, Schiff, and Valdes 1988). The study made a decisive effort to call attention to the sectoral impact of macroeconomic policies, but it assumed with little hesitation that agricultural products are tradable and perfect substitutes in import and export. The core finding of Krueger, Schiff, and Valdes, as well as others, was that trade and exchange rate policies supporting import substitution have a strongly negative impact on relative price incentives aimed at agricultural producers. The study also found that agricultural export taxes lower domestic export prices, while nonagricultural import tariffs in import-competing sectors, such as fertilizer and pesticides, increase the cost of agricultural production inputs significantly. Finally, the study found overvalued exchange rates very damaging.

It is characteristic of the Krueger-inspired literature on agricultural bias that it focuses strongly on distortions in the domestic-pricing mechanism. The trade policy interventions act to change domestic prices of exports and imports, while the ultimate measure of agricultural bias is based on price terms of trade for agricultural producers. No account is taken of quantity adjustments in goods and factor markets or in the external account. This is critical. Quantity adjustments can potentially affect relative agricultural prices strongly. The choice of a partial-equilibrium approach becomes even more questionable with the knowledge that import-substituting trade policies may induce demand-side constraints on economic growth. Emphasizing the role of the agricultural sector as the primary driving force in economic development is often justified by the potential for income feedback effects on the rest of the economy. It follows that analyses of the relative price impact of macroeconomic policy measures must take these important mechanisms into account.

These points are pursued by Bautista et al. (2001), who compare the partial and general-equilibrium approaches and find severe deficiencies in the partial-equilibrium methodology. They analyze the impact of agricultural export taxes and nonagricultural import tariffs, relying on a stylized Tanzanian CGE model. From this analysis it emerges that the level of agricultural bias is significantly moderated in the context of their stylized economy. The exchange rate effects, which were singled out as a very damaging source of agricultural bias in the partial-equilibrium literature, display a minor impact on relative agricultural prices.

This chapter reports a similar set of trade policy experiments for the case of Mozambique. While the Mozambican CGE model set out in Chapter 6 is similar in structure to the Tanzanian one, there are also important differences. The Mozambican model accounts for marketing

This chapter was written by Henning Tarp Jensen, and Finn Tarp.

margin wedges between producer and retail prices and associated home consumption of own production. Moreover, in the present context, the implications of the closure of the CGE model are investigated in detail; and, in contrast to Bautista et al. (2001), a standard factor market closure is applied. Nevertheless, the two models are sufficiently similar in structure to make a comparison based on country-specific characteristics.

Two kinds of trade policies were experimented with, including a uniform 25 percent tariff on nonagricultural imports and a uniform 25 percent tax on agricultural exports (Table 8.1). Moreover, separate experiments are implemented with fixed and flexible exchange-rate regimes. Altogether, the distinctions between nonagricultural import tariffs and agricultural export taxes versus fixed and flexible exchange-rate regimes give rise to four different types of experiments, which are analyzed under different macroclosures below.

In the partial-equilibrium literature, significant attention was paid to the importance of overvalued exchange rates, but the cause of the overvaluation was only identified in qualitative terms, not as an integral element of the measurement of agricultural bias. This approach is not possible in the context of the CGE-model framework. The exchange rate solution of a CGE model is by definition an equilibrium solution, given the distortions imposed on the model. Accordingly, the analysis of deviations of the exchange rate from the fundamental equilibrium exchange rate (FEER) level requires the specification of FEER, and the explicit formulation of the distortions that lead to deviations from FEER.

In the current study, FEER is defined as the exchange rate solution to a base run where all indirect taxes directly entering into the price mechanism have been replaced by nondistorting income taxes. The agricultural export taxes and nonagricultural import tariffs represent the distortions that lead to deviations of the exchange rate from the base-run FEER level. In the base run, foreign capital inflows, which have nonzero net values, are compensated for. This is based on pragmatic grounds. Severe aid-dependency is an important and stubborn feature for Mozambique. This characteristic should therefore be taken into account in the derivation of FEER because donor support for Mozambique is likely to continue.

The distinction between external closures for fixed and flexible exchange rates (Table 8.1) is used to decompose the total effect of price incentives from trade policy interventions into direct price effects and indirect exchange rate effects.[58] Since FEER is defined as the exchange rate in the

Table 8.1 Experiment descriptions for agricultural bias simulations

Simulation	Description
Base run	Tax distortions eliminated
Experiment 1	25 percent import tariffs on nonagriculture, with flexible exchange rate
Experiment 2	25 percent import tariffs on nonagriculture, with fixed exchange rate
Experiment 3	25 percent export taxes on agriculture, with flexible exchange rate
Experiment 4	25 percent export taxes on agriculture, with fixed exchange rate

Source: Authors' static CGE-model simulations.

[58]This decomposition has no relation to the original direct and indirect effects as defined in the partial-equilibrium literature. In the current context, indirect effects reflect exchange-rate effects, while total effects reflect the full impact of the policy intervention under study.

base-run, undistorted economy, experiments with a fixed exchange rate are going to reflect FEER. In contrast, experiments with a flexible exchange rate and exogenously imposed net inflows of foreign capital are going to reflect the so-called official exchange rate (OER). From the definitions of FEER and OER, it follows that total effects of price incentives can be measured by the distance between the base run and the experiments with flexible exchange rates (reflecting OER), while indirect effects of exchange rates are measured by the distance between the experiments with fixed and the flexible exchange rates (reflecting FEER and OER, respectively).[59]

The traditional partial-equilibrium literature focused narrowly on the impact on agricultural price incentives through the pricing mechanism without regard to potential feedback effects associated with quantity adjustments. This approach is likely to overstate relative price effects because quantity adjustments lower the need for price adjustments. The CGE model used here explicitly allows for quantity adjustment, except for some restrictions implied by the model closure. The choice of factor market closure for the current experiments implies that agricultural and nonagricultural labor supplies are fixed. Moreover, the scope for changes in the sectoral composition of final demand is determined by the combined choice of macroeconomic and external closures.

It follows that price and quantity adjustments in the experiments depend heavily on the choice of macroclosure (Table 8.1). Strong quantity adjustment in the foreign capital account can occur under a fixed exchange rate regime, but exchange rate adjustment under a flexible exchange rate regime can also alter the domestic currency value of capital inflows significantly. These adjustments can have considerable repercussions on the domestic economy, depending on the macroclosure. The choice of macroclosure is important for the proper measurement of total and indirect exchange rate effects. The approach in this chapter is to make use of different macroclosures to measure upper and lower bounds for the total and indirect exchange rate effects. Accordingly, two kinds of macroclosure are distinguished, one with savings-driven investment and one that is balanced, which means that private investment remains fixed in proportion to nominal absorption, while a savings rate—in this case, the average household savings rate—is allowed to vary to clear the domestic capital account.[60]

A macroclosure with savings-driven investment implies that changes in foreign capital inflows strongly affect investment expenditures. Since investment goods originate almost exclusively in the nonagricultural sector, a savings-driven investment closure means that increasing or decreasing capital inflows have maximum negative or positive effect on relative agricultural prices. In contrast, a balanced macroclosure implies that changes in foreign capital inflows affect the different components of final demand in a balanced way. It follows that the balanced macroclosure maintains the structure of nominal demand and

[59]The flexible exchange rate experiments are essential for the measurement of both total and indirect exchange rate effects. It is therefore important to specify a proper exogenous level of foreign capital inflows. Trade policy interventions are likely to affect both the exchange rate and the level of net capital inflows. Since reasonable estimates of changes to net capital inflows are not available, the initial (base run) level of capital inflows is imposed on all flexible exchange rate experiments.

[60]Household savings rates are allowed to vary proportionately. This implies that urban households take most of the adjustment, while the savings of poor rural households remain low.

minimizes the relative price effects of changing foreign capital inflows.[61]

Agricultural export taxes lead to exchange rate depreciation in the experiments using a flexible exchange rate. This implies an increase in the domestic currency value of foreign capital inflows. Since investment goods originate in the nonagricultural sector, the savings-driven investment closure leads to lower bounds for the total effects on agricultural terms of trade, while the balanced macroclosure leads to upper bounds. In contrast, the stronger expansion of capital inflows in the experiments with a fixed exchange rate implies that the exchange rate effects reflect a relative decrease in capital inflows. The savings-driven investment closure therefore leads to upper bounds for the indirect exchange rate effects on agricultural terms of trade, while the balanced macroclosure leads to lower bounds.

Nonagricultural import tariffs imply a strong exchange rate appreciation in the experiment with a flexible exchange rate. A savings-driven investment closure therefore leads to upper bounds for indirect exchange rate effects on agricultural terms of trade, while the balanced macroclosure leads to lower bounds. In contrast, the stronger contraction of capital inflows in the experiment with a fixed exchange rate means that a savings-driven investment closure leads to lower bounds for indirect exchange rate effects on agricultural terms of trade, while the balanced macroclosure leads to upper bounds.

The choice of model closure is also important for the implied structure of the base-run, undistorted economy. The base run is based on an external closure with fixed foreign capital inflows and a flexible exchange rate; and a macroclosure, with savings-driven investment. The motivation for the external closure is that capital inflows (including aid) are presumed to remain reasonably constant after the elimination of all tax distortions in the price mechanism. The savings-driven investment closure was chosen because the increase in the domestic currency value of foreign capital inflows is expected to affect investment expenditures in particular.

The evaluation of the total and indirect exchange rate effects on relative price incentives will be based on average agricultural terms of trade evaluated at different points in the pricing mechanism. Value-added prices are the most appropriate measures of relative price incentives for the allocation of productive resources. However, agricultural terms of trade evaluated at other points in the pricing mechanism make it possible to trace out the causes of the impact on value-added prices and to evaluate the effects on demand-side incentives affecting consumer prices.[62]

Simulations with a Savings-Driven Investment Closure

Quantity Adjustments in the Foreign Trade Account

When a savings-driven investment closure is applied, changes in foreign capital inflows play a critical role in economic

[61]Both of the macroclosures maintain recurrent government expenditures as well as government investment as fixed proportions of nominal absorption. The two macroclosures arguably represent extreme cases when it comes to the impact of foreign-capital inflows on the domestic economy. Changes in investment expenditures are likely to be politically more feasible than changes in recurrent expenditures, but recurrent expenditures will also have to change in response to strong changes in net capital inflows. Macroeconomic adjustment would in reality lie somewhere between savings-driven investment and a balanced macroclosure.

[62]The original price incentive measures in the partial-equilibrium literature were also based on agricultural terms of trade measures.

adjustments, and effects on nonagricultural investment expenditures are, as pointed out above, particularly strong. It is therefore instructive to review in some detail the mechanisms underlying the quantity adjustments in the foreign trade account before summarizing the results of the policy simulations.

A uniform nonagricultural import tariff of 25 percent leads, under a fixed exchange rate regime, to a 33 percent decline in total capital inflows. This effect is driven mainly by tariff-induced increases in domestic import prices, which lower import demand. The decrease in capital inflows induces a strong negative demand-side effect on investment. Investment is also hurt from the supply side, since machinery and equipment are not produced domestically.

In addition, decreasing import demand lowers the commercial service price. This moderates the decreasing import demand but also underpins increased exports of goods and services. Incentives for exports of industry sector goods improve directly from lower marketing costs. More importantly, domestic producer and consumer prices for services are competitively lowered because of declining producer prices for industry goods. The result is strongly increasing exports from the service sector. The channel for prices of commercial services has little effect on the level of foreign capital inflows but is very important for the relative development of individual trade aggregates. Lower marketing costs lead to increased export earnings, which in turn finance a more moderate decline in imports of essential intermediate inputs and investment goods.

Under a flexible exchange rate regime, exchange rate appreciation acts to maintain the foreign currency level of capital inflows. The appreciation curtails import price increases for essential intermediate inputs and investment goods, limiting supply-side effects. The appreciation also lowers

Table 8.2 Price indices and agricultural terms of trade for agricultural bias simulations

		Change from base run (percentage)			
Prices	**Base run**	**Experiment 1**	**Experiment 2**	**Experiment 3**	**Experiment 4**
Import					
Agricultural terms of trade	100	-16.2	-17.0	-0.0	0.0
Agricultural prices	100	-8.3	-2.9	0.2	0.0
Nonagricultural prices	100	9.3	17.1	0.2	0.0
Export					
Agricultural terms of trade	100	-0.8	4.1	-35.0	-35.2
Agricultural prices	100	-10.0	5.0	-34.8	-35.2
Nonagricultural prices	100	-9.2	0.9	0.4	-0.0
Retail					
Agricultural terms of trade	100	-6.6	-6.9	-0.0	-0.0
Agricultural prices	100	-4.7	-4.8	0.0	0.0
Nonagricultural prices	100	1.9	2.4	0.0	0.0
Producer					
Agricultural terms of trade	100	1.4	4.3	-1.1	-1.2
Agricultural prices	100	-2.1	-0.8	-1.1	-1.2
Nonagricultural prices	100	-3.5	-4.9	0.0	0.0
Value-added					
Agricultural terms of trade	100	8.1	14.6	-1.2	-1.4
Agricultural prices	100	-2.5	-1.2	-1.3	-1.3
Nonagricultural prices	100	-9.8	-13.8	-0.1	0.0
Exchange rate	100	-9.0	0.0	0.3	0.0
Commercial service price	100	-5.9	-9.7	-0.2	0.0

Source: Authors' static CGE-model simulations.

the domestic currency value of foreign capital inflows. This induces a demand-side effect similar to the one in the experiment with a fixed exchange rate. Since the exchange rate appreciates by 9 percent, the domestic currency value of foreign capital inflows drops by 9 percent (Table 8.2). This stands in contrast to the 33 percent reduction in the experiment with a fixed exchange rate. It follows that the exchange rate effects in the import tariff experiments reflect a relative 24 percent increase in foreign capital inflows, while the total effects reflect a 9 percent decrease.

While agricultural exports are small, the relative importance of capital inflows is also borne out by the experiments on agricultural export taxes. The fixed exchange rate experiment implies a 1.1 percent increase in foreign capital inflows because of decreasing export earnings. Moreover, the 0.3 percent exchange rate depreciation (Table 8.2) leads to a 0.3 percent increase in capital inflows in the experiment with a flexible exchange rate. It follows that the exchange rate effects in the export tax experiments reflect a decrease of 0.8 percent in foreign capital inflows, while the total effects reflect a 0.3 percent increase.

Finally, in the case of Mozambique, investment expenditures are allocated mainly between two sectors—construction, and machinery and equipment. While construction is only produced domestically, the machinery and equipment sector has an import share exceeding 75 percent. Decreasing foreign financing of investment expenditures on transport machinery and equipment is automatically evened out by an almost similar decrease in imports. In contrast, a decrease in foreign financing of construction for investment purposes falls squarely on the domestic economy. It follows that the impact of changing capital inflows on the domestic economy is determined mainly by the impact on the construction sector through the investment channel.

Macroeconomic Impact

The results of the four policy experiments with savings-driven investment indicate that nonagricultural import tariffs have small negative effects on real GDP (Table 8.3). The negative impact is slightly stronger in the experiment with a fixed exchange rate, where foreign capital inflows decrease the most. Nevertheless, total and indirect exchange rate effects on real GDP are marginal. The impact on nominal GDP is slightly negative under a fixed exchange rate, while it is visibly positive in the experiment with a flexible exchange rate. Overall, the positive total effects on nominal GDP and the GDP deflator are dominated by a positive, indirect exchange rate effect.

Since real and nominal GDP capture the impact on domestic income generation, these measures are not affected directly by changes in foreign capital inflows. In contrast, nominal absorption, which is a measure of welfare, is strongly affected by changes in capital inflows. The welfare implications of nonagricultural import tariffs are therefore very different between the

Table 8.3 Macroeconomic indicators for agricultural bias simulations

Indicator	Base run (100 billion metical	Change from base run (percentage)			
		Experiment 1	Experiment 2	Experiment 3	Experiment 4
Real GDP	172.1	-0.2	-0.5	-0.0	-0.0
Nominal GDP	172.1	2.9	-0.2	-0.2	-0.1
Nominal absorption	227.6	0.0	-8.1	-0.1	0.2

Source: Authors' static CGE-model simulations.

experiment with the fixed exchange rate and that with a flexible exchange rate. While absorption is virtually unchanged in the experiment with a flexible rate (reflecting that foreign capital inflows are kept at their initial base-run level), it decreases strongly in the experiment with a fixed rate. Consequently, while the total effect of nonagricultural tariffs and an overvalued exchange rate is negligible, it is made up of two large and oppositely signed direct and indirect effects.

The strong positive welfare effect of the exchange rate overvaluation is somewhat counterintuitive. However, the results can be given an interpretation whereby the exchange rate overvaluation lowers the cost of essential imports of intermediate inputs and investment goods. This induces domestic and foreign entrepreneurs to increase direct investment and borrowing from abroad. Decreasing export earnings because of the exchange rate overvaluation adds to the increased need for foreign financing. It follows that the welfare increase, which appears as induced by the exchange rate overvaluation, is in reality financed by increased inflows of foreign savings, assumed to be forthcoming to finance the foreign trade gap.

Touching on the experiments involving agricultural export taxes, 3 and 4 (Table 8.3), the macroeconomic indicators clearly reflect the low agricultural trade shares that characterize Mozambique. Real GDP does not change in either of the two experiments, and small changes in nominal GDP indicate that relative prices move little. While the total effect on absorption is marginally negative, it is made up of two slightly bigger counteracting direct and indirect effects. This pattern is similar to the import tariff experiments. However, this time the direct effect of the exchange rate is positive, while the indirect impact is negative. Overall, the indirect and total effects of agricultural export taxes and an undervalued exchange rate on macroeconomic aggregates are negligible.

A breakdown of real GDP (Table 8.4) indicates that the total effects of nonagricultural import tariffs, measured by experiment 1, lead to important reallocation among GDP components. Government consumption benefits from the tax revenue neutrality of the experiments. Moreover, private consumption benefits from the lower household tax burden, which more than compensates for the tariff-induced increases in nonagricultural consumer prices. Overall, consumers of agricultural goods and services benefit the most under a flexible exchange rate regime. Accordingly, producer price declines in agriculture and service sectors and a lower commercial service price imply that agricultural goods, and especially services, become much cheaper.

Table 8.4 Real GDP components for agricultural bias simulations

GDP component	Base run (100 billion metical)	Change from base run (percentage)			
		Experiment 1	Experiment 2	Experiment 3	Experiment 4
Exports	37.2	-9.2	15.9	-0.7	-1.5
Imports	92.6	-3.7	-13.2	-0.3	0.1
Home consumption	33.8	1.1	-1.1	0.1	0.1
Marketed consumption	105.9	3.8	0.1	-0.2	-0.1
Recurrent government	17.1	5.1	-1.3	-0.1	0.1
Nongovernmental organizations	6.0	-13.3	-3.1	0.3	-0.1
Investment	64.7	-7.3	-28.3	0.2	0.9
Real GDP	172.1	-0.2	-0.5	-0.0	-0.0

Source: Authors' static CGE-model simulations.

The total effects on GDP components clearly show that investment is affected the worst by nonagricultural import tariffs and the associated overvalued exchange rate. As noted above, investment is squeezed both from the supply and demand sides. Since capital transfers finance more than 70 percent of total investment expenditures, the effect on demand-side revenue from overvaluation of the exchange rate completely dominates the total effect on investment. The strong negative total effect on exports is also mainly due to the exchange rate overvaluation, which lowers domestic export prices. Overall, total effects of nonagricultural import tariffs on imports, exports, and investment are strongly negative, while total effects on private and government consumption are positive.

The indirect exchange rate effects of imposing high nonagricultural import tariffs also imply strong changes among GDP components. This is closely connected with the fact that the indirect exchange rate effects reflect a 9 percent exchange rate appreciation and a 24 percent increase in foreign capital inflows. Overall, indirect exchange rate effects on consumption, investment, and imports are strongly positive. The relative increase in foreign capital inflows induces an especially strong positive, indirect effect on investment. In contrast, the indirect exchange rate effect on exports is strongly negative because of the exchange rate appreciation and the increased domestic demand for production.

In the experiments involving agricultural export taxes, 3 and 4, the total effects on the composition of real GDP are again small because of very low agricultural export shares. Exports drop because of declines in domestic agricultural export prices induced by export taxes, while imports drop because of the exchange rate depreciation, which increases domestic import prices. Home consumption of own production increases because of downward pressures on agricultural producer prices. Finally, upward pressure on nonagricultural market prices implies that private and government market-based consumption decline. Overall, the (small) total effects of agricultural export taxes include lower consumption and foreign trade, and increasing investment.

Agricultural export taxes also have some visible indirect exchange rate effects on the composition of GDP. These effects reflect the 0.3 percent depreciation in exchange rates and a relative 0.8 percent decrease in foreign capital inflows. The decrease in capital inflows, combined with increases in import prices of investment goods induced by exchange rates, implies a relatively strong negative, indirect exchange rate effect on investment. Furthermore, the exchange rate depreciation improves the trade balance through increasing exports and decreasing imports. In sum, the indirect exchange rate effects of agricultural export taxes are generally negative for consumption, investment, and imports, and positive for exports.

Agricultural Terms of Trade

The agricultural terms of trade were evaluated at different points in the pricing chain (Table 8.2). The total effect of nonagricultural import tariffs is to lower the terms of trade evaluated at domestic import prices by 16.2 percent. The fall in the price of commercial services improves domestic prices for agricultural imports prices more than for nonagricultural import. Accordingly, the price channel for commercial services moderates the negative total effect on relative prices for agricultural import.[63] The indirect exchange rate effect on relative prices of agricultural imports is only marginally positive because the exchange rate

[63]Agricultural import prices would have decreased by 20 percent by definition, had marketing margins not been present in the model.

appreciation and the decline in commercial service prices affects agricultural and nonagricultural import prices in a similar way. This is so because marketing margin rates for imported agricultural and nonagricultural goods are similar.

The total effect of nonagricultural import tariffs on relative agricultural export prices is modest. The small total incentive effect is due to almost equivalent rates of decline in agricultural and nonagricultural export prices. The negative impact on domestic agricultural export prices is noted. The 6.3 percent decline in the commercial service price should increase relative agricultural export prices. However, the large share of marketing costs in the value of agricultural exports also implies that agricultural export prices are sensitive to exchange rate changes. It follows that the 9 percent exchange rate appreciation has a particularly negative effect on agricultural export prices. Overall, the total effect of nonagricultural import tariffs is to lower relative agricultural export prices by 0.8 percent.[64]

While the indirect exchange rate effects are negative for agricultural and nonagricultural export prices alike, agricultural prices are affected the most because of the mutually reinforcing effects of the exchange rate appreciation and the relative 5.1 percent increase in the commercial service price. High agricultural margins for export marketing imply that increased commercial service costs worsen the agricultural terms of trade. Moreover, the exchange rate appreciation worsens the agricultural terms of trade even further because of the implied exchange rate sensitivity. Overall, the indirect exchange rate effect on relative agricultural export prices is a drop of 4.9 percent.

The total effect on agricultural terms of trade evaluated at the prices for composite goods is strongly negative. This is a result of declining agricultural and increasing nonagricultural price indices. The decline in agricultural market prices follows from declining producer prices and marketing costs. Lower producer prices and marketing costs also have a tendency to lower nonagricultural market prices. However, tariff-induced increases in nonagricultural import prices dominate. Overall, the total effect of nonagricultural import tariffs is to decrease relative agricultural market prices by 6.6 percent.

The indirect exchange rate effect on relative agricultural market prices is small. This effect reflects a 9 percent exchange rate appreciation and 24 percent increase in foreign capital inflows. On the one hand, the appreciation leads to lower nonagricultural market prices for imported goods because of relatively high nonagricultural import shares. On the other hand, increased foreign capital inflows lead to increased demand and prices for nonagricultural investment goods (construction). Finally, the 5.1 percent increase in the commercial service price increases agricultural market prices relatively strongly. Overall, the indirect exchange rate effect of nonagricultural import tariffs leads to a small 0.3 percent net increase in relative agricultural market prices.

The total incentive effects of nonagricultural import tariffs include increasing relative agricultural producer prices. The relative drop in nonagricultural producer prices may seem counterintuitive, since nonagricultural import tariffs are supposed to protect nonagriculture. The reason for this effect is partly to be found in the differences in marketing margin rates between sectors. Import tariffs induce a drop in import demand. This leads to a fall in the commercial service price, which imparts a downward pressure on agricultural and industry sector market prices. Since no marketing margin is added to service sector

[64]Notice, however, that the high negative total effects on domestic export prices has a larger impact on nonagricultural producer price incentives because of the larger nonagricultural export shares.

activities, this leads to a competitive lowering of service sector market and producer prices. The producer price in the construction sector also declines because of declining foreign financing for investment purposes. Overall, the nonagricultural import tariffs lead to a total 1.4 percent increase in relative agricultural producer prices in spite of the protection afforded by the import tariffs to the nonagricultural sector.

The indirect exchange rate effect of nonagricultural import tariffs on relative agricultural producer prices is moderately negative. As mentioned previously, the exchange rate effect reflects an exchange rate appreciation and a relative increase in foreign capital inflows. The exchange rate appreciation works to lower the producer prices on (nonagricultural) exports directly, while the increase in foreign capital inflows leads to increasing demand and producer prices for construction. In addition, the relative increase in the commercial service price leads to competitive increases in service sector producer prices. The net result of these disparate effects is that the indirect exchange rate effect of nonagricultural import tariffs amounts to a 2.9 percent decrease in relative agricultural producer prices.

The total effect of nonagricultural import tariffs on relative agricultural value-added prices is strongly positive. The positive total incentive effects for agricultural producers cannot be explained by relative changes in producer prices. They only change slightly. Rudimentary production technologies imply that agricultural value-added prices decrease by a mere 2.5 percent in accordance with producer prices. In contrast, nonagricultural value-added prices decrease by 9.8 percent in the more input-intensive nonagricultural sectors. This is much stronger than the 3.5 percent decline in nonagricultural producer prices. Consequently, nonagricultural value-added prices particularly are negatively affected by nonagricultural import tariffs through the input cost channel.

The individual price indices indicate that changes in producer prices and value-added prices are correlated for both agriculture and nonagriculture. However, intermediate input costs are clearly important for the nonagricultural sector. This can be seen from the fact that percentage changes differ markedly between nonagricultural producer prices and value-added prices. The effect of large input costs has two dimensions. The first is to introduce sensitivity to changes in input prices. The second is to increase sensitivity to changes in producer prices. Since the average input cost share of nonagricultural production is 50 percent, both dimensions are important for nonagricultural prices.

Overall, the total effect of nonagricultural import tariffs on relative agricultural value-added prices is 8.1 percent. It follows that this positive total effect mainly stems from the high sensitivity of nonagricultural value-added prices to changes in producer prices and from the tariff-induced increases in consumer price, which increase nonagricultural input prices. Since the agricultural terms of trade evaluated at value-added prices is the most appropriate measure of relative incentives for agricultural producers, nonagricultural import tariffs and the associated overvalued exchange rate imply a bias against nonagriculture rather than a bias against agriculture.

The indirect exchange rate effect of nonagricultural import tariffs on relative agricultural value-added prices is strongly negative. Accordingly, the positive total effect follows from a strong positive effect on direct prices, which reflects a 33 percent increase in capital inflows. In contrast, the indirect exchange rate effect reflects a 9 percent exchange rate overvaluation and a 24 percent increase in capital inflows. Overall, the indirect exchange rate effect of nonagricultural import tariffs works to lower relative agricultural value-added prices by 6.5 percent. This cannot be explained alone by the modest indirect exchange rate effect on relative agricultural producer prices,

implying that the input cost channel plays a role. Hence, the positive indirect exchange rate effect on relative agricultural value-added prices results from the combination of increasing relative agricultural producer prices, a high sensitivity of nonagricultural value-added prices to declining producer prices and tariff-induced increases in nonagricultural input prices.

The last two experiments, 3 and 4, are used to analyze the impact of a uniform 25 percent agricultural export tax. The impact on relative prices is generally small, since agricultural export shares are low. The only major impact of the 25 percent agricultural export tax is to decrease relative agricultural export prices by 35 percent. The reason for this seeming inconsistency is that agricultural marketing margin rates are relatively high. High margins imply that domestic export prices are especially sensitive to changes in the domestic currency value of world market prices.[65] Since agricultural export taxes subtract from the domestic currency value of the world market prices for exports, domestic agricultural export prices react strongly to export taxes.

In general, agricultural export taxes have only marginal effects on nonagricultural prices. The declining agricultural terms of trade evaluated at producer and value-added prices reflect the strongly declining producer prices for exports. The mild impact is a result of the low agricultural export shares. In conclusion, the total incentive effects of agricultural export taxes are moderately adverse toward agricultural production in general but very adverse toward production of agricultural export goods in particular. The indirect exchange rate effects on agricultural terms of trade following from the 0.3 percent undervaluation of the exchange rate are very small. Overall, the agricultural export taxes lead to a positive indirect incentive effect on relative agricultural value-added prices in the order of 0.2 percent.

Simulations with a Balanced Macroclosure

Quantity Adjustments in the Foreign Trade Account

This section presents trade policy analyses of export taxes and import tariffs in the context of a balanced macroclosure where the private investment share of absorption is fixed. Government consumption and investment are also fixed in proportion to nominal absorption, so constant shares are close to being maintained in absorption.[66] Maintaining private investment as a constant share of absorption requires allowing a savings rate—in this case the average household savings rate—to vary and thus maintain equilibrium between savings and investment.

In general, changes in the foreign capital inflows do not depend much on the choice of macroclosure. This is so because the changes in the commercial service price and the exchange rate are similar irrespective of the choice of macroclosure.

Under a fixed exchange rate regime, nonagricultural import tariffs lead to a 29 percent drop in foreign capital inflows, as compared with 33 percent under a savings-driven investment closure. The mechanism remains the same as before, namely tariff-induced increases in domestic import prices drive nonagricultural imports of investment

[65]Marketing costs make up for the difference between domestic agricultural prices and the world market price in domestic currency. If marketing margins were not accounted for, a uniform 25 percent agricultural export tax would lead to a 25 percent decrease in domestic agricultural export prices, by definition.

[66]Were it not for the revenue-driven NGO demand component, which is relatively small, fixed government consumption and total investment shares of absorption would imply a constant private consumption share of absorption as well.

goods and services down. Moreover, the non-agricultural import tariff experiment with a flexible exchange leads to a 9 percent decline in the domestic currency value of capital inflows regardless of the choice of macroclosure. In the following, total effects accordingly reflect a 9 percent decline in capital inflows, while the indirect effects reflect a 20 percent increase.

The total effects of agricultural export taxes reflect a 0.3 percent increase in capital inflows regardless of the choice of macroclosure. Moreover, the current indirect effects reflect a 0.9 percent decrease in capital inflows as compared with a 0.8 percent decrease with savings-driven investment. In general, it can be concluded that the policy impacts on foreign capital inflows do not depend on the choice of macroclosure. The experiments with a balanced macroclosure are therefore comparable to the experiments with a savings-driven investment closure in relation to their impacts on capital inflows.

Macroeconomic Impact

Both nonagricultural import tariffs and agricultural export taxes have effects on aggregate real GDP similar to the experiments with a savings-driven investment closure (Table 8.5). While there are real small negative real effects of imposing nonagricultural import tariffs, agricultural export taxes show no visible effects on real GDP. The impact on nominal macroeconomic indicators is also very similar to the previous experiments with savings-driven investment. Overall, the positive total effects of non-agricultural tariffs on nominal GDP and the GDP deflator are dominated by positive indirect exchange rate effects.

The marginal total effect of nonagricultural import tariffs on nominal absorption is again made up of strong direct and indirect effects. Furthermore, the positive indirect effect of exchange rates still follows from the 20 percent increase in capital inflows. The impact of agricultural export taxes remains small. Again, a 0.9 percent decrease in capital inflows leads to a negative indirect exchange rate effect on nominal absorption. Overall, the effects of export taxes and import tariffs on macroeconomic indicators do not change much with the change to a balanced macroclosure.

In line with the previous set of experiments, small changes in real GDP cover significant changes in the composition of final demand (Table 8.6). Total effects of nonagricultural import tariffs do not change much with the change to a balanced macroclosure, except for a more moderate decline in real investment and a smaller expansion of private marketed consumption. Accordingly, the conclusion remains that private and government consumption expands at the expense of real investment.

The fact that the composition of real GDP still changes may seem like a paradox given that the balanced macroclosure maintains the structure of domestic nominal demand. However, changing relative prices affect the composition of real final demand. Tariff-induced increases in nonagricultural

Table 8.5 Macroeconomic indicators for agricultural bias simulations

Indicator	Base run (100 billion metical)	Change from base run (percentage)			
		Experiment 1	Experiment 2	Experiment 3	Experiment 4
Real GDP	172.1	-0.2	-0.4	-0.0	-0.0
Nominal GDP	172.1	2.7	-0.7	-0.2	-0.1
Nominal absorption	227.6	-0.1	-7.6	-0.1	0.2

Source: Authors' static CGE-model simulations.

Table 8.6 Real GDP components for agricultural bias simulations

GDP component	Base run (100 billion metical)	Change from base run (percentage)			
		Experiment 1	Experiment 2	Experiment 3	Experiment 4
Exports	37.2	-9.9	11.1	-0.7	-1.4
Imports	92.6	-4.0	-13.0	-0.2	0.1
Home consumption	33.8	0.8	-1.8	0.1	0.2
Marketed consumption	105.9	0.9	-8.1	0.0	0.3
Recurrent government	17.1	4.8	-1.6	-0.1	0.1
Nongovernmental organizations	6.0	-13.4	-4.2	0.3	-0.0
Investment	64.7	-2.3	-11.1	-0.1	0.2
Real GDP	172.1	-0.2	-0.4	-0.0	-0.0

Source: Authors' static CGE-model simulations.

import prices lead to increasing prices for nonagricultural investment goods. In contrast, service prices are competitively lowered. Overall, the total effects of nonagricultural import tariffs still involve decreasing trade and investment, and increasing consumption.

The indirect exchange rate effects of nonagricultural import tariffs are also affected strongly by the change to a balanced macroclosure. Since the indirect exchange rate effects reflect a 20 percent increase in capital inflows, the change to a balanced macroclosure moderates the relative expansion of nonagricultural investment demand in favor of a stronger expansion of more agriculturally oriented consumption demand.

The negative indirect exchange rate effect on exports is also moderated with a balanced macroclosure. Accordingly, the more moderate 3.8 percent increase in marketing costs lowers competitive price increases in the service sector. Nevertheless, exports still decline by around 20 percent because of declines in domestic export prices induced by changes in the exchange rate and a general increase in domestic absorption resulting from increased capital inflows.

Overall, indirect exchange rate effects of nonagricultural import tariffs continue to involve increasing real consumption, investment, and imports; and decreasing exports. However, the choice of a balanced macroclosure implies a stronger increase in consumption, a more moderate increase in investment, and a more moderate decrease in exports. The contemporary expansion of real consumption and investment continue to reflect a relative 20 percent increase in foreign capital inflows for financing purposes.

The change to a balanced macroclosure also affects the impact of agricultural export taxes on the composition of final demand. While total and indirect exchange rate effects are small, the change in tradeoff between private consumption and investment demand remains visible. The total effect on investment turns positive, while the impact on private consumption becomes negative. Overall, the total effect of agricultural export taxes continues to include a reduction in trade, while total effects on investment and consumption are marginal.

The most visible impact of the balanced macroclosure in relation to the agricultural export tax experiments is on the indirect exchange rate effects. Accordingly, the negative indirect effect on investment is clearly moderated at the expense of a negative indirect effect on private consumption. Overall, the indirect exchange rate effects of agricultural export taxes include decreasing consumption, investment and imports, and increasing exports.

Agricultural Terms of Trade

The impact of nonagricultural import tariffs on relative agricultural import prices is not affected in any important way by the choice of macroclosure (Table 8.7). Average marketing margin rates are similar for agricultural and nonagricultural imports. It follows that slightly varying changes in the commercial service price and the exchange rate leave the agricultural terms of trade virtually unaffected by the choice of macroclosure (Tables 8.1 and 8.7). Overall, the nonagricultural import tariffs lead to a strong negative total effect of –16.2 percent on relative agricultural import prices, while the overvalued exchange rate leads to a small positive indirect exchange rate effect of 0.7 percent.

Agricultural export prices are somewhat more sensitive to the choice of macroclosure, since agricultural marketing margin rates are relatively high. The total effects of nonagricultural import tariffs reflect a 6.3 percent decline in the commercial service price, compared with a 5.9 percent decline with savings-driven investment. It follows that the total effect of nonagricultural import tariffs on relative export prices remains around –1.0 percent, regardless of the choice of macroclosure.

In contrast, indirect exchange rate effects reflect an increase of 3.8 percent in the commercial service price compared with a 5.1 percent increase with savings-driven investment. The more moderate increase in marketing costs benefits relative agricultural export prices. It follows that the change to a balanced macroclosure moderates the negative indirect effect on agricultural export prices. Nevertheless, the exchange rate appreciation and the relative increase in the commercial service price still imply that nonagricultural import tariffs lead to a strong negative indirect exchange

Table 8.7 Price indices and agricultural terms of trade for agricultural bias simulations

		Change from base run (percentage)			
Prices	**Base run**	**Experiment 1**	**Experiment 2**	**Experiment 3**	**Experiment 4**
Import					
Agricultural terms of trade	100	-16.2	-16.9	0.0	0.0
Agricultural prices	100	-8.1	-2.5	0.2	0.0
Nonagricultural prices	100	9.6	17.4	0.2	0.0
Export					
Agricultural terms of trade	100	-1.0	3.3	-35.0	-35.1
Agricultural prices	100	-9.9	4.0	-34.8	-35.1
Nonagricultural prices	100	-9.0	0.7	0.3	0.0
Retail					
Agricultural terms of trade	100	-7.5	-10.0	0.0	0.1
Agricultural prices	100	-5.4	-7.1	0.1	0.1
Nonagricultural prices	100	2.2	3.2	0.0	0.0
Producer					
Agricultural terms of trade	100	-0.8	-3.2	-1.0	-0.9
Agricultural prices	100	-4.0	-7.1	-1.0	-0.9
Nonagricultural prices	100	-3.2	-4.0	0.0	0.0
Value-added					
Agricultural terms of trade	100	5.3	4.8	-1.1	-1.0
Agricultural prices	100	-4.7	-8.3	-1.2	-1.0
Nonagricultural prices	100	-9.5	-12.5	-0.1	0.0
Exchange rate	100	-8.8	0.0	0.3	0.0
Commercial service price	100	-6.3	-11.4	-0.1	0

Source: Authors' static CGE-model simulations.

rate effect of –4.3 percent on relative agricultural export prices.

Nonagricultural import tariffs decrease relative prices for agricultural goods by 7.5 and 10.0 percent, respectively, in the experiments with flexible and fixed exchange rates. Accordingly, a balanced macroclosure implies a stronger negative total effect, composed of a stronger negative direct effect and a stronger positive indirect exchange rate effect. The individual price indices indicate that the change to a balanced macroclosure has a negative impact on agricultural prices (Tables 8.2 and 8.7). These agricultural price effects are the most important effects of a change to a balanced macroclosure.

Overall, the strong negative total effect of nonagricultural import tariffs on relative agricultural composite prices still follows from the combination of increase in nonagricultural market prices and decreases in agricultural market prices. Consequently, the import tariffs increase domestic nonagricultural (import) prices, while decreases in producer prices and marketing costs decrease agricultural market prices.

Nonagricultural import tariffs decrease relative agricultural producer prices by 0.8 percent in the experiment with flexible exchange rates and by 3.2 percent in the experiment with fixed exchange rates. As a result, the change to a balanced macroclosure leads to a negative total effect and a positive indirect exchange rate effect. The individual price indices indicate that a balanced macroclosure affects nonagricultural producer prices positively and agricultural producer prices negatively (Tables 8.2 and 8.7). The reason is that adjustment to declining capital inflows are shifted from nonagricultural investment goods to agricultural consumer goods.

Overall, the negative total effect of nonagricultural import tariffs on relative agricultural producer prices continues to be the net outcome of simultaneous declines in agricultural and service sector producer prices. Producer prices in industry and manufacturing sectors generally decline less than in other sectors because of tariff protection and lower marketing costs. The positive indirect exchange rate effect reflects a strong positive impact on agricultural producer prices. While the relative demand increase for agricultural consumption goods directly affects the domestic economy, increasing demand for nonagricultural investment goods leaks out partly through imports. Accordingly, the 20 percent increase in capital inflows increases agricultural producer prices more strongly than nonagricultural producer prices.

Nonagricultural import tariffs increase relative agricultural value-added prices by 5.3 percent and 4.8 percent, respectively, in the experiments with flexible and fixed exchange rates. The positive total effect is moderated by the change to a balanced macroclosure, while the indirect exchange rate effect has turned marginally positive. The balanced macroclosure affects agricultural value-added prices positively (the major impact) and nonagricultural value-added prices negatively. This was also the case for producer prices. This might suggest that the change to a balanced macroclosure affects relative agricultural value-added prices through its impact on agricultural producer prices. However, the effect of the change to a balanced macroclosure on nonagricultural producer prices is also important, since the input cost channel magnifies the effect of producer prices changes on value-added prices.

Overall, nonagricultural import tariffs have a total effect of 5.3 percent on relative agricultural value-added prices. The total effect on relative producer prices is small. It follows that the positive total effect mainly stems from the input cost channel including the very sensitive nature of nonagricultural value-added prices to changes in producer prices, and the tariff-induced price increases for nonagricultural inputs. Nonagricultural import tariffs also lead to a positive indirect exchange rate effect of 0.5 percent on relative value-added prices. The small

positive indirect effect results because agricultural and nonagricultural value-added prices increase in parallel between the fixed and flexible exchange rate experiments. The reason is that the structure of domestic final demand is maintained almost constant. This minimizes the relative price impact of the relative 20 percent increase in capital inflows.

The change to a balanced macroclosure has very little importance for the results in the experiments with agricultural export taxes. Total and indirect exchange rate effects remain small because of the very low agricultural export shares in the model. Consequently, the conclusion remains that agricultural export taxes reduce agricultural producer incentives slightly, while price incentives for production of agricultural export crops are reduced strongly.

Conclusions

During the 1980s the benefits of free trade and deregulated markets were increasingly emphasized, and partial-equilibrium studies in the late 1980s concluded that import-substituting trade and exchange rate policies have strong negative effects on agricultural production incentives. The generality of these conclusions are, however, seriously questioned when the analysis is performed inside a general-equilibrium framework. Our experiments suggest that quantity adjustment in the foreign trade account is important to consider when analyzing the agricultural bias in a general-equilibrium framework. The specific characteristics of the model are important for the results obtained. High agricultural marketing margins imply that agricultural price incentives improve when declining demand for marketing services, driven by declining trade, lowers the price of marketing services. Moreover, increases in industry input costs, because of import tariffs or exchange rate depreciation, tend to benefit relative agricultural price incentives. Overall, the bias against agriculture following from agricultural export taxes is minor, while nonagricultural import tariffs actually increase agricultural production incentives strongly.

The impact of import-substituting policies on relative agricultural value-added prices suggests that historical policies may not have imparted an agricultural bias in Mozambique, as previously believed. Consequently, the increasing agricultural share of value-added up through the early 1990s, identified in Chapter 4, appears to have come about not so much because of structural adjustment induced improvements to agricultural price incentives, but rather because the sector was recovering from the war in the 1980s and early 1990s, and the drought in 1992. However, it is important to be aware of the limitations of the results presented in this chapter. Accordingly, the fact that agricultural export taxes have little effect on relative agricultural price incentives rests squarely on the fact that agricultural export shares are small in the model. These results cannot be used to argue that export taxes on, for example, raw cashews can make up a vital source of government revenue. This would require that agricultural export shares, a key structural characteristic of the model, increased substantially.

CHAPTER 9

Marketing Margins and Agricultural Technology

Following the peace agreement in 1992 and the first free general elections in 1994, displaced people returned to rural agricultural areas in massive numbers. This played an important role in the recovery of aggregate agricultural production, as discussed in Chapter 4. Nevertheless, production technologies employed by most farmers remain rudimentary and the quality of inputs is poor. Therefore significant possibilities exist for shifting to better production technologies through using improved seed varieties and other improved inputs, and through better farming practices (Bay 1998). Moreover, a key problem limiting the impact of market reforms and the potential benefits of better agricultural technology is that many farmers do not have access to markets. The lack of markets is widespread, and transactions costs are very high. Some progress has been made regarding the extension of primary and secondary road networks, and this has been accompanied by some integration of trading activities between different parts of the country. The overall goal of bringing the different regions into a single, integrated domestic economy that links rural production areas with urban consumption centers through the establishment of countrywide transport, storage, and communication facilities is, however, far from achieved.

Against this background, this chapter presents a quantitative assessment of the potential benefits from increases in the productivity of the agricultural sector and improvements to marketing networks. The analysis is based on the CGE model set out in Chapter 6. The 1995 SAM shows that marketing margins for some sectors were as high as three times the producer price in 1995, and they are especially large for primary agricultural production. These marketing costs represent wedges between producer and purchaser prices, and partly explain why more than half of agricultural production remains unmarketed. Since the vast majority of the population relies on agricultural production for their livelihood, potential exists for very large income gains through improved market integration in rural areas. Synergy between a poverty-reducing strategy of increasing agricultural productivity and parallel improvements in the marketing infrastructure can be expected.

Simulations

Marketing margins in the model, discussed here, are based on the distinction between factory and farmgate prices on the one hand and purchaser prices on the other, reflecting storage and

This chapter was written by Channing Arndt, Henning Tarp Jensen, Sherman Robinson, and Finn Tarp.

marketing costs.[67] The marketing margins were introduced into the CGE model through commercial service coefficients. This treatment amounts to assuming that each production good from a given production sector requires a fixed amount of marketing services to reach the market. In essence, they are input-output coefficients relating the demand for commerce services required to move goods from producer to market. A single production activity provides the marketing services associated with imported, exported, and domestically marketed commodities.

The model formulation incorporates home consumption and marketed consumption through a linear expenditure system (LES). In this formulation, the marginal budget shares of marketed and nonmarketed goods are fixed and each commodity has an associated minimum consumption level below which physical consumption cannot fall. Home-consumed goods are, as already noted, valued at producer prices, while marketed goods are valued at purchaser prices, including consumption taxes and marketing margins. Labor supplies are fixed in the agricultural and nonagricultural sectors.[68] As a result, wage rates are allowed to diverge between agricultural and non-agricultural labor.

In the model, implementation of agricultural technology improvements, through Hicks-neutral productivity increases, is straightforward and in line with our focus on the productivity-enhancing importance of introducing better-quality inputs, such as improved seed, in combination with better farming practices. Reductions in marketing margins are modeled through scaling down the commercial service coefficients further discussed below.[69] In the analysis, investment expenditures associated with improved technology and marketing infrastructure are ignored. This treatment amounts to assuming that these investments are undertaken before the current simulations, and the analysis makes no attempt to quantify the costs of realizing the policy initiatives studied here. The focus is instead on benefits.

The simulations include a uniform 30 percent improvement in productivity across agricultural sectors and a 15 percent reduction in the commercial service coefficients for imported, exported, and domestically produced and marketed commodities (Table 9.1). Achieving agricultural productivity growth on the order of 30 percent in Mozambique is probably feasible over a reasonably short time span because of the rudimentary nature of current agricultural production practices. Reductions in marketing margins on the order of 15 percent are also feasible, given the scope for improving the marketing system after the devastation caused by the war. While a 15 percent gain may come relatively cheaply, large investments in marketing infrastructure will likely be needed to achieve significant further declines in marketing costs. In short, the costs of achieving these gains are not explicitly included in the model. However, the costs of attaining these gains are likely

[67]The price gap may reflect some degree of imperfect competition. In the SAM and the model, they are assumed to reflect real costs.

[68]Simulations with a specification of constant elasticity of transformation between agricultural and nonagricultural labor supplies lead to the same conclusions.

[69]The current experiments analyze the effects of reductions in the demand for marketing services following from investment in marketing infrastructure. The experiments do not take account of potential efficiency gains in the production of commercial services associated with improvements to the marketing infrastructure. The demand effect is assumed to dominate, at least initially, in the Mozambican context. Better infrastructure will make it possible to transport, for example, 1 ton of maize faster and with less input of work-hours and fuel, but the trucks carrying the cargo remain the same. In any case, efficiency gains in the provision of marketing services would yield similar qualitative results, reinforcing the conclusions derived from the analysis in this chapter.

Table 9.1 Experiment descriptions for marketing margin and agricultural technology simulations

Experiment	Description
Base run	Base social accounting matrix (SAM) data set for 1995
Experiment 1	Increase in productivity by 30 percent for all agricultural products
Experiment 2	Reduction of marketing margins for all goods by 15 percent
Experiment 3	Scenarios 1 and 2 combined

Source: Authors' static CGE-model experiment design.

to be relatively low. For the attainment of further gains, a more detailed consideration of cost would be desirable.

The productivity increase of 30 percent for all agricultural products (experiment 1) yields an aggregate welfare improvement of 6.8 percent (the change in absorption deflated by the aggregate CPI (Table 9.2). The productivity increase raises output and lowers relative prices significantly in the agricultural sector. The price decline moderates the increase in aggregate rural income and transmits much of the gain to the urban sector. Since agriculture has very high trade margins, the greater output generates a significant increase in demand for commerce services, driving up their price. The result is that the gap between supplier and market prices for exports and imports rises. Exports decrease more than imports in real terms, and a mild depreciation of the real exchange rate (3.3 percent) restores equilibrium in the trade balance.[70]

Table 9.2 Macroeconomic indicators and prices for marketing margin and agricultural technology simulations

Indicator	Base run (100 billion metical)	Change from base run (percentage)		
		Experiment 1	Experiment 2	Experiment 3
Real GDP	172.1	6.8	5.0	12.2
Absorption	223.3	6.8	4.9	12.9
Price indices				
Value-added	100	1.4	5.3	7.3
Export producer	100	4.8	5.3	10.3
Import purchaser	100	6.2	0.2	6.4
Cost of living indices				
Rural	100	-5.9	2.8	-3.1
Urban	100	3.7	-0.8	3.0
Real exchange rate index	100	3.3	-0.1	2.8
Agricultural terms of trade				
Producer	100	-24.9	7.4	-17.8
Value-added	100	-29.4	7.1	-22.4
Export	100	-1.8	6.7	5.1
Import	100	0.2	-0.6	-0.5
Price of commerce	1	9.8	2.2	12.7

Source: Authors' static CGE-model simulations.

[70]The real exchange rate is defined as the ratio between an index composed of domestic exports and imports prices, and an index composed of prices of domestically marketed and nonmarketed goods.

The 15 percent reduction in marketing margins (experiment 2) leads to a 4.9 percent increase in welfare. This is a large welfare gain.[71] The decrease in marketing margins narrows the spread between producer and purchaser prices, raising the former and lowering the latter. Both producers and consumers gain, and the gains are spread evenly across the economy, as further discussed below. The impact on trade is the converse of experiment 1: exports gain slightly more than imports, and the real exchange rate appreciates slightly (0.1 percent), to restore equilibrium.

Results from combining the first two experiments (experiment 3) support the hypothesis that prior improvements in marketing infrastructure allow the economy to reap greater benefits from improvements in agricultural productivity. The increase in welfare in experiment 3 is about 10 percent greater than the sum of the effects of experiments 1 and 2 run separately. The reduction in marketing margins diminishes the decrease in agricultural producer prices that would otherwise follow from the significant expansion of supply as agricultural productivity rises. Improvements to the marketing network ensure that increased production following agricultural productivity improvements benefits both farmers and consumers more, as the gap between producer and purchaser prices is narrowed.

The relative changes in the cost-of-living indices for rural and urban households differ across the simulation scenarios.[72] Gains in agricultural productivity (experiment 1) lower agricultural prices significantly, and since rural households allocate a larger share of their budget to agricultural goods, their cost-of-living index falls relative to that of urban households. In contrast, lower marketing margins (experiment 2) increase producer prices in agriculture and increase the relative cost of living for rural households with significant home consumption. The effects on cost of living with the combined scenario (experiment 3) are very close to the sum of the two separate experiments.

Increased agricultural productivity, which increases output, worsens the agricultural terms of trade (Table 9.2). Decreased marketing costs improve the agricultural terms of trade by increasing the producer price of agriculture more than that of nonagriculture. In the combined scenario (experiment 3), however, the agricultural productivity effect is stronger and the terms of trade move significantly against agriculture. From a policy perspective, the combined scenario is attractive because the adverse terms-of-trade effect of increasing agricultural productivity is significantly ameliorated.

The welfare impact of the experiments in terms of changes in household consumption is measured by equivalent variation from the base (Table 9.3).[73] Given that average household savings rates are assumed fixed in the model, these measures provide a good indicator of the distributional impact of the scenarios between rural and urban households. Rural households are the main gainers from increased agricultural productivity. The significant increases in agricultural production are accompanied by substantial decreases in producer prices, so rural household income increases only slightly. Yet, rural households benefit

[71]Both static gains from trade liberalization, for example, rarely exceed 1 percent.

[72]The numeraire is the cost-of-living index, including urban and rural household consumption. Changes in the individual rural and urban indices are therefore relative to an average. Thus, when the cost of living of urban households drops rural people must experience an opposite effect.

[73]Equivalent variation measures the lump-sum transfer that would make the household indifferent between the scenario and the base case plus the transfer.

Table 9.3 Equivalent variation on consumption for marketing margin and agricultural technology simulations

		Percentage of base consumption		
Households	**Base run**	**Experiment 1**	**Experiment 2**	**Experiment 3**
Urban	0	5.2	4.7	10.5
Rural	0	12.3	4.6	18.2
Total	0	8.5	4.6	14.1

Source: Authors' static CGE-model simulations.

significantly on the consumption side, since they allocate a relatively large share of their budgets to agricultural goods.

Urban and rural households gain roughly the same percent increase from lowering trade margins (experiment 2). As noted above, narrowing the gap between producer and purchaser prices spreads the gains across the economy. Again, the results for experiment 3 indicate a synergy between the two effects—the gain in welfare for both urban and rural households from experiment 3 is greater than the sum of the gains from the two separate simulation scenarios.

Interactions between agricultural productivity increases and marketing margin reductions are significant for most of the final demand components of real GDP (Table 9.4)—the results from experiment 3 generally do not equal the sum of the other two experiments. For example, increased agricultural productivity (experiment 1) leads to significant import substitution in grains, which has a high import share[8]; hence aggregate exports decline because less export earnings are required to achieve the fixed trade balance. Lowering trade margins, on the other hand, narrows the gap between border prices and domestic market prices for both imports and exports, and leads to increases in both. The trade-creating effect, which dominates in the combined scenario, indicates a significant

Table 9.4 Components of real GDP for marketing margin and agricultural technology simulations

		Change from base run (percentage)		
GDP components	**Base run (100 billion metical)**	**Experiment 1**	**Experiment 2**	**Experiment 3**
Exports	32.7	-2.2	9.4	8.0
Imports	83.9	-0.8	3.7	3.1
Home consumption	32.6	24.3	-0.8	22.5
Marketed consumption	106.8	4.4	6.4	11.8
Recurrent government	16.8	-0.7	2.7	2.4
Nongovernmental organizations	5.5	-2.5	1.5	-1.5
Investment	61.5	-1.1	2.4	1.2
Real GDP	172.1	6.8	5.0	12.2

Source: Authors' static CGE-model simulations.

[74]This effect is likely to diminish as Mozambique becomes more self-sufficient in producing food following economic recovery, but recent events demonstrate how difficult this is.

interaction between increasing the supply of traded goods and lowering the costs of moving these goods to and from international markets.[75]

Agricultural productivity increases have a major effect on the level of home-consumed production. Increased agricultural production decreases producer prices, which makes home consumption of agricultural goods more attractive. Moreover, the increase in the price of marketing services amplifies the gap between producer and purchaser prices, which further favors home consumption. Lowering marketing margins ameliorates the effect of the widening price gap—experiment 2 lowers home consumption—and provides incentives for a further switch toward marketed consumption in the combined experiment. However, the agricultural production effect on the consumption patterns still dominates in this case.

In terms of the effects of the scenarios on returns to labor and capital, the increase in agricultural productivity leads to almost no change in the agricultural wage—it rises by 0.1 percent (Table 9.5). The decline in producer prices almost exactly offsets the effect of increased productivity as far as agricultural labor is concerned. In experiment 1, some of the gains are transmitted through lower prices to the nonagricultural sectors. The wage of nonagricultural labor and the capital rental rate both rise significantly, but the significant increase in demand for capital-intensive commercial services increases capital returns relative to wages.

Lower trade margins (experiment 2) increase all factor returns but favor agricultural labor, since the agricultural sectors have the highest trade margins. The combined scenario is notable in that it spreads the gains more evenly across the three factors, with all factors gaining more than the sum of the effects of the two separate scenarios. The synergy between increasing agricultural productivity and lowering trade margins in parallel yields returns to all factors that exceed the sum of the separate scenarios, with little change to the overall functional distribution of income. From a policy perspective, the results of these interactions are very desirable, since much political conflict is rooted in changes in the distribution of income among factors of production.

Conclusions

The results presented in chapter indicate that increasing agricultural productivity is an important priority for Mozambique, with large potential gains. However, increasing agricultural output in an environment of very high marketing costs leads to a

Table 9.5 Factor price indices for marketing margin and agricultural technology simulations

		Change from base run (percentage)		
Factor prices	**Base run**	**Experiment 1**	**Experiment 2**	**Experiment 3**
Labor	1.0	0.1	11.4	15.0
Nonagricultural labor	1.0	8.9	4.9	14.4
Capital	1.0	10.6	2.0	13.4

Source: Authors' static CGE-model simulations.

[75]Trade creation of course depends greatly on the ability of Mozambican exporters to penetrate export markets, highlighting that this is an important area for policy concern.

significant fall in prices. These price declines transmit most of the gains in factor income to the nonagricultural sectors and factors of production. Rural households do, however, gain from greater availability of food and lower producer prices, which together lower the cost of home-consumed goods.

Lowering marketing costs decreases the gap between producer and purchaser prices in all markets. The gains are large even for relatively small reductions in the margins. Furthermore, these gains are spread across the economy, but agriculture gains relatively more because its marketing margins are higher. The scenario creates trade; both aggregate exports and imports grow, because the lower marketing margins increase the returns to producers supplying to export markets and lower the domestic market price to purchasers of imports. The consumption of marketed goods rises significantly, while home-consumption declines slightly.

The combined scenario reveals significant synergy between increasing agricultural productivity and lowering marketing costs in parallel. The welfare gains from the combined scenario are larger than the sum of the gains from the two separate scenarios. Lowering marketing costs somewhat ameliorates the worsening in the agricultural terms of trade caused by the increase in supply due to the increase in agricultural productivity. Both rural and urban households gain significantly as returns to all factors increase—agricultural and nonagricultural wages, and capital rentals. Compared with the separate scenarios, the combined scenario yields little change in the distribution of income across factors of production—the functional distribution. This result makes the combined scenario appealing from a policy perspective. It should cause a relatively low level of political strain, while providing relatively large increases to the welfare of poor rural households.

Because of the multiplicity of preconditions for a broadly based development process and the limited availability of government resources in Mozambique, there is a clear need for prioritizing among different policy initiatives. So far, government priorities have been directed toward increasing the efficiency of governance, and improving incentive structures and the quality of price signals in the economy. Following the introduction of democratic rule and the recent recovery of the economy to more normal levels, priorities seem to have shifted in favor of improvements in the educational and health systems as well as extensions to the primary road network. This study shows that there are good reasons for also directing resources toward improved agricultural productivity, especially in small-scale farming; and continuing to reduce marketing costs through improved infrastructure, including particularly investment in the secondary and tertiary road network. There are significant synergy effects between improved agricultural productivity and reduced marketing costs, and the synergy between the two raise the welfare of poor rural households while preserving the politically sensitive functional distribution of income.

CHAPTER 10

Agricultural Technology, Risk, and Gender

The CGE model (described in Chapter 6) was employed to analyze the interactions between agricultural technology improvement, risk, and gender roles in agricultural production with a particular focus on cassava.[76] These interactions are important. For example, analysis of data from the 1996–97 marketing year (a good production year) revealed that 64 percent of the rural population had insufficient calories available to meet the caloric requirements of household members (MPF/EMU/IFPRI 1998).

As usual, moving from a microeconomic, household approach to a macroeconomic, general-equilibrium approach has numerous pitfalls. Some detail is necessarily suppressed. However, the authors of this report would like to point out, from the outset, that the results and conclusions from the analysis presented here are driven primarily by a few features relating to gender roles and the characteristics of the agricultural sector. First, rural women are busy people.[77] Second, gender roles in household activities exist. Women bear almost all the burden of domestic tasks, including the daily provision of meals, and are responsible for ensuring food security at the household level (Naeraa-Nicolajsen 1998). Third, agriculture is the critical income source for the large majority of rural households. Fourth, cassava is a very important crop in value terms and has distinct risk-reducing attributes. Critically, for gender-related issues, available data indicate that women provide the large majority of labor input into cassava production.

In addition to the model characteristics already discussed in detail in Chapter 6, this chapter distinguishes between male and female labor, and introduces risk aversion. These model dimensions are briefly described below.

Male and Female Agricultural Labor

Agricultural labor is divided into male and female categories. The percentages of labor allocated to each in this study (Table 10.1) reflect the available data on gender roles in agricultural production summarized in the previous section, interviews with knowledgeable individuals in Mozambique, and the authors' own judgment. As emphasized above, cassava production is

---

This chapter was written by Channing Arndt and Finn Tarp.

[76]World Development devoted a special issue to gender and macroeconomics in which calls were made to introduce gender into CGE models (see Cagatay, Elson, and Grown 1995).

[77]The World Bank's Mozambique Agricultural Sector Memorandum (1997) asserts that rural women work, on average, 14-16 hours per day, although it is not clear where these figures were obtained. For further background see Arndt and Tarp (2000).

female dominated. The division of labor implies that 63 percent of agricultural labor is undertaken by women (Table 10.1). This agrees reasonably well with the 60 percent figure calculated by Pehrsson (1993). Even though time-allocation studies show roughly that women and men spend equal time working in agricultural production, these are reasonable figures, since there are more working-age women than working-age men in rural areas. Because of the war and male migration for off-farm work, slightly more than one rural household in five is headed by a female, with this proportion being higher in the south and lower in the north (Datt et al. 1999). In addition, primarily because of the war, females represented 53 percent of the population in 1997 as opposed to 51 percent in 1981, the year just prior to the onset of hostilities (NIS 1999). The effects of the war on the gender structure of the population are certain to be strongest in the working-age cohort.

Table 10.1 Female labor share by agricultural activity for agricultural technology, risk, and gender simulations

Activity	Female (percentage)
Grains	69
Cassava	80
Other basic food crops	70
Raw cashews	60
Raw cotton	50
Other export crops	20
Livestock	10
Forestry	50

Source: Authors' assessments based on interviews with experts on Mozambican agriculture, and Naeraa-Nicolajsen (1998).

Risk Aversion

Low incomes, rudimentary technology, heavy dependence on agriculture, and a variable climate generate a strong need for risk-reduction strategies among rural households. Gender inequality may also make women in rural households more risk averse than men.[78] In more recent household models, men and women are therefore treated as separate agents with different, often competing, interests and, potentially, an unequal power structure. Under these conditions, women may not be sure to have access to an adequate share of family cash income. Different attitudes to risk are likely, especially when women are responsible for food security at the household level.

As mentioned above, cassava is drought tolerant, resistant to disease, relatively flexible with respect to timing of labor inputs, and easy to store. Because of these attractive risk-reducing properties and the control that women exert over cassava, it is assumed, in some of the simulations in the next section, that cassava plays an explicit role in risk reduction. Specifically, it is assumed that a safety-first strategy is pursued. Under this strategy, households aim to produce a certain (exogenous) amount of cassava for risk-reduction purposes only. Once the resources necessary to produce the minimum amount of cassava have been allocated, the household allocates resources to other agricultural and nonagricultural activities according to relative prices.[79]

The risk-aversion strategy of safety first is implemented by adding an endogenous variable, $RISK_j$, that serves as a risk premium. The variable $RISK_j$ enters the factor demand equation (3) and factor income equation (4):[80]

[78]Gender asymmetries have been shown to be important for intrahousehold resource allocation (Haddad, Hoddinott, and Alderman 1997), and Hoddinott and Haddad (1995) find that as women's share of cash income increases, the household budget share of food tends to increase and the household budget share on alcohol and tobacco tends to decline.

[79]This approach differs from an expected utility-maximization approach.

[80]These two equations are referred to as A12 and A25 in Appendix A and in Chapter 6.

$$FDSC_{fj} = \frac{RISK_j \cdot QA_j \cdot PV_j \cdot \alpha_{fj}}{WF_f \cdot WFDIST_{fj}}, \text{ and} \quad (3)$$

$$YFCTR_f = \sum_j WF_f \cdot FDSC_{fj} \cdot \left(\frac{WFDIST_{fj}}{RISK_j} \right) \quad (4)$$

where $FDSC_{if}$ represents use of factor f in activity j; QA_j is output of activity j; PV_j the value-added price of activity j; α_{jf} is the cost share of factor f in production of the value-added aggregate for activity j; WF_f is the price (wage or rental rate) of factor f; $YFCTR_f$ is total income for factor f; and $WFDIST_{fj}$ a scaling factor that allows factor returns to differ by sector (when capital is fixed in one sector, for example).

As shown in equation (3), a value greater than one for the variable $RISK_j$ implies that more factors are allocated to the production of activity j than pure profit-maximization would dictate. Activity j might be cassava, whose risk-reducing properties cause farmers to allocate extra resources to cassava production. This risk-based allocation of resources to activity j comes at a cost in terms of factor income. In the factor income equation (4), returns to factors allocated to the activity j are reduced by the risk premium factor represented by the variable $RISK_j$. In the risk scenarios, the risk premium on cassava production is complementary to cassava production. That is, as long as the value for the variable $RISK_{cassava}$ is greater than 1, cassava production ($QA_{cassava}$) is fixed at base levels, while the risk premium is endogenous. If, as in some of the experiments, the value for $RISK_{cassava}$ is driven to 1 (for example, the risk premium is eliminated), cassava production is then permitted to increase.

Other Simulation Features, Parameter Estimation, and Model Validation

Besides male and female agricultural labor, a third category of labor, nonagricultural labor, is also included. The simulation results presented below are based on a formulation with separate labor pools fixed in agriculture or nonagriculture.[81] As mentioned above, remaining elements of the model are standard. Capital (excepting that associated with mining and fishing activities) is mobile across sectors. Production technology is Cobb-Douglas in value-added.[82] This value-added aggregate combines with intermediate products in a Leontief fashion. The model contains a rural and an urban household. The model is closed by fixing the value of foreign currency inflows and allowing the exchange rate to adjust endogenously. This closure is the most logical because of the importance of aid flows.

Important omissions. While capturing many salient features of the Mozambican economy, the model used here also misses much. Perhaps most importantly, production within the household and other intra-household issues of resource allocation are ignored. For example, traditional processing of cassava is time-consuming, is done within the household, and is undertaken almost exclusively by women. Since formal studies of time allocation to cassava processing have not been undertaken in Mozambique, a precise estimate of time allocation to cassava processing is not available. However, time-allocation studies have been undertaken in other African countries. For example, Adekanye (1985) finds significant time allocated by rural women in Nigeria to the processing of cassava into *gari*, a local staple. Improved treatment of issues of gender and resource allocation, as

[81]A version of the model permits migration between the male agricultural labor and the nonagricultural labor pools. Simulations with this specification lead to similar conclusions.

[82]This implies an elasticity of substitution of 1 between male and female labor in agricultural production.

well as production activities within the household, are therefore critical topics for future research and data generation.

Simulations

To address the issues raised in this chapter, four CGE scenarios were conducted:

1. A 30 percent Hicks-neutral increase in agricultural productivity in all agricultural commodities except cassava
2. A 30 percent Hicks-neutral increase in agricultural productivity in all agricultural commodities;
3. A 15 percent decline in marketing margins for all commodities; and
4. Experiments 2 and 3 combined.

Each of these experiments was conducted under the alternative assumption of the presence or absence of risk-reducing behavior in cassava production. Thus, results from a total of eight simulations are presented.

The simulations were designed to reflect plausible shocks to the economy over the medium term. Agricultural technology is highly rudimentary. At the same time, agricultural potential is high. Given the divergence between performance and potential, a 30 percent technology increase is reasonable to conservative. In the family sector (which dominates agricultural production), the most promising new technologies come in the form of improved seed and better farming practices, especially higher planting densities. In addition, agricultural chemical use is practically zero at the moment. Use of agricultural chemicals offers promise for increased production in high-potential agriculture regions served by operational marketing networks (Bay 1998). A Hicks-neutral technological improvement is a reasonable representation of the first two improvements, which are the more likely advances to come about in the near term.

Regarding marketing margins, the 15 percent shock introduced in the simulations reflects the effects of the war, which ended only in 1992. Substantial efforts have been undertaken to improve infrastructure and provide market information. These investments, combined with a general growth in the sophistication of marketing sector participants, should lead to approximately a 15 percent increase in the efficiency of the marketing system relative to the level observed in 1995.

In analyzing these eight scenarios, aspects not related to gender were considered first, followed by gender-specific results. The impact of the alternative scenarios on cassava production, price, and the risk premium was studied under various scenarios featuring risk (Table 10.2). In the no-risk scenarios, the risk variable has a value of 1, reflecting the no-risk premium. In the risk scenarios, the risk variable is endogenous, with a starting value of 1.3, which reflects a premium of 0.3.[83] In these scenarios, the premium will vary depending upon the shock. If the shock increases the opportunity cost of attaining the safety-first level of cassava production, the risk premium will increase. If, on the other hand, the shock reduces the opportunity cost of attaining the safety-first level of cassava production, the risk variable will decrease toward its lower-bound value of 1, reflecting a risk premium of zero. Once the risk variable attains a value of one, cassava production is permitted to increase above the safety-first level.[84]

Not surprisingly, production and price movements differ considerably for cassava

[83]There are no data on the appropriate value for the risk premium. This level allows for elimination of the risk premium, and consequent increases in cassava production, in some scenarios.

[84]The PATH solver scheme automatically handles these complementary slackness conditions (Dirkse and Ferris 1995).

Table 10.2 Cassava production, price, and risk premium for agricultural technology, risk, and gender simulations

		Change from base run (percentage)			
Scenario	**Base run**	**Experiment 1**	**Experiment 2**	**Experiment 3**	**Experiment 4**
No risk					
Production[a]	10.3	3.5	25.2	-0.7	23.4
Price	1.0	2.2	-20.3	10.3	-9.9
Risk premium	1.0	0.0	0.0	0.0	0.0
Risk					
Production[a]	10.3	0.0	9.4	0.0	77.0
Price	1.0	7.4	-4.0	9.2	8.9
Risk premium[b]	1.3	-29.7	-100.0	5.9	-100.0

Source: Authors' static CGE-model simulations.
[a]The unit for cassava production is the value of production in 100 billion 1995 metical.
[b]Calculated using the formula (new – base)/(base – 1).

between the risk and no-risk scenarios. For example, in experiment 1, where productivity increases for all crops excepting cassava, the no-risk scenario predicts a small increase in cassava production. This comes about to satisfy increased cassava demand due to higher income. Cassava is not imported or exported, so domestic supply equals domestic demand in equilibrium. In contrast, in the risk scenario, production of cassava remains at the minimum safety-first level, while the risk premium declines. In the risk scenario for experiment 2 (productivity increases for all agricultural activities), the risk premium disappears and cassava production increases 9.4 percent over the safety-first level. By comparison, cassava production increases by 25.2 percent in the no-risk scenario. Because of the muted production response, cassava price movements in the risk scenario are far less pronounced as well.

When marketing margins are reduced (experiment 3), cassava production is projected to decline very slightly in the no-risk scenario.[85] This occurs even though marketing margins on cassava production are very high relative to other crops. The small share of cassava marketed in total production supplies the explanation. Only about 8 percent of cassava production is marketed. When marketing margins are reduced, demand for marketed cassava increases. However, this increase is more than compensated for by a decline in home consumption of cassava. The resulting decline in cassava production frees resources, which in the present model are allocated to production of crops that are more market-oriented. The results from experiment 4, the combined experiment, are roughly additions of the two preceding experiments.

Some additional comments on technical change in cassava merit mention. Cassava is widely regarded as a neglected crop in agricultural research (Cock 1985; CIAT 1999). One reason for this neglect is the low share of production of cassava that is marketed. For Mozambique, the logic of neglecting cassava research because of a low marketed share is dubious. Caloric intake for most of the rural population is insufficient. As a result, increases in home consumption of cassava (a 27 percent increase is predicted in the no-risk scenario) are a good thing. However, since cassava is a

[85]This translates into a slight increase in the risk premium in the risk scenario (Table 10.2).

risk-reducing crop, an improvement in cassava technology is also likely to reduce the risk premium or insurance cost associated with cassava production. As shown in the risk scenario, the level of cassava production remains relatively constant after technological change in cassava. It is the risk premium that declines. With the technological improvement, the resources necessary to meet the safety-first requirement are reduced. For example, considering experiment 2, the increase in grain production is 51 percent in the risk scenario compared with 44 percent in the no-risk scenario. The differential reflects resources allocated to grain production rather than to cassava production. The effect is similar, though less pronounced, for most other agricultural activities.

At this point, it is also worth considering the omission of female labor time allocated to cassava processing. In the more realistic risk scenario this omission is not critical. If cassava production levels change relatively little, total time allocation to cassava processing remains unaffected. Overall, results are likely to be very similar. In the no-risk scenario, on the other hand, explicit treatment of cassava processing would quite likely influence some of the results. In particular, the increase in cassava production induced by technical advance would almost surely be attenuated, as the demands on female labor time for processing would preclude a large expansion of cassava production. The net effect on female labor time allocated to cassava and cassava processing combined is an empirical question.

In CGE models only relative prices matter. To establish a reference point, one price—known as the numeraire—is fixed. The CPI was chosen as the model numeraire. As a result, nominal absorption (or absorption as read directly from model output) is effectively deflated by the CPI and is an appropriate welfare indicator. In a macroeconomic perspective, the difference in welfare between the risk and no-risk scenarios is very small (Table 10.3). However, two items do emerge. First, because of the importance of cassava as a crop, technology gains in cassava production provide substantial gains to the economy. Welfare increases by an additional 1.5 percent from experiment 1 to experiment 2. Second, simultaneous improvements in agricultural technology and marketing efficiency interact. The welfare gains in experiment 4 exceed the sum of welfare gains from experiments 2 and 3 by 1.2 percent and 1.1 percent in the no-risk and risk scenarios, respectively. In other words, these synergy effects account for about 9 percent of the total welfare gain in experiment 4 under both the no-risk and risk scenarios.

The measure for agricultural terms of trade is simply a ratio of price indices for the agricultural and nonagricultural sectors (Table 10.4). An increase in this measure

Table 10.3 Microeconomic indicators for agricultural technology, risk, and gender simulations

Scenario	Base run (100 billion metical[a])	Change from base run (percentage)			
		Experiment 1	Experiment 2	Experiment 3	Experiment 4
No risk					
Real GDP	172.1	5.1	6.8	5.0	12.2
Nominal absorption	223.3	5.3	6.8	4.9	12.9
Risk					
Real GDP	172.1	5.2	6.7	5	12.2
Nominal absorption	223.3	5.2	6.7	4.9	12.7

Source: Authors' static CGE-model simulations.

[a]The exchange rate was 8,890 metical per U.S. dollar in 1995.

indicates that agricultural prices are rising relative to nonagricultural prices. A variety of price indices (for example, consumer, producer, and export) may be used. In this case, the relative price of value-added in the agricultural and nonagricultural sectors. As is standard following an agricultural productivity shock, agricultural terms of trade decline, indicating transmission of some of the benefits of the productivity increase to the rest of the economy through lower agricultural prices. Other measures of terms of trade show roughly similar declines. For the productivity shocks, the declines in terms of trade with value-added are smaller in the risk scenarios. This is primarily because of the firmness of cassava prices in the risk scenario compared with the no-risk scenario (Table 10.2).

Household welfare, for urban and rural households, was measured by equivalent variation[86] (Table 10.5). A total welfare measure was also used. Despite the decline in terms of trade, rural households benefit substantially from improvements in agricultural technology. Gains from improvements in marketing efficiency are shared roughly equally between the urban and the rural household. As with nominal absorption, interaction effects between improvements in agricultural technology and increases in efficiency in the marketing system lead to greater than additive benefits to both rural and urban households in the combined experiment (experiment 4).

While total welfare gains are very similar between the risk and no-risk scenarios, the distribution of benefits between rural

Table 10.4 Agricultural terms of trade in valued-added terms for agricultural technology, risk, and gender simulations

		Change from base run (percentage)			
Scenario	**Base run**	**Experiment 1**	**Experiment 2**	**Experiment 3**	**Experiment 4**
No risk	100.0	-21.9	-29.4	7.1	-22.4
Risk	100.0	-21.4	-27.9	7.0	-20.5

Source: Authors' static CGE-model simulations.

Table 10.5 Equivalent variation on consumption for agricultural technology, risk, and gender simulations

		Percentage base consumption			
Scenario	**Base run**	**Experiment 1**	**Experiment 2**	**Experiment 3**	**Experiment 4**
No risk					
Urban	0.0	4.7	5.2	4.6	10.4
Rural	0.0	8.7	12.3	4.6	18.2
Total	0.0	6.6	8.5	4.6	14.1
Risk					
Urban	0.0	4.9	5.8	4.6	11.1
Rural	0.0	8.5	11.5	4.7	17.4
Total	0.0	6.6	8.5	4.6	14.1

Source: Authors' static CGE-model simulations.

[86]Formally, equivalent variation shows the amount of money, at base prices and income levels, that would have to be given to (or taken from) the household to achieve the utility level attained by the household in the experiment. Here, this measure is a percent of base income (Table 10.5).

and urban households is somewhat different. Specifically, rural households gain less from agricultural technology improvement when risk is introduced into the model. The intuition behind this shift in gain between rural and urban households is as follows: Equivalent variation measures consumption of goods. In the no-risk scenario, resource allocation is unfettered by risk considerations. An increase in cassava production technology increases cassava production. Since only 8 percent of this production is marketed in the base case, most of the increase in cassava production is home consumed. More than 90 percent of this home consumption occurs in rural households.[87] The increase in cassava consumption increases welfare, particularly rural household welfare. In the risk case, the increase in cassava technology affects the risk premium rather than cassava production. Instead of increasing cassava production, resources are allocated to other crops, all of which tend to have a higher marketed share of production. While the share of marketed production is by no means fixed, it is a very important determinant of first-order impacts of the technology or marketing efficiency shock. In the risk scenario, the increase in production of crops other than cassava tends to push more goods into the marketing channels where urban consumers can access them. As a result, urban welfare tends to be higher and rural welfare lower in the risk scenario compared with the no-risk scenario.

Factor returns (Table 10.6) represent a final welfare indicator.[88] The rural household in the CGE model represents an average rural household. This household owns some nonagricultural labor (family members working in the city or in rural industry) and some capital. However, a large number of rural households own only male and female agricultural labor. For these typically very poor households, returns to labor are probably a better welfare indicator than the equivalent variation measures presented (Table 10.5).

In the analysis on experiments 1 and 2, a first noteworthy impact of the technology shocks is the effect on the return to capital, which increases dramatically. Part of the explanation lies in the choice of the CPI as

Table 10.6 Factor price indices for agricultural technology, risk, and gender simulations

		Change from base run (percentage)			
Scenario	**Base run**	**Experiment 1**	**Experiment 2**	**Experiment 3**	**Experiment 4**
No risk					
Male agricultural labor	1.0	-0.1	-0.3	12.3	16.2
Female agricultural labor	1.0	2.3	0.3	10.9	14.2
Nonagricultural labor	1.0	6.6	8.9	4.9	14.4
Capital	1.0	8.1	10.6	2.0	13.4
Risk					
Male agricultural labor	1.0	-0.2	-0.3	12.2	16.4
Female agricultural labor	1.0	2.8	1.9	10.8	16.2
Nonagricultural labor	1.0	6.5	8.6	4.9	14.0
Capital	1.0	8.0	10.5	2.0	13.2

Source: Authors' static CGE-model simulations.

[87]Urban households in Mozambique often maintain a field in the countryside where they produce goods for home consumption.

[88]Robinson and Thierfelder (1999) point out that factor returns are not always valid as a welfare indicator. However, for this case of technology shocks and marketing margin improvements, they are a valid indicator.

numeraire. Since food is such a large part of the household consumption basket, declines in the food price raise the price of nonagricultural goods, such as capital and nonagricultural labor, relative to the CPI. Marketing margins represent the second major push factor on returns to capital. The commerce sector, which supplies marketing services, is a large sector representing about 22 percent of total value-added in the 1995 SAM. It is also capital intensive with capital accounting for 68 percent of factor cost. Since agriculture and processed food account for almost all of the sales of the commerce sector, technological change in agriculture substantially increases demand for marketing services from the commerce sector. This increase in demand is reinforced by a consumer preference structure that allocates greater shares of marginal income to marketed commodities. Expansion of the commerce sector (output increases by 5 percent, and price by 9.8 percent), in experiment 2 has a strong impact on the return to capital.

The second important impact in experiments 1 and 2 concerns the returns to male and female agricultural labor. Wage rates to male agricultural labor decline slightly, while female agricultural labor rates rise. This is an effect of crop composition. By construction, male agricultural labor tends to be more highly involved in production of goods with a relatively high marketed share. The share-weighted average proportion of production marketed is 40 percent for males and 29 percent for females.[89] Given the increase in the price of marketing services provided by the commerce sector, the relatively heavy involvement of males in marketed production tends to reduce male wages. In other words, male wages decline slightly to accommodate the increase in the price of marketing services. Since female labor is more concentrated in activities with relatively low marketed shares of production, the effect of increases in the price of marketing services is less strong and female wages tend to rise.

The impacts on female wages between the risk and no-risk scenarios in experiments 1 and 2 differ significantly. The relative firmness of cassava prices, because of the presence of the risk premium, makes the difference. As pointed out above, in the risk scenario, the risk-reducing properties of cassava cause greater allocation of resources to cassava than ordinary profit maximization would dictate. As shown in equation (4), this "overallocation" of resources comes at the cost of reduced returns to factors allocated to cassava production as represented by the risk premium. Female labor represents by far the largest share of factor cost in cassava production (nearly 80 percent, since the contribution of capital in cassava production is negligible), and the value of cassava production is large. Thus, the risk premium substantially dampens female wage rates in particular.[90] As the risk premium declines in response to the technology shocks (Table 10.2), returns to female labor allocated to cassava production increase. This has the effect of supporting the overall female wage.

Finally, it is worth noting that the interaction effects between improvements in agricultural technology and increases in marketing efficiency, captured in experiment 4, are strong for agricultural wages, particularly male agricultural wages. In the risk scenario, the interaction effects add an additional 4.5 percent to the additive percentage wage increases from experiments 2

[89]Marketing margins are slightly higher on average for goods produced by females. This would tend to increase the role of margins for females relative to males. However, this slight difference in average margins is not enough to offset the effects of the male tendency to produce for the market and the female tendency to produce for home consumption.

[90]Cassava accounts for 30 percent returns in the factor of female agricultural labor.

and 3 for male labor, and 3.5 percent for female labor. In other words, interaction effects account for 27 and 22 percent of the agricultural labor wage gains in experiment 4 for males and females, respectively. Interaction effects are not nearly as pronounced for the other factors of production. These large interaction effects in agricultural labor wage rates (male and female) are due to the relatively greater importance of marketing margins in the sectors of primary agriculture and primary agriculture processing. The larger interaction effects for male labor compared with female labor are a result of the relative concentration of male labor in agricultural activities where the marketed share of output is relatively high.

Conclusions

The results lead to the following conclusions. First, general agricultural technology improvements induce important welfare gains for the economy in general and for rural households in particular. Second, regardless of whether risk is a factor in cassava production, technological improvements in cassava production have strong welfare effects. Third, if—as is likely—risk reduction is a factor in cassava production, impacts of technological improvement in cassava are likely to be particularly positive for rural women. With improved cassava technology, women have the opportunity to allocate time to other activities, including crops that are more market-oriented. In addition, the factor returns penalty to risk reduction, which weighs particularly heavily on female agricultural labor because of its high level of involvement in cassava production, declines. As a result of this decline in the risk premium, female wage rates tend to improve with improved technology in cassava. Women would also have the possibility of reallocating time formerly devoted to cassava production to, for example, domestic tasks or leisure. This possibility is not, however, captured in the model. In this case, female wage gains for agricultural labor would tend to be even stronger following technological change in cassava because of an effective decline in the supply of female agricultural labor. Fourth, recent research points strongly to increased household welfare stemming from increased female cash income and time allocation to domestic tasks (Haddad 1999). It can also be recalled that Elson (1989) argues that recognition of the crucial role of women cultivators in food production should lead to a greater focus on increasing their productivity in growing staple foods, such as cassava. The analyses in this report support this. Consequently, technical change in cassava appears to be a particularly strong lever for increasing rural household welfare. Finally, technological change in agriculture and improvements in marketing systems interact, with significant additional benefits accruing to both male and female occupants of rural households. These interaction effects are significant in both the risk and the no-risk scenarios.

The research presented in this chapter represents an attempt to incorporate gender issues into CGE models. Much remains to be done in responding adequately to this challenge. With reference to Mozambique, firming our understanding of the functioning of the agricultural sector, through continued data collection and analysis, is a clear priority. This would permit, for example, a richer specification of gender and risk issues. More information is also desirable to understand more fully the importance of productive activities at the household level, such as food processing. In addition, further household and regional disaggregation would, for example, permit the model to capture regional variation in gender roles in agricultural production. Finally, with reference to more general gender-related modeling issues, it would be highly relevant and challenging to examine intrahousehold production activities and resource allocation within a CGE model.

CHAPTER 11

Food Aid

Questions regarding the impact of food aid are typically posed and analyzed in a partial-equilibrium context. This is appropriate because it is clear that the exact implementation of food aid programs can strongly influence outcomes. Nevertheless, it is also clear that food aid programs are often large enough to generate important general-equilibrium effects. The analytics of food aid in general equilibrium have, for example, been traced out by Bhagwati (1985). However, despite vastly increased capacity to conduct applied or CGE analysis in recent years, relatively little CGE analysis has been conducted on food aid issues. The CGE analyses conducted to date have generally focused on assessment of food aid needs (Riaz 1992; Sadoulet and de Janry 1992). Using a broader lens, this chapter seeks to contribute to the debate regarding monetization of food aid. Specifically, the general-equilibrium effects of alternative distribution schemes for food aid following a drought are examined. The results indicate that different distribution schemes (for example, who takes possession of the food for either direct consumption or resale) have very distinct general-equilibrium effects.

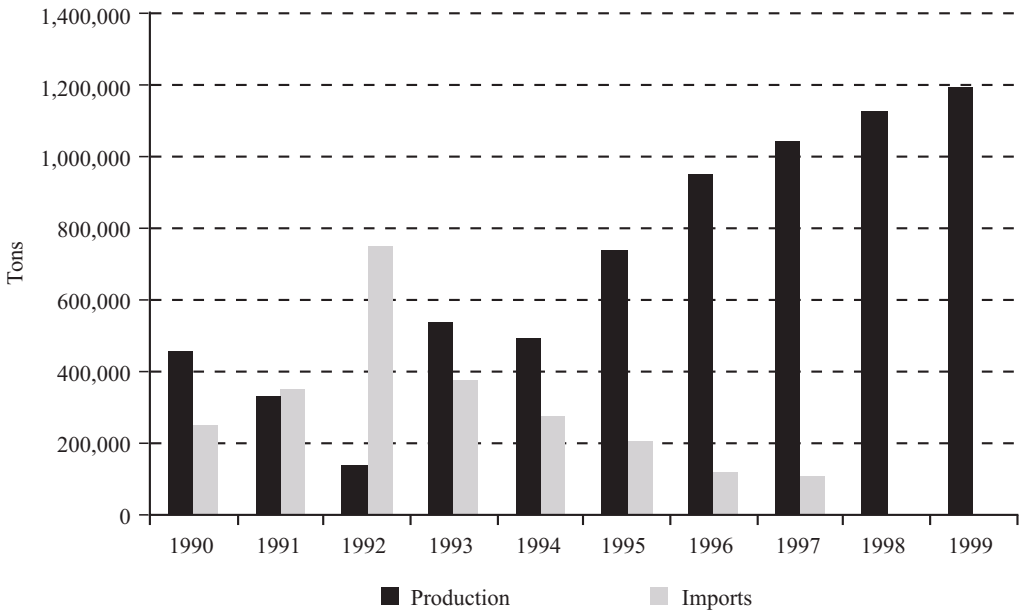
In Mozambique, the economic and social impacts of drought can be very large and food aid can play a significant role in palliating the negative effects of drought. To give an extreme example, because of the combined effects of war and drought, the Mozambican population essentially subsisted on food aid in 1992 (Tschirley, Donovan, and Weber 1996). Since that time, the return of peace and good rains have, as alluded to in Chapter 4, helped to dramatically increase agricultural production and reduce food imports. Food aid volumes have declined commensurately with the increases in production and decreases in imports of food (Figure 11.1).[91] Yet, natural calamities are bound to strike again, and following a widespread and reasonably severe shock, food imports will reappear on a large scale. It is also reasonable to expect that a substantial share of these imports will arrive in the form of food aid. Investigating alternative schemes for food aid can therefore potentially help policymakers.

The CGE framework underlying the policy simulations in this chapter is described in Chapter 6. Food aid enters the model through the equilibrium conditions of the composite commodity market. It simply increases the composite commodity supply. While the machinery of the model would allow for increased supply of any commodity in the model through food aid, food aid in Mozambique has almost invariably arrived in the form of grains. Food aid is thus modeled as an increase in the supply of grains.

This chapter was written by Channing Arndt and Finn Tarp.

[91]Mozambique remains a structural importer of wheat and rice. These imports represent about 15 percent of total domestic supply of cereals (SADC/FSU 1999).

Figure 11.1 Maize production and imports for food aid simulations



Source: SADC/FSU (1999).

Under this formulation, food aid represents an increase in the supply of goods without any associated real resource costs of production or delivery. As such, the model takes the perspective of the recipient who simply receives an increased supply of food (in the form of grain). This formulation is attractive in that it is simple and conforms to the basic vision of the purpose of food aid. A potential disadvantage of the formulation is that marketing margins are avoided. As emphasized above, receipt and distribution of goods, such as grains, entails real resource costs. The model does not capture any real resource costs associated with receipt and distribution of food aid.

While imperfect, this approach is probably the best available option. Real resource costs associated with receipt and distribution of food aid are not known. They are likely to be considerably below the *domestic* real resource marketing cost for locally produced or privately imported products for two reasons. First, food aid distributors tap international credit markets and do not have commercial motivations. As a result, the costs of working capital and risk considerations, both of which are mentioned above as major contributors to the marketing margins, do not apply. Second, distribution infrastructure, such as trucks, often arrives with the food aid allowing (all too frequently according to critics) food aid providers to sidestep local marketing services (Colding and Pinstrup-Andersen, 2000).[92] These considerations, combined with the advantages of simplicity, make the current formulation attractive.

[92]Note that it is not being argued here that it is cheaper or better, from the donor perspective, to sidestep local credit and distribution channels. It is merely stated that it is done. An extreme example is the airlifting of grain to drought-stricken regions. From the donor perspective, this operation is very expensive. From the recipient perspective, grain simply appears in the region with practically no domestic resource costs associated with receipt and distribution.

Table 11.1 Experiment descriptions for food aid simulations

Simulation	Description
Base run	1995 data
Experiment 1	Drought with no food aid
Experiment 2	Drought with monetized food aid and revenue to government
Experiment 3	Drought with food distributed directly to households as aid

Source: SADC/FSU (1999).

Once the food aid enters the system, careful consideration is given to who takes ownership. The food aid is valued at market prices. If, for example, the government takes ownership of the food aid, it can sell the food aid and use the resulting revenue in any manner it chooses.[93] If, on the other hand, the food aid is distributed directly to households, it can either be consumed directly or sold to purchase other goods.

The model is closed in the standard way. As stated before, two types of labor, agricultural and nonagricultural, are present in the model. However, because of the short-run nature of the simulations in this chapter, capital is fixed in each sector, and agricultural labor is fixed by agricultural activity. For agricultural activities, this amounts to assuming that a production plan is decided upon before the onset of drought. Once the drought begins, agents in the agricultural sector, particularly the smallholders who dominate production, have very little opportunity to react.

Simulations

Three simulations were used for the portion of the study described in this chapter (Table 11.1). Experiment 1 simulates a drought in the absence of any food aid for drought relief. Experiment 2 combines drought with food aid. Food aid volumes amount to nearly 60 percent of the volume of grain imports observed in experiment 1, or 85 percent of the volume of grain imports observed in 1995, the base year for the SAM. The food aid imports are monetized at market prices, and the revenue is delivered to government. Government is assumed to spend the food aid revenue on recurrent and investment expenditure in accordance with observed spending shares. Experiment 3 is the same as experiment 2, except that the food aid is delivered directly

Table 11.2 Declines in technology used to simulate drought for food aid simulations

Activity	Decline
Grain	0.67
Cassava	0.85
Raw cashews	0.93
Raw cotton	0.85
Other exports	0.67
Basic food crops	0.75
Livestock	0.85
Forestry	1.00

Sources: Authors' assessments from interviews with experts on Mozambican agriculture; existing time-series data on production as analyzed by Bacou (2000); and technology parameters estimated by Arndt, Robinson, and Tarp (2002) from their simulations for agriculture in 1992 (a severe drought year).

Note: Delines in technology make up a weighted-average, agricultural-productivity decline of 20 percent.

[93]Donors may of course decide to play a role here, but it is assumed here that this does not change in any way the use of the revenue. This seems reasonable in view of past experience.

Table 11.3 GDP and welfare for food aid simulations

Indicator	Base run (100 billion metical)	Change from base run (percentage)		
		Experiment 1	Experiment 2	Experiment 3
Real GDP	172.1	-5.0	-4.9	-4.9
Absorption	223.3	-5.9	-3.7	-4.6

Source: Authors' static CGE-model simulations.

to rural and urban households according to population shares.[94]

In Mozambique, agricultural production is essentially the process of converting labor into agricultural goods. The vast majority of production is based on smallholders using rudimentary technology. Input use is essentially confined to seed, capital use involves rudimentary tools only, and land is generally abundant.[95] In this environment, drought can be adequately simulated by shocking agricultural technology in a Hicks-neutral fashion. Since labor and capital are fixed by agricultural activity, the technology declines translate directly into production declines (Table 11.2).[96]

As reflected in the macroeconomic effects of the shocks (Table 11.3), the drought results in a decline in GDP and absorption, as expected. Since the CPI is the numeraire, absorption can be used as a measure of aggregate welfare. The agricultural share in GDP of about 25 percent and the decline in agricultural productivity of about 20 percent imply a GDP decline of about 5 percent. This lack of spillover of drought-induced decline of GDP into nonagricultural sectors is consistent with the work of Benson and Clay (1998), who find—in a cross country analysis focused on Africa—that the GDP effects of drought in countries with relatively low levels of development, such as Mozambique, tend to be confined to the agricultural sector because of relatively weak links between primary agriculture and nonagricultural sectors in the input-output matrix. As a result, the drought-induced decline in agriculture is relatively isolated and the impacts on overall GDP are roughly equivalent to the impacts on agricultural GDP multiplied by the share of agriculture in total GDP.[97]

As expected, the addition of food aid does not change GDP substantially. (The small change observed is due to changes in output composition.) However, food aid does increase welfare as measured by nominal absorption deflated by the CPI. On the basis of this measure alone, monetized food aid (experiment 2) is preferred, as it results

[94]The simulations assume a 70 percent rural and 30 percent urban population split in accordance with the 1997 population census.

[95]There is evidence of land scarcity in some areas (Ministry of Agriculture and Fisheries/Michigan State University 1992).

[96]The cotton sector receives some special treatment. Data from national accounts indicate that raw cotton is neither exported nor imported. The textile industry relies entirely on domestically produced cotton. As a result, demand for domestically produced cotton is extremely inelastic and changes in production result in substantial price movements. Perhaps because of this issue, textile firms have been granted monopsony power in purchasing raw cotton in predetermined "action zones." These monopsonies are regulated (and partially owned) by the government. Prices for raw cotton are contracted in advance of the growing season. To reflect this environment, it is assumed that the producer price of cotton is fixed (relative to the CPI), and that textile firms maintain a stock of raw cotton to smooth out variability in production.

[97]The definition of GDP plays a role here. Processing of agricultural products within the home for home consumption does not form a part of GDP, and these are important rural nonfarm activities. However, because of the definition of GDP, the inevitable effects of drought on home processing for home consumption are not included.

Table 11.4 Equivalent variation on consumption for food aid simulations

Households	Base run	Percentage of base consumption		
		Experiment 1	Experiment 2	Experiment 3
Urban	0.0	-4.3	-3.4	-2.6
Rural	0.0	-9.8	-9.2	-5.7
Total	0.0	-6.9	-6.1	-4.1

Source: Authors' static CGE-model simulations.

Table 11.5 Grain and food aid imports for food aid simulations

Measure	Base run	Experiment 1	Experiment 2	Experiment 3
Volume of grain food aid	0.0	0.0	3.5	3.5
Volume of grain imports	4.1	6.0	2.5	2.8

Source: Authors' static CGE-model simulations.
Note: One unit in the measure by volume is defined as the amount of grain imports that could be purchased with 100 billion metical at 1995 prices.

Table 11.6 Agricultural terms of trade for food aid simulations

Indicator	Base run	Change from base run (percentage)		
		Experiment 1	Experiment 2	Experiment 3
Agricultural terms of trade in value-added terms	100.0	31.6	26.5	35.6

in the smallest drought-induced decline in absorption and welfare. However, investment and government spending are significant components of absorption, and the focus in drought years is on household consumption.

By the measure of equivalent variation on consumption for urban and rural households for the three experiments (Table 11.4), the ranking is reversed. Household welfare, as measured by equivalent variation on consumption, is substantially higher when food aid is distributed directly to households (experiment 3) as opposed to being monetized by government (experiment 2). The differential effects of alternative food aid distribution schemes on the components of total absorption drive this result on aggregate household welfare. When food aid is distributed to households, the first-order incidence of the food aid accrues directly to households and the household share of total absorption expands with concomitant impacts on household welfare.[98]

To explain the differences in welfare results between households (as well as the differences in the impacts on aggregate absorption across experiments), grain import volumes and relative price effects must be examined (Table 11.5). The resulting data show that food aid primarily substitutes for commercial imports. The total supply of grain available (domestic production, plus imports, plus food aid) varies, but not dramatically, across the experiments.

[98]Ordinarily, researchers strive to prevent shifts in the composition of absorption from contaminating welfare analysis. However, in this short-run analysis of the implications of drought and food aid, these compositional shifts are in focus.

Following a drought in experiment 1, agricultural terms of trade increase dramatically reflecting the contraction of agricultural production (Table 11.6). Large budget shares for food, especially home consumption, imply that rural household welfare decreases despite the improved terms of trade in the sale of their agricultural production. Urban household welfare declines primarily because of higher prices for agricultural products.

When food aid in the form of grains appears, as in experiment 2, the effect is to diminish the increase in agricultural terms of trade relative to experiment 1. The producer price of grains—which rises by 28 percent in experiment 1, but only by 16 percent in experiment 2—is the main reason for the more modest increase in the agricultural terms of trade. Prices of other agricultural products rise very slightly between experiments 1 and 2. Because of these price shifts, the benefits of food aid tend to accrue to urban households (Table 11.4). In sharp contrast, when food aid is distributed directly to households, agricultural terms of trade tend to increase relative to the drought scenario. The difference in impact on agricultural terms of trade between experiments 2 and 3 is very substantial.

The differential impact on agricultural terms of trade between experiments 2 and 3 arises from the very different marginal budget shares between households and government. Urban and rural households spend respectively 64 and 88 percent of an additional unit of income directed to consumption (for example, an increment to supernumerary income) on primary agricultural commodities and processed foods. On the other hand, only 5 percent of government spending on commodities is directed toward primary agricultural commodities and processed foods. By assumption, marginal and average government budget shares are equated in the model formulation. Consequently, the first-order impact of monetized food aid with the revenue given to government is an increase in spending on nonagricultural goods. The opposite occurs when food aid is given directly to households. The income increases resulting from food aid are directed overwhelmingly toward agricultural goods. These differential spending patterns affect the desired composition of total absorption and strongly influence relative prices.

The effects of these differentials in spending patterns can also be seen in the figures on grain import volumes (Table 11.5). In the absence of food aid, drought drives up commercial grain import volumes by nearly 50 percent relative to the base. When food aid is delivered and monetized, with the proceeds accruing to government—as in experiment 2—the income and welfare impacts on the primary demanders of grain, households (particularly rural households), are relatively small. As a result, grain demand is essentially constant and food aid mainly serves to displace commercial imports. The total volume of grain imports remains essentially the same (commercial imports plus food aid).[99] When the food aid is delivered to households as in experiment 3, household income or welfare expands and demand for grain expands along with it. Total imports of grain, including food aid, in experiment 3 are 5 percent greater than in experiment 1.[100] The increase comes through the income expansion through food aid transfer; such income expansion stimulates household demand.

The results on impacts on factor prices (Table 11.7) follow logically from the

[99]Since food aid enters as composite commodity and imports must combine with domestic production to form the composite commodity, technically, different products are being added together here. This would be similar to adding together white and yellow maize, which gives a good idea of total maize availability. Nevertheless, despite the relatively high Armington elasticity, this product differentiation between imported and domestic grains drives the relative price shifts observed for grains between experiments 1 and 2.

[100]Imports of other food commodities also increase.

Table 11.7 Factor price indices for food aid simulations

Factor	Base run	Change from base run (percentage)		
		Experiment 1	Experiment 2	Experiment 3
Agricultural labor	1.0	-2.5	-4.2	-0.2
Nonagricultural labor	1.0	-7.3	-4.9	-7.9
Capital	1.0	-9.2	-8.3	-9.8

Source: Authors' static CGE-model simulations.

preceding discussion. Drought in experiment 1 reduces returns to all factors relative to the CPI. Because of the improvements in agricultural terms of trade, agricultural labor experiences the mildest decline in factor price relative to other factors. When food aid is monetized and the proceeds spent by government in experiment 2, the drought-induced improvement in agricultural terms of trade is moderated. As a result, returns to agricultural labor decline and returns to nonagricultural labor and capital increase relative to experiment 1. When food aid is delivered directly to households in experiment 3, the improvements in agricultural terms of trade, relative to experiments 1 and 2, result in increases in returns to agricultural labor and decreases in returns to non-agricultural labor and capital relative to both preceding experiments. In fact, in experiment 3, agricultural labor wages decline very little relative to the base situation with no drought.

Conclusions

Drought clearly affects total welfare negatively, as measured by absorption (Table 11.3). Moreover, total welfare declines less as compared with the drought scenario when food aid is supplied, and this conclusion is independent of the distribution scheme opted for. Total welfare, as measured by total absorption, is least affected by drought when food aid is channeled through the government. Nevertheless, alternative distribution schemes have very distinct impacts on household welfare (as measured by equivalent variation) and prices, notably the relative price of agricultural goods. Compared with monetization of food aid by government (experiment 1), direct distribution to households (experiment 2)—done by population shares in the experiments—strongly benefits (poorer) rural households. Moreover, when food is distributed directly to households (experiment 3), impacts on agricultural terms of trade are positive compared with a scenario of no food aid, which is exactly the opposite of the terms of trade effect related to monetization.

When households take ownership of the food aid, they (rather than government) experience the first-order impact of the resource transfer. Moreover, since rural households direct the large majority of any increment to income to the purchase of agricultural goods, the increase in household income generated by the food aid expands the demand for agricultural goods. Alternatively viewed, when households derive income from food aid, the desired components of nominal absorption shift toward agricultural products. As a result, agricultural terms of trade improve (even relative to the scenario of drought without food aid, in experiment 1), which further benefits rural households. These results indicate that, when improving the welfare of drought-stricken rural households is the primary goal of food aid, direct distribution of food aid is preferred. This conclusion would be less convincing, however, if the government were able to use food aid revenue in a manner strictly targeted at rural households that are drought-stricken.

CHAPTER 12

Scenario Building: The Merged Model

The macroeconomic simulations in this chapter are based on a macroeconomic model that takes on most of the features from the operational projection model formulated by Brixen and Tarp (1996). As such, it reflects basic behavioral features of the World Bank's Revised Minimum Standard Model (RMSM) and the IMF's financial programming approach to modeling. The basic premise for the set up of the macroeconomic projections was that postwar recovery was complete so the 1997 economic performance could be seen as normal given the level of development in Mozambique at that time. Accordingly, the parameter values used in this chapter are in large measure based on calibrated parameter values for 1997.[101]

Another important underlying assumption is that the environment of political stability would be maintained and that natural disasters would not occur. The last major drought was recorded in 1992, while the prediction of a significant drought in 1998, in connection with the strong El Ninõ weather phenomenon of that year, did not materialize. The drought of 1992 resulted in negative overall growth for the economy, and it is clear that the appearance of another major disaster during the simulation period would have affected the results significantly. The simulations therefore include two scenarios distinguished by the inclusion of an economic shock following a natural disaster.

Model Framework and Base-Year Data

The seminal theoretical contribution to the merged-model literature is that of Khan, Montiel, and Haque (1990). This work does not, however, focus on aspects of implementation for policy formulation and simulations. The merged model was developed as a practical tool by Brixen and Tarp (1996), who focus on the consistency between the underlying IMF and World Bank frameworks. In the same vein, the modified version of the operational merged model used here should be seen as a practical tool for analysis and simulations. It is primarily meant as a guide to policymakers on matters of consistency.[102]

This chapter was written by Henning Tarp Jensen, and Finn Tarp.

[101]Note that the simulations in this chapter were undertaken pre-1999; hence projections were made on, then, future developments to 2001–02. Data were not available at the time of writing to compare the projections with actual developments.

[102]Shortcomings of the model, such as the absence of distributional considerations and the smoothness of the closure mechanism, are outlined by Tarp (1993) and pursued in Chapter 13.

The specification of this study's modified merged model reflects the two "parent" approaches closely. This is apparent from Appendix B, where the full set of equations is given. Nevertheless, this meant that some compromises had to be made in the specification of interaction between the submodels. The simple RMSM model presented by Addison (1989) does not account explicitly for the government sector. Accordingly, this model does not need to account explicitly for the flow of value-added into household budgets. The simple financial programming framework presented by the IMF (1987) does include a government sector. However, the focus of the financial programming framework on the financial sector implies that the borrowing requirement of the government sector is exogenously imposed.

To model the government sector separately in line with the financial programming model, Brixen and Tarp (1996) divided consumption and investment aggregates in the RMSM model into private and government parts. Tax revenue was taken into account in the budget constraint for the private sector, and a simple linear function for private consumption was introduced. On the financial (financial programming) side of the model, the balance of payments accounted for net capital inflows in the form of factor and interest payments as well as net factor income. However, the private sector part of these net capital inflows was not included in the private sector budget on the real (RMSM) side of the model. This excluded private income from abroad in the form of remittances and factor payments from private disposable income. In contrast, so-called terms-of-trade gains following price changes in the world market were included in the private sector budget.

The inclusion of terms-of-trade gains into private disposable income does not follow immediately from the simple RMSM model. Terms-of-trade gains form part of gross domestic savings in the RMSM model. As such it only affects the resource gap defined as a trade balance adjusted for terms of trade. Aggregate consumption and investment are left unchanged. The original merged model retains the latter characteristic. Since terms-of-trade gains are included in private disposable income, such gains do, however, affect the relative distribution of consumption and investment between the private and government sectors. This further affects private and government budgets, and ultimately influences the politically sensitive level of government domestic credit.

The terms-of-trade gains were originally introduced into the simple RMSM model, since this model is otherwise formulated without reference to prices. Accordingly, the formulation represents an attempt to allow for the possibility that relative changes in world market prices can affect available foreign resources. A country that is import constrained because of a lack of foreign currency can benefit from higher relative world market prices for exports through increased access to foreign currency. This enables imports of essential investment goods, which can underpin increased GDP growth. It follows that the formulation for terms-of-trade gains is only useful in so far as prices are not modeled and the country is import constrained because of a lack of foreign resources.

Yet, the merged model does specify prices, including import and export prices, as well as absorption and GDP deflators. It follows that the resource gap forms an integral part of the balance-of-payments section of the model, implying that the terms-of-trade gains should be eliminated from the model. Consequently, the modified version of the merged model in Appendix B defines private disposable income as the sum of nominal value-added (including the nominal value of the trade balance), net government transfers, and income from abroad. The original merged model defined absorption prices as a weighted average of the GDP deflator and import prices. However,

the formulation with fixed shares implies that the nominal values of imports, GDP, and absorption, in general, are not going to be consistent. Accordingly, the modified model includes a new specification for absorption prices whereby nominal values of macroeconomic aggregates remain consistent.

In sum, the model equations in Appendix B are divided into four parts—real sector, government accounts, balance of payments, and prices and monetary sector—and they have been extended to match the dimensions of a reduced version of the MACSAM presented in Chapter 5. The NGO sector has been included as a separate sector, which consumes on the basis of revenues received from abroad. Longer-term domestic debt is not explicitly accounted for in the current model, but is included into the money stock, which continues to be governed by a quantity equation specification.

The revisions to the original merged model referred to above are primarily made to capture the workings of the economy in a more appropriate way. Nevertheless, the revisions also make it possible to relate the merged-model specification to the SAM framework. Relating the real side of the merged model to the SAM framework is convenient, because it lays the groundwork for the construction of a financial sub-SAM. The explicit specification of a consistency framework encompassing both the real and financial sectors of the merged model facilitates the collection and integration of base-year data. Moreover, the simulations can rely partly on the 1995 SAM data set for the real side of the Mozambican economy.[103]

Nevertheless, because the modeling exercise includes yearly simulations covering the period 1998–2002, it was necessary to rely on 1997 data as the principal base year. In any case, base-year data were generated for the full three-year period of 1995–97. The construction of 1995–96 base-year data was considered desirable because it enabled a check on the consistency of model parameter values.[104] Calibrating model parameters to each of the 1995–97 base years provided an idea of how model parameters have evolved over time. Given the available SAM data set only includes real economy data for 1995, it was necessary to obtain the remaining base-year data, including real economy data for 1996–97 and financial economy data for 1995–97, from other sources; several were used including national income and expenditure accounts, balance of payments statistics, government finance statistics, and monetary surveys.[105]

The simulations, described in the next section, take into account two large, (at the time planned) projects in Mozambique—the Cahorra Bassa power plant and the Mozal aluminum smelter. In the model, these projects are envisioned to work like enclaves in the economy. As a result some labor income and royalties flow to domestic agents. It is also assumed, however, that all intermediate inputs are imported, that all output is exported, and that profits are fully repatriated by foreign owners. With the large projects assumed to function as enclaves, it is possible to run simulations with and without them. Accordingly, separate

[103]The combined SAM framework for the real and financial sector of the merged model proves much more important in relation to the creation of a dynamic CGE model in the Chapter 13. Accordingly, the financial sub-SAM provides a complete roadmap on how to incorporate the financial sector of the merged model into the framework of a dynamic CGE model based on the static CGE model presented in Chapter 6.

[104]Apart from providing a check on parameter values in the merged model, the inclusion of 1995 as a base year is essential for the dynamic CGE modeling exercise presented in Chapter 13 of this volume. Accordingly, the 1995 SAM data set provides structural details that are not available from other data sources.

[105]Details on the construction of the 1995-97 base-year data set within the combined SAM framework are in Jensen (1999). Data differ slightly because of the inclusion of updated numbers.

variables are included for projected imports, exports, and investment by the large projects (*ENCM, ENCX, and ENCIV*). Additional value-added flowing from the large projects toward domestic economic agents (*MADD*) is assumed to be spent between consumption and investment according to the fixed marginal propensities to consume and invest. The assumption that all output is exported implies that the large projects have a positive impact on foreign currency inflows. Nevertheless, the increased access to foreign currency is assumed to be spent on increased imports, leaving the level of foreign currency reserves unaffected by the large projects. Finally, the expenditures by large projects on investment goods and imported production inputs are financed by foreign capital inflows (*NTRENC*), while profits are fully repatriated (*NFPENC*).

Finally, the closure of the simulation model includes the exogenous specification of growth paths for several variables, including real GDP and most price indices. The specific growth paths of the exogenous variables are fully described in relation to the individual scenarios. However, instead of specifying the development of the government net foreign debt exogenously, a technical relationship is introduced that relates the foreign debt of the government to the level of foreign currency exports. This technical relationship is based on considerations that were made before the HIPC initiative negotiations in late 1999. At that time, the expectation was that that initiative would reduce the government net foreign debt to around 200 percent of foreign currency export earnings. This translates into a ratio of 2.0 in terms of the technical relationship.

The calibration of the model parameters to the 1995–97 base-year data implies that parameter values change over time (Table 12.1). The nine parameters in the current version of the merged model number one less than the parameters included in the original merged model. The difference in the number of parameters is a result of a change made to the price equation, where the fixed weighting parameter has been replaced by endogenously determined absorption shares. The private propensity to save (B) is derived from the ratio of private nominal consumption to disposable income. The increasing private propensity to save over the years reflects the relatively strong growth in GDP during 1995–97. The parameter relating changes in foreign exchange reserves to changes in imports (*D*) varied significantly over the base-year period. It follows that foreign exchange reserves increased markedly, while the bill in foreign currency of imports actually decreased somewhat.

The parameter relating government net foreign debt to exports (*G*) remained relatively high over the base-year period. The

Table 12.1 Parameter values for the merged model, 1995–97

		Value		
Parameter	**Symbol**	**1995**	**1996**	**1997**
Private propensity to save	B	0.10	0.12	0.17
Ratio of ΔR to ΔM	D	1.21	-4.82	-10.51
Ratio of NFDG to XPI*X	G	13.90	11.95	12.40
Marginal effect of GDP on IV κ_0	0	0.29	0.18	0.09
Incremental capital-output ratio κ_1	1	2.00	2.00	2.00
Constant in import function α_0	0	-0.72	-0.93	-1.15
GDP elasticity of imports α_1	1	1.00	1.00	1.00
RER elasticity of imports α_2	2	-1.00	-1.00	-1.00
Velocity	V	3.66	3.57	2.41

Source: Author' merged model.

decline in the ratio between 1995 and 1996 is a result of a relatively strong, concurrent increase in foreign currency exports. The private foreign debt increased moderately in percentage terms throughout the base-year period. The investment function has two parameters (κ_0 and κ_1). It is therefore necessary to assume a value for one of the parameters—in this case the incremental capital-output ratio (κ_1)—while the other parameter (κ_0) is residually determined. Assuming that the incremental capital–output remained at a constant level, it follows that the marginal effect of GDP on total investment declined strongly. The relatively strong growth in recent years was accompanied by declining or unchanged real investment expenditures, implying that production efficiency increased markedly.

Since the import function includes three parameters, it was decided to assume values for the GDP and real exchange rate elasticities of the imports (α_1 and α_2), and to let the constant of the import function (α_0) be residually determined. The declining value of α_0 reflects the import compression that characterizes the base-year period. Finally, the velocity of money circulation (V), derived as the ratio between nominal GDP and the money stock, declined markedly between 1996 and 1997. Accordingly, a strongly increasing money stock led to a decline in the velocity, even in the face of strongly increasing nominal GDP. The strong decrease in velocity between 1996 and 1997 suggests that the privatization of state-owned banks and the simultaneous stabilization of domestic prices had a quick and strong effect on the money holdings of domestic agents.[106]

Simulations

Optimistic Scenario

The optimistic scenario relies on constant parameter values over the full simulation period, 1998–2002 (Table 12.2). Moreover, parameter values are equivalent to 1997 calibrated values with three exceptions. First, the ratio between accumulation of foreign exchange reserves and increase in imports was assumed to remain constant at 5/12. The calibrated coefficients for the

Table 12.2 Parameter values for the optimistic scenario in the merged-model simulations, 1998–2002

		Year				
Parameter	**Symbol**	**1998**	**1999**	**2000**	**2001**	**2002**
Private propensity to save	B	0.17	0.17	0.17	0.17	0.17
Ratio of ΔR to ΔM	D	0.42	0.42	0.42	0.42	0.42
Ratio of NFDG to XPI*X	G	10.99	5.86	2.00	2.00	2.00
Marginal effect of GDP on IV κ_0	0	0.13	0.13	0.13	0.13	0.13
Incremental capital-output ratio κ_1	1	2.00	2.00	2.00	2.00	2.00
Constant in import function α_0	0	-1.15	-1.15	-1.15	-1.15	-1.15
GDP elasticity of imports α_1	1	1.00	1.00	1.00	1.00	1.00
RER elasticity of imports α_2	2	-1.00	-1.00	-1.00	-1.00	-1.00
Velocity	V	2.41	2.41	2.41	2.41	2.41

Source: Author' merged model.

[106]The level of the velocity parameter is very low for a developing country. Two explanations are possible: The money stock includes some longer term loans that ought to have been excluded, or nominal GDP is underestimated. In the view of the authors, the latter explanation is the most likely. While longer-term loans are very uncommon in Mozambique, nominal GDP was revised upward in late 1999.

period 1995–97 were very much influenced by temporary possibilities for import substitution and significant reserve accumulation following monetary stabilization. They were therefore not reasonable for use in simulations. Instead, the chosen parameter value reflected the government objective that foreign exchange reserves should cover five months of import expenditures in the medium to longer term.

Second, variations in the technical coefficient relating the foreign debt of the government to export earnings are based on information on the (then) expected future path of government net foreign debt without the HIPC initiative (IMF 1998), and the expectation that the initiative would lower the government net foreign debt to 200 percent of export earnings around mid-1999. Third, the parameter that measures the marginal impact of GDP on investment in the investment function (κ_0) was changed. Unchanged real investment and increasing growth over the base-year period set the background for the apparent increase in production efficiency. At an unchanged capital–output ratio of 2.0, this implied that the depreciation rate declined from 14.3 percent in 1995 to a mere 4.4 percent in 1997. Such a sharp drop in the depreciation rate is clearly unreasonable and reflects that the capital–output ratio improved somewhat as well.

The improvement in production efficiency was the net result of the privatization and restructuring of public enterprises, recovery-induced improvements of capacity utilization in private companies, and good weather conditions favoring agriculture and related sectors. These conditions relate to the recovery and structural adjustment years, but they cannot be expected to have a similar effect on the relationship between investment and growth over the simulation period. Accordingly, κ_0 was assumed to remain fixed at the average of the 1996–97 calibrated values for the duration of the simulation period. This implies a constant 6.7 percent depreciation rate of capital over the simulation period at a constant capital-output ratio of 2.0.

Finally, both the private savings rate and the velocity of money circulation were fixed at their 1997 level.[107] The same goes for the scale parameter in the import function. Substantial import substitution in key parts of the economy, including agriculture and agricultural processing, was not expected to continue.

Closure of the model. The closure of the model implies that growth paths must be specified exogenously for real exports and GDP. The exogenously imposed growth paths for sectoral GDP and exports, excluding large projects, implied that export growth rates remain 3 to 4 percent higher than GDP growth rates. Accordingly, GDP growth rates averaged 9.3 to 9.5 percent annually, while export growth rates averaged 12.2 to 13.8 percent. The inclusion of large projects as enclaves necessitated the inclusion of estimates of enclave investment expenditures and import demand, remunerations to domestic laborers employed by large projects, and the associated repatriation of profits by foreign owners. Since the current modeling exercise concentrates on the increasing electricity production by the Cahorra Bassa dam and the phasing-in of the Mozal aluminum smelter, estimates of income and expenditures were readily obtained from the Government of Mozambique (1998). These estimates implied that the Mozal aluminum project would have a significant effect on aggregate imports and exports, as well as on aggregate investment expenditures during the construction period

[107] As discussed above, the velocity is potentially underestimated. This implies that further noninflationary expansion of the money stock may be possible. However, such a scenario was not considered appropriate on the basis of currently available data.

1998–2000. The effect on aggregate GDP would be more moderate.

The three different exogenous prices and the exchange rate were set to increase so as to leave the external terms-of-trade virtually unchanged. Accordingly, while the GDP deflator and the world market import and export prices were set to increase by 5 and 3 percent annually, respectively, the exchange rate was set to depreciate by 2 percent annually. Government tax revenue was assumed to grow in line with nominal GDP, but government transfers (to households) were only assumed to increase in line with the GDP deflator. Furthermore, net foreign transfers to the government (that is, aid inflows) were set to increase modestly at 3 percent annually, implying that government investment expenditures could be allowed to expand at 6 percent annually. Aid inflows into the NGO budget were presumed to remain constant in terms of U.S. dollars, as were net factor payments from abroad.

Simulations for the goods market. Despite the respectable growth that characterized the recovery process, low income levels persisted thereafter, particularly in rural areas, and many structural problems remain to be addressed effectively. Accordingly, poverty remains widespread and food security issues remain important in determining the structure of agricultural production. Furthermore, in the late 1990s, the government budget was squeezed to a bare minimum to attain balance and comply with the conditions of donor countries. It follows, as discussed elsewhere in this report, that Mozambique needs a broad-based growth plan to raise the income for the majority of the population, who live in rural areas. This process must, at the same time, increase government income through goods taxes—the only feasible means of raising revenue. In any case, the basic premise for the simulations is that the successful stabilization of the 1990s paved the way for the economy to move toward a sustainable growth path. For this reason, reasonably fast growth was expected over the simulation horizon (Table 12.3).

The sectoral GDP data indicate that real GDP growth was high in the agricultural sector up until 1997 (Table 12.4). The high growth rates reflect both the end to

Table 12.3 Growth in the material balance for the merged-model simulations, 1995–2002

Variable	Symbol	Growth rate (percentage)							
		1995	1996	1997	1998	1999	2000	2001	2002
Consumption	C	-4.0	3.6	8.8	9.4	8.8	8.2	8.1	8.3
Private consumption	CP	24.7	4.3	6.8	9.0	8.8	8.9	9.1	9.2
Government consumption	CG	-51.1	-4.2	34.2	15.5	11.6	5.4	3.5	3.8
Nongovernmental organization Consumption	CN	-75.3	10.9	-11.1	-2.9	-2.9	-2.9	-3.0	-3.0
Investment	IV	21.0	-10.2	11.7	7.6	7.9	10.0	10.4	10.0
Private investment	IVP	73.1	-12.1	2.7	9.3	9.9	13.9	14.4	13.4
Government investment	IVG	-10.5	-8.0	21.8	6.0	6.0	6.0	6.0	6.0
Exports	X	20.8	19.4	-2.0	12.2	12.7	13.2	13.7	13.8
Imports	M	3.0	-7.6	-3.3	9.3	9.1	9.2	9.4	9.5
GDP	GDP	4.3	7.1	12.5	9.4	9.2	9.3	9.4	9.5
Consumption, including large projects	CTOT	-4.0	3.6	8.8	10.5	9.0	8.0	7.7	8.3
Investment, including large projects	IVTOT	21.0	-10.2	11.7	55.0	14.5	0.0	-20.3	9.9
Exports, including large projects	XTOT	20.8	19.4	-2.0	23.5	14.4	22.4	53.3	7.5
Imports, including large projects	MTOT	3.0	-7.6	-3.3	54.4	15.1	2.8	-5.6	7.3
GDP, including large projects	GDPTOT	4.3	7.1	12.5	11.8	9.7	9.6	11.8	9.0

Source: Authors' merged-model simulations.

hostilities and recovery from the devastating effects of the 1992 drought. Further possibilities for recovery-induced growth were nevertheless limited, because such high growth rates could not be expected to continue. Accordingly, the GDP growth rate for the agricultural sector was assumed to decline gradually during the simulation period. In contrast, the industry sector was assumed to experience high growth over the simulation period. As previously discussed, this sector was particularly depressed during the war because of lack of intermediate input supplies and devastated distribution networks, and hence was privatized and restructured.

The service sector is naturally a large contributor to GDP. In the model, this is assumed to continue as the integration of the economy proceeds, and as Mozambique establishes stronger trade relationships with the surrounding region. Altogether the agriculture and service sector shares of GDP were projected to fall to 27 and 45 percent, respectively, in 2002, while the industry sector share was projected to increase to 28 percent.

Overall, annual GDP growth was projected to remain reasonably constant, at around 9.3 to 9.5 percent, over the simulation horizon. Taking the income earnings flowing from the large projects of Cahorra Bassa and Mozal into account GDP growth rates were projected to increase by 1 percent to 4 percent over the simulation period. Domestic income flowing from the large projects was based on estimates of income generation from employment of domestic labor and expenditure outlays on domestically produced goods for investment purposes. Nevertheless, it was assumed that the majority of large project earnings would be repatriated by foreign capital owners. This is reflected in the similarity of the consumption growth rates with and without large projects (Table 12.3).

A lack of penetration of export markets appeared to have been a key reason for the mixed export experience in the mid-1990s. Yet, the small agricultural exports increased

Table 12.4 Growth in sectoral GDP for the merged-model simulations, 1995–2002

		Growth rate (percentage)							
Variable	**Symbol**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Agriculture GDP	AGDP	22.0	12.3	8.6	8.0	7.0	6.0	5.0	5.0
Industry GDP	IGDP	13.3	10.8	22.9	11.0	11.0	12.0	13.0	13.0
Service GDP	SGDP	-6.3	2.5	8.1	9.0	9.0	9.0	9.0	9.0
GDP	GDP	4.3	7.1	12.5	9.4	9.2	9.3	9.4	9.5

Source: Authors' merged-model simulations.

Table 12.5 Growth in sectoral exports for the merged-model simulations, 1995–2002

		Growth rate (percentage)							
Variable	**Symbol**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Agriculture exports	AX	56.2	-7.7	150.9	10.0	10.0	10.0	10.0	10.0
Industry exports	IX	9.4	31.9	-10.3	14.0	15.0	16.0	17.0	17.0
Service exports	SX	29.1	11.7	-5.8	11.0	11.0	11.0	11.0	11.0
Exports	X	20.8	19.4	-2.0	12.2	12.7	13.2	13.7	13.8

Source: Authors' static CGE-model simulations.

strongly in 1997, implying that the agricultural share of total exports rose to an estimated 10 percent (Table 12.5). This was in large measure because of progress in exporting maize out of the northern provinces. This spurt in agricultural exports seemed unlikely to continue but, given the low initial level, reasonable growth rates in agricultural exports were anticipated. Growth rates for industrial exports also varied considerably over the base-year period, but they eventually stabilized making supplies of production inputs more regularly forthcoming and the prospects for a fast expansion of industrial production and exports encouraging.

Finally, service sector exports account for a major share of total export earnings in the model. Tensions with neighboring countries significantly reduced the historically important exports of transit services during the 1980s and early 1990s. The end to sabotage against the rail lines supplying the land-locked countries of the Mozambican hinterland, and the renewed opening-up to transit shipments of goods bound for South Africa were projected to be the major factors behind export earnings rebounding in this sector. Moreover, ongoing investment projects were projected to develop the transport corridors that run alongside the major east–west rail lines, and hence the service sector was projected to be dynamic. Specifically, sectoral growth paths indicated that the agricultural and service sector share of total exports would reduce to 8 and 43 percent, respectively, in 2002, while the industry sector share would increase to 49 percent.

The high export growth rates also implied that the export–GDP ratio would increase for each of the individual sectors as well as on the aggregate level. The material-balance data clearly indicated that the export performance of Mozambique would be significantly affected by the inclusion of the large projects (enclaves) (Table 12.3). Accordingly enclave export earnings were expected to amount to no less than 35 percent of total export earnings in 2002.

Despite the remarkable real increase in 1997, the material balance data indicated that the recurrent budget would remain very small, with expenditures contributing no more than 10.2 percent of GDP. The optimistic scenario reflects that expansion of government expenditures on health and education, as well as those aimed at reversing the severe wage compression for civil servants, was a realistic possibility over the period 1998–2000. However, a subsequent expansion of private disposable income limits the ability of the economy to accommodate continuing expansion in later years.

Growth rates for private consumption vary somewhat over the simulation horizon, since estimates obtained from the IMF (1998) indicated that interest payments were expected to increase relatively strongly until 2000, implying that effective interest rates and the debt-servicing ratio would increase strongly as well. Second, government taxes were assumed to grow in line with nominal GDP, while transfers of government income would only increase with the domestic price level. This would lead to a continuous increase in the net tax burden on the private sector. Overall, these factors suggested that private disposable income and consumption would only start to increase more strongly after the increasing foreign interest payments leveled off after 2000.

Following a significant drop in overall investment in 1996, increased government investment expenditures, in particular, were responsible for the significant rebound of investment in 1997. In spite of the depressed state of the country, continued high government investment expenditures to some extent depended on continued backing from the donor community. It must also be kept in mind that problems surround the classification of investment expenditures in the government budget. The government share of investment is likely to be overstated, while the private share is

Table 12.6 Current account of the balance of payments for the merged-model simulations, 1995–2002

Variable	Symbol	Share of GDP (percentage)							
		1995	1996	1997	1998	1999	2000	2001	2002
Resource balance	RESBAL	-29.9	-20.6	-15.9	-15.5	-15.0	-14.4	-13.7	-13.0
Export	X	18.8	18.8	15.6	16.0	16.5	17.1	17.8	18.5
Import	M	48.7	39.4	31.6	31.6	31.6	31.6	31.6	31.6
Net factor service income	NETFSY	-5.6	-4.4	-1.2	-1.7	-1.7	-2.2	-2.1	-2.1
Net factor payments	NFP	2.0	1.9	1.5	1.3	1.2	1.0	0.9	0.8
Private foreign interest payments	INFP	5.6	4.5	1.0	0.5	0.7	1.4	1.3	1.3
Government foreign interest payments	INFG	2.0	1.8	1.7	2.5	2.2	1.9	1.7	1.6
Net transfers	NTR	15.4	12.1	12.7	11.6	74.7	66.6	8.7	7.9
Private net transfers	NTRP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Government net transfers	NTRG	12.2	8.8	10.1	9.3	72.7	64.8	7.1	6.5
Nongovernmental organization net transfers	NTRNGO	3.2	3.3	2.6	2.3	2.0	1.8	1.6	1.4
Current account balance	CURBAL	-20.1	-12.8	-4.5	-5.6	58.0	50.0	-7.2	-7.2
Resource balance, including enclaves	RESBALENC	-29.9	-20.6	-15.9	-26.4	-27.8	-22.9	-8.7	-8.6
Net factor service income, including enclaves	NETFSYENC	-5.6	-4.4	-1.2	-2.8	-3.1	-4.0	-6.4	-5.9
Net transfers, including enclaves	NTRENC	15.4	12.1	12.7	23.6	87.3	75.4	8.3	7.6
Current account balance, including enclaves	CURBALENC	-20.1	-12.8	-4.5	-5.5	56.5	48.5	-6.8	-6.9

Source: Authors' merged-model simulations.

understated.[108] To correct for these inaccuracies, a relatively modest growth path was assumed for government investment.

The constant 6 percent annual growth rate in real government investment was supported by an assumed 3 percent annual increase in foreign currency aid transfers, which were included in government net foreign transfers (Table 12.6). Since the domestic inflation rate is higher than the rate of exchange rate depreciation (Table 12.7), the slow growth of aid inflows induced a moderate pressure to transfer resources from the recurrent to the investment side of the government budget. Nevertheless, since very high investment growth would be necessary to underpin high GDP growth rates, gaining moderate government investment growth would mean that private investment would have to grow in the range of 9.3–14.4 percent. These high growth rates are in contrast to actual private investment performance but seemed plausible given the stabilization of the economy and the reestablishment of a reasonable domestic savings rate. Overall, the investment share of the government budget was set to decrease to 52 percent by the end of period under study, while the private sector share

[108]Total investment numbers are based on United Nations standards of national accounting (NIS 1998). The total investment level is therefore reliable. Private investment must therefore be underestimated, since it is residually derived as the difference between total and government figures.

Table 12.7 Price inflation for the merged-model simulations, 1995–2002

Variable	Symbol	Growth rate (percentage)							
		1995	1996	1997	1998	1999	2000	2001	2002
Absorption price	P	51.0	40.3	7.4	5.1	5.1	5.1	5.1	5.1
GDP deflator	PD	51.9	40.9	8.8	5.0	5.0	5.0	5.0	5.0
Export price	XPI	21.0	0.7	1.4	3.0	3.0	3.0	3.0	3.0
Import price	MPI	5.0	5.3	-0.9	3.0	3.0	3.0	3.0	3.0
Exchange rate	E	50.2	25.3	2.3	2.0	2.0	2.0	2.0	2.0

Source: Authors' merged-model simulations.

of total investment was expected to increase to 56 percent.

Different paths in consumption and investment growth in the model imply fluctuations in the consumption–investment ratio, but the ratio was projected to decrease only slightly across the simulation period, from 3.0 in 1998 to 2.8 in 2002. The simulations therefore imply that the composition of absorption would remain relatively unchanged. Including the enclaves did not change this outcome. The consumption share of absorption was projected to drop only temporarily during 1999–2000 because of the huge Mozal investment expenditures. Following the discontinuation of this expense, the overall consumption and investment pattern was projected to revert to normal.

The assumed discontinuation of the import compression leading up to 1997 implied that the deficit of U.S. dollars on the resource balance, exclusive of large project resource flows, would worsen gradually over the simulation period. When including the enclave projects, the significant investment-related imports of the Mozal project were projected to worsen the resource balance considerably during 1998–2000. However, this should be seen in connection with the significant inflow of foreign financing, showing up in net foreign transfers, in addition to the enclaves (*NTRENC*, Table 12.6). In contrast, huge Mozal exports were projected to lower the trade balance deficit significantly during 2001–02. Yet, the improved trade balance would apparently only be positive because the outflow of profits as dividends to foreign investors—included as a negative item in net factor service income (*NETFSYENC*)—implied that the current account of the balance of payments (*CURBALENC*) was not much affected.

Simulations for prices. On the basis of the significant price stabilization that occurred in the later part of the base-year period (Table 12.7), it was assumed that the different price indices would increase in a smooth and modest fashion over the simulation period. The official domestic inflation target was 5 percent for the years 1998–2000; consequently this was used as the basis for the optimistic scenario. Assuming that monetary control would be maintained and that no major external shocks would affect inflation, domestic inflation was projected to remain at 5 percent throughout the full simulation period of 1998–2002, which seemed reasonable. Moreover, world market prices for both imports and exports were assumed to develop smoothly at a constant 3 percent annual growth rate. Finally, the nominal exchange rate was set to depreciate by 2 percent annually over the simulation period. As a first approximation, the real exchange rate was assumed to remain stable at around the 1997 level.

Simulations for the balance of payments. The current account of the balance of payments indicated that the gradual improvement in the ratio of trade balance to GDP would be driven mainly by increases in real exports, while the functional

specification of import demand would result in a fixed nominal import share of GDP (Table 12.6).[109] The simulations also imply that the gradual improvement of the trade balance would not be transmitted to the current account because of an increase in the flow deficit of factor service income (NETFSY), induced by interest payments, and a relative decline in unrequited net transfers (NTR).

Net factor service payments were projected to decline as a share of GDP, based on the expectation that unchanged working opportunities in the South African mining industry would depress such payments, and because private debt servicing was assumed to increase. A turnaround in government foreign interest payments based on the assumption that Mozambique would be awarded significant debt reduction under the HIPC initiative would only pull slightly in the opposite direction.[110]

Net foreign transfers to the government sector varied significantly over the simulation period because the assumed debt reduction in relation to the HIPC initiative was implemented as a net foreign transfer.[111] Aside from the initiative, reliance on foreign aid through net transfers from abroad was set to decrease to 7.9 percent of GDP in 2002, in accordance with a key objective of the Mozambican government.[112] The means for achieving this goal was the relatively fast growth of exports, which would reduce the importance of the trade balance deficit and lower the relative need for foreign financing through aid transfers. However, improvement in the trade balance would not be sufficient to sustain the assumed decrease in aid dependence, as evidenced by the increase in the current account deficit. The GDP deflator, export price, import price, and exchange rate data (Table 12.7) show that the large projects affect individual components of the current account strongly but leave the overall current account virtually unchanged.

Simulations for the capital account (Table 12.8) indicate that the declining current account deficit during the stabilization period created room for the large increase in foreign exchange reserves, amounting to slightly more than 90 percent of the value of imports in 1997. Such a level of reserves is

Table 12.8 Capital account of the balance of payments for the merged-model simulations, 1995–2002

		Share of GDP (percentage)							
Variable	**Symbol**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Current account balance	CURBAL	-20.1	-12.8	-4.5	-5.6	58.0	50.0	-7.2	-7.2
Change in private net foreign debt	DNFDP	19.4	12.8	13.0	2.8	3.1	3.6	3.4	3.3
Change in government net foreign debt	DNFDG	5.2	5.3	5.9	4.3	-59.6	-52.2	5.2	5.4
Change in foreign exchange reserves	DR	4.4	5.3	14.4	1.5	1.5	1.5	1.5	1.5

Source: Authors' merged-model simulations.

[109]Import demand is determined by a linear functional relationship between the logarithm of imports and the logarithms of GDP and the terms of trade. The specific choice of parameter values then implies that the import-GDP ratio is fixed.

[110]The government interest payments were projected to fall only slightly during 1999–2001 because of implicit assumptions about increasing debt servicing, as reflected in the developments of the effective interest rates.

[111]The foreign transfers that go toward financing the debt reduction were divided between 1999 and 2000. This was intended to capture the expected debt reduction in mid-1999.

[112]This is because of the assumption that U.S. dollar net transfers to government would increase by a mere 3 percent annually, while U.S. dollar net transfers to NGOs would remain unchanged.

higher than the government objective of maintaining reserves equivalent to five months of imports on a continuous basis. Annual changes in reserves were therefore projected to amount to 5/12 of the annual change in the U.S. dollar value of imports over the simulation horizon.[113]

The government was also assumed to be able to obtain foreign loans amounting to 200 percent of the increase in exports earnings (excluding exports of large projects). The significant debt reduction related to the HIPC initiative around mid-1999, which was expected to lower the level of the Mozambican debt stock to 200 percent of the level of exports excluding large projects, was also expected to affect government net borrowing figures strongly in 1999–2000. The expected developments of the international reserves and government borrowing would enable a reasonably stable evolution of private borrowing. Accordingly, private foreign borrowing was expected to peak at 3.6 percent of GDP in 2000, after which it was projected to decrease slightly.

Simulations for the government and financial accounts. The total government budget was assumed to decrease as a share of GDP over the simulation horizon because of modest growth in foreign aid transfers (Table 12.9). Increases in foreign aid transfers were likely to remain modest because of general donor reluctance to increasing grants, as well as the stated government objective of reducing aid dependency in the medium to long term. The implied decrease in government income relative to GDP was not expected to be countered by the developments in domestically collected revenue. Ongoing tax reform, including the replacement of circulation taxes with a value-added tax system, as well as ongoing judiciary and administrative reform efforts were unlikely to result in any major breakthrough in medium-term revenue collection. Domestic revenue was therefore projected to grow at rates similar to nominal GDP, excluding large projects. Altogether, available government resources were expected to decline compared with GDP.

The real side of the government budget simulations indicated that reasonable growth in government investment and other components of the material balance would put strict limits on the possible expansion of government consumption. Nevertheless, government consumption was projected to maintain its share of GDP across the full simulation period because of the reduced importance of interest payments resulting

Table 12.9 Government budget for the merged-model simulations, 1995–2002

		Share of GDP (percentage)							
Variable	**Symbol**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Government tax revenue	TG	13.1	13.4	14.4	14.4	14.4	14.4	14.4	14.4
Government net foreign transfers	E*NTRG	12.2	8.8	10.1	9.3	72.7	64.8	7.1	6.5
Government consumption	P*CG	9.7	8.7	10.2	10.8	11.0	10.6	10.1	9.6
Government investment	P*IVG	16.6	14.2	15.2	14.7	14.3	13.9	13.5	13.1
Government transfers	GT	0.8	1.1	1.4	1.2	1.1	1.0	1.0	0.9
Government foreign interest payments	E*INFG	2.0	1.8	1.7	2.5	2.2	1.9	1.7	1.6
Government borrowing requirement	BRG	3.8	3.6	3.9	5.6	-58.4	-51.8	4.7	4.1

Source: Authors' merged-model simulations.

[113]The change in reserves makes up a constant share of GDP over the simulation period because of the combination of a constant incremental reserve-import ratio and the import demand specification, which maintains a constant nominal import-GDP ratio.

Table 12.10 Government finance for the merged-model simulations, 1995–2002

Variable	Symbol	Share of GDP (percentage)							
		1995	1996	1997	1998	1999	2000	2001	2002
Change in government domestic credit	DDCG	-1.4	-1.7	-2.0	1.2	1.2	0.4	-0.5	-1.3
Change in government net foreign debt	E*DNFDG	5.2	5.3	5.9	4.3	-59.6	-52.2	5.2	5.4
Government borrowing requirement	BRG	3.8	3.6	3.9	5.6	-58.4	-51.8	4.7	4.1

Source: Authors' merged-model simulations.

Table 12.11 Money supply for the merged-model simulations, 1995–2002

Variable	Symbol	Share of GDP (percentage)							
		1995	1996	1997	1998	1999	2000	2001	2002
Private domestic credit	DCP	14.7	13.7	17.0	17.0	17.0	17.8	19.5	21.8
Government domestic credit	DCG	-1.9	-2.9	-4.4	-2.6	-1.0	-0.5	-1.0	-2.1
Foreign exchange reserves	E*R	14.4	17.3	28.8	27.0	25.5	24.1	22.9	21.8
Money supply	MS	27.3	28.0	41.5	41.5	41.5	41.5	41.5	41.5

Source: Authors' static CGE-model simulations.

from the expected debt reduction inside the HIPC initiative. Overall, the developments of the different parts of the government budget implied that the government share of GDP would be reduced to 24 percent in 2002.

Overall, the relatively moderate growth in investment expenditures implied that the government borrowing requirement would increase only slightly, to 4.1 percent of GDP in 2002. Data on the financing of the required government borrowings indicated that foreign borrowing would remain important (Table 12.10). Assuming that the government would have had access to foreign loans amounting to 200 percent of the increase in exports earnings, the government would have to rely only marginally on domestic sources of finance during 1998–2000, and would be able to support the domestic capital market in 2002. Altogether, nominal domestic credit to the government was expected to remain virtually unchanged between 1997 and 2002, thus making allowances for the large concurrent expansion of private sector demand for domestic credit.

The banking sector's balance sheet, including the central bank, shows that the money supply was set to grow at the same pace as nominal GDP (Table 12.11). Nevertheless, domestic credit to the economy was projected to expand strongly, implying that government restraint would allow the private sector to expand domestic borrowing quickly.

Pessimistic Scenario

The parameter values for the pessimistic scenario (Table 12.12) are similar to those for the optimistic scenario (Table 12.2) for the years 1998–99. However, the pessimistic scenario incorporated a natural disaster in 2000, temporarily affecting structural characteristics. In general, such a disaster was expected to lower the aggregate propensity to save, to increase the depreciation rate of capital and the capital–output ratio, and to increase the ratio between nominal imports and GDP. It follows that the pessimistic scenario is based on the assumption that a natural disaster would encompass the destruction of economic infrastructure. This would increase the need for

Table 12.12 Parameter values for the pessimistic scenario in the merged-model simulations, 1998–2002

Parameter	Symbol	Value				
		1998	1999	2000	2001	2002
Private propensity to save	B	0.17	0.17	0.13	0.14	0.15
Ratio of ΔR to ΔM	D	0.42	0.42	0.00	0.00	0.00
Ratio of NFDG to XPI*X	G	11.00	5.88	2.25	2.40	2.50
Marginal effect of GDP on IV κ_0	0	0.14	0.14	0.26	0.19	0.14
Incremental capital-output ratio κ_1	1	2.00	2.00	-0.05	1.27	1.54
Constant in import function α_0	0	-1.15	-1.15	-0.85	-1.00	-1.15
GDP elasticity of imports α_1	1	1.00	1.00	1.00	1.00	1.00
RER elasticity of imports α_2	2	-1.00	-1.00	-1.00	-1.00	-1.00
Velocity	V	2.41	2.41	2.53	2.65	2.77

Source: Authors' merged-model simulations.

donor support to undertake investment projects for reconstruction purposes. Such reconstruction would be essential if the economy were to return quickly to the strong positive growth path that had characterized prior years. Overall, the pessimistic scenario is optimistic in the sense that it assumes that funds for reconstruction would be forthcoming.

The private savings rate was assumed to decline by approximately 25 percent. Savings rates were not envisioned to decline further because a natural disaster would primarily affect rural areas, where savings are low. Moreover, given that rural farmers are helped to re-establish themselves, savings rates should revert to more normal levels relatively quickly. The destruction of infrastructure was assumed to imply a 12 percent increase in the capital–output ratio, as well as an increase in the depreciation rate of capital to 12 percent. This indicates that the marginal effect of GDP on investment increases strongly, while the incremental capital–output ratio (κ_1) is virtually zero. Nevertheless, a quick return of a more normal depreciation rate and capital–output ratio implied that the investment function parameters would be close to initial levels in 2002.[114] The increase in the ratio between nominal imports and GDP is implemented through a lowering of the negative constant in the import function. The underlying need for emergency assistance was assumed to be limited to a couple of years, implying that the import level would return to normal in 2002.

Natural disaster also affects the financial side of the economy. While donor support was expected to be forthcoming, it was also assumed to remain short of what would be needed for relief and reconstruction purposes. It was therefore likely that additional borrowing over and above 200 percent of additional export earnings would be forthcoming. Assumed increases in foreign borrowing imply that the debt–export ratio would reach 250 percent in 2002.[115] In

[114]The depreciation rate of capital would be reduced to 9 percent in 2001 and to 7 percent in 2002, while the capital-output ratio would be reduced to 2.12 in 2001 and to 2.06 in 2002. The functional relationship between the depreciation rate of capital and the capital-output ratio, on the one hand, and the investment function parameters, on the other, is outlined in Jensen (1999).

[115]Additional borrowing will possibly be on beneficial terms, implying that the effective interest rate should be reduced in later years. However, this is not included in the current scenario.

addition, the stock of foreign exchange reserves was assumed to remain unchanged from 2000, implying that the private sector would be allowed additional access to domestic credit.[116] This is necessary because the velocity of money circulation was expected to start increasing by 5 percent per year from 2000. The increasing velocity follows from a gradual acceleration in the inflation rate, following reduced access to essential goods and the possible need to increase government revenue through the inflation tax. Overall, the pessimistic scenario includes the assessment that most real effects of a simulated natural disaster in 2000 could be overcome by 2002.

Closure of the model. In accordance with the optimistic scenario, government revenue was assumed to increase in line with nominal GDP, and government transfers to households were expected to increase with the GDP deflator. Net foreign transfers to the government (excluding transfers related to the HIPC initiative) were set to increase by 50 percent in 2000 and to remain at that level through 2001. This level of aid transfer was then reduced by 25 percent given donations for emergency and reconstruction purposes were assumed to be phased out in 2002. While aid inflows into the NGO sector were projected to increase strongly—by 50 percent—in 2000 as part of the relief operations, the increased inflows were assumed to be phased out by consecutive 20 percent declines during 2001–02.

Acceleration in the inflation rate is also, as mentioned above, included in the pessimistic scenario. A non-accommodating exchange rate, projected to reach 11 percent in 2002, implies a terms-of-trade loss with negative repercussions on the purchasing power of export earnings and foreign aid inflows.[117] The real appreciations do benefit the private household sector, where imports become cheaper. The positive effects on real imports, are, however, dwarfed by the heavy inflows of relief supplies and investment goods.

Exports were assumed to rebound after a minor decline despite recurring terms-of-trade losses. While exports were projected to suffer a minor setback of around 2 percent in 2000, growth was projected to rebound 2002, with a real growth rate of around 14 percent. GDP growth was projected to suffer a much more serious initial decline of around 10 percent in 2000. The simulated natural disaster was expected to lower agricultural GDP by a third and industry GDP by 9 percent but to leave GDP in the service sector unchanged. Nevertheless, GDP growth rates were projected to rebound and reach 14 and 12 percent, respectively, in the following two years.[118] The large projects were not expected to be affected by the natural disaster. The impact of the enclaves on the domestic economy, therefore, was expected to remain unchanged compared with the optimistic scenario.

Simulations for the goods market. The simulations for the real side of the economy in Table 12.13 show that simulations for the years 1998–99 are similar to the optimistic simulations. However, after the natural

[116]The level of foreign currency reserves is relatively high compared with government objectives. Accordingly, reserves could possibly be lowered to help in financing emergency and reconstruction expenditures. However, the current scenario shows that fixed foreign exchange reserves also reduce the reserve-import ratio strongly. Initial reductions should be followed by subsequent increases, implying that the reserve stock can be used for temporary financing purposes only.

[117]The terms-of-trade loss can conceivably come about because the real exchange rate may be overvalued, as already argued in Chapter 4. The GDP deflator was assumed to increase by 10 percent and 15 percent, respectively during 2000 and 2001, while the exchange rate was assumed to depreciate by 5 and 8 percent, respectively.

[118]For comparative purposes, it can be noted that the impact on GDP is more severe than the impact of the drought in 1992, while the rebound is of the same relative order of magnitude.

disaster in 2000, final demand—including consumption, investment, and exports—would drop precipitously, while imports would increase strongly because of the inflow of relief supplies. The decline in the marginal propensity to save moderates the decline in private consumption at the expense of private investment, which decreases by around 12 percent. The government was also assumed to change priorities away from investment toward consumption. Government investment was projected to decline by 6 percent while increases in both inflows and foreign borrowing indicate that government consumption should expand considerably—by 30 percent. This implies, together with a 45 percent expansion in real NGO expenditures, that overall consumption would expand slightly.

The real expansion of total consumption may seem counterintuitive. However, the assumption that the natural disaster affects only parts of Mozambique implies that strong regional differences would likely arise. Consumption would most likely continue to expand in unaffected regions, while government and NGO consumption would have to replace private consumption in affected areas. The natural disaster would generally lower investment and private investment in particular. Declining economic activity combined with households using savings in affected areas and a shift in government priorities imply that economywide savings and investment would deteriorate markedly.

Following the initial impact of the relief operations, NGO expenditures were projected to return to normal levels in 2002. Moreover, a strong expansion of government investment in 2001 would re-establish economic infrastructure and lead to a reduction in the relatively high capital–output ratio. Subsequently, government investment would return to normal levels in 2002. Private investment would quickly return to high growth rates, although at a lower level than in the optimistic scenario. The lower private investment seems incompatible with the strong rebound in GDP. However, this period can be interpreted as a grace period where high government investment in infrastructure enables the private sector to take advantage of spare production capacity. Both relief supplies and the reconstruction

Table 12.13 Growth in material balance for the merged-model simulations, 1995–2002

		Growth rate (percentage)							
Variable	**Symbol**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Consumption	C	-4.0	3.6	8.8	9.4	8.7	0.8	6.4	10.2
Private	CP	24.7	4.3	6.8	9.0	8.9	-4.7	12.5	10.1
Government	CG	-51.1	-4.2	34.2	15.6	9.5	30.2	-17.5	17.7
Nongovernmental organization	CN	-75.3	10.9	-11.1	-2.9	-2.9	45.1	-24.8	-25.9
Investment	IV	21.0	-10.2	11.7	7.5	9.0	-8.9	21.9	-0.3
Private	IVP	73.1	-12.1	2.7	9.2	12.2	-11.7	10.4	11.8
Government	IVG	-10.5	-8.0	21.8	6.0	6.0	-6.0	33.0	-10.0
Exports	X	20.8	19.4	-2.0	12.2	12.7	-1.9	9.8	13.6
Imports	M	3.0	-7.6	-3.3	9.3	9.3	22.9	1.6	0.9
GDP	GDP	4.3	7.1	12.5	9.4	9.3	-10.5	14.1	11.6
Consumption, including large projects	CTOT	-4.0	3.6	8.8	10.5	8.9	0.8	5.9	10.1
Investment, including large projects	IVTOT	21.0	-10.2	11.7	54.9	15.3	-12.5	-16.3	-0.3
Exports, including large projects	XTOT	20.8	19.4	-2.0	23.5	14.4	9.0	55.1	6.7
Imports, including large projects	MTOT	3.0	-7.6	-3.3	54.4	15.2	12.0	-10.1	0.3
GDP, including large projects	GDPTOT	4.3	7.1	12.5	11.8	9.8	-9.7	16.5	10.6

Source: Authors' merged-model simulations.

of destroyed infrastructure were expected to be supported by increased imports.

Growth was expected to be driven by the rebound in agriculture in 2001, while it would be balanced at more normal levels in 2002. The seemingly strong rebound projected for 2001 was not expected to push agricultural GDP above 1998 levels (Table 12.14). Even this kind of rebound would depend strongly on the actions of NGOs and the government. Because of low agricultural export shares, total exports (Table 12.5) were expected to experience only a moderate decline in 2000, before returning to normal levels in 2002. It follows that total export growth would also return to normal in 2002. The impact of large projects is the same as for the optimistic scenario, reflecting the assumption that the disaster would not affect the enclave projects.

Simulations for prices. The data on prices (Table 12.16) indicate that the GDP deflator and the exchange rate would start to diverge from the optimistic scenario in 2000. Accordingly, the disaster would have sparked an inflationary process because of increased demand pressure and the possible need to collect domestic revenues through

Table 12.14 Growth in sectoral GDP for the merged-model simulations, 1995–2002

		Growth rate (percentage)							
Variable	**Symbol**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Agriculture GDP	AGDP	16.9	10.9	7.0	8.0	7.0	-35.0	40.0	15.0
Industry GDP	IGDP	10.0	12.7	22.2	12.0	13.0	0.0	8.7	13.0
Service GDP	SGDP	-4.4	2.3	11.9	9.0	9.0	0.0	6.0	9.0
GDP	GDP	4.3	7.1	12.5	9.4	9.3	-10.5	14.1	11.6

Source: Authors' merged-model simulations.

Table 12.15 Growth in sectoral exports for the merged-model simulations, 1995–2002

		Growth rate (percentage)							
Variable	**Symbol**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Agriculture exports	AX	56.2	-7.7	150.9	10.0	10.0	-20.0	20.0	15.0
Industry exports	IX	9.4	31.9	-10.3	14.0	15.0	0.0	10.7	16.0
Service exports	SX	29.1	11.7	-5.8	11.0	11.0	0.0	7.3	11.0
Exports	X	20.8	19.4	-2.0	12.2	12.7	-1.9	9.8	13.6

Source: Authors' merged-model simulations.

Table 12.16 Price inflation for the merged-model simulations, 1995–2002

		Growth rate (percentage)							
Variable	**Symbol**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Absorption price	P	51.0	40.3	7.4	5.1	5.1	8.5	14.8	19.9
GDP deflator	PD	51.9	40.9	8.8	5.0	5.0	10.0	15.0	20.0
Export price	XPI	21.0	0.7	1.4	3.0	3.0	3.0	3.0	3.0
Import price	MPI	5.0	5.3	-0.9	3.0	3.0	3.0	3.0	3.0
Exchange rate	E	50.2	25.3	2.3	2.0	2.0	5.0	8.0	11.0

Source: Authors' merged-model simulations.

the inflation tax. The acceleration in domestic inflation was assumed to outpace the acceleration in the depreciation rate of the metical, leading to an appreciation in the exchange rate. This would benefit the private sector in relative terms, since imported goods would become relatively cheaper. In contrast, the government and NGO sectors, which rely strongly on foreign transfers and foreign borrowing, would be hurt by worsening terms of trade.

Simulations for the balance of payments. The simulations for the balance of payments again indicate that developments would diverge from the optimistic scenario only after the impact of the natural disaster in 2000 (Tables 12.17 and 12.18). The disaster was expected to negatively affect the trade balance considerably during 2000–01 because of imports of essential relief supplies and investment goods, and subdued exports. The widening deficit in the trade balance was expected to be financed partly by increasing transfers to the government and NGOs, but the data on the current account of the balance of payments show that the government would have to supplement the increased aid inflows with foreign borrowing and stop accumulating foreign exchange reserves (Table 12.18). The figures on resource balance, net factor service income, net transfers, and current account balance—all including enclaves—again show that the large projects were assumed to be unaffected by the natural disaster (Table 12.17).

Simulations for the government and financial accounts. The combined recurrent and investment budget of the government (Table 12.19) indicates that the government budget would clearly be focused on consumption for relief purposes in 2000, while the focus would turn to investment in the reconstruction of economic infrastructure in

Table 12.17 Current account of the balance of payments for the merged-simulations, 1995–2002

		Growth rate (percentage)							
Variable	**Symbol**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Resource balance	RESBAL	-29.9	-20.6	-15.9	-15.5	-15.0	-24.8	-20.1	-15.5
Export	X	18.8	18.8	15.6	16.0	16.5	17.8	16.6	16.1
Import	M	48.7	39.4	31.6	31.6	31.6	42.6	36.7	31.6
Net factor service income	NETFSY	-5.6	-4.4	-1.2	-1.7	-1.7	-2.6	-2.6	-2.5
Net factor payments	NFP	2.0	1.9	1.5	1.3	1.2	1.2	1.0	0.8
Private foreign interest payments	INFP	5.6	4.5	1.0	0.5	0.7	1.6	1.5	1.4
Government foreign interest payments	INFG	2.0	1.8	1.7	2.5	2.2	2.2	2.1	1.9
Net transfers	NTR	15.4	12.1	12.7	11.6	74.6	85.4	13.5	8.5
Private net transfers	NTRP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Government net transfers	NTRG	12.2	8.8	10.1	9.3	72.6	82.2	11.4	7.1
Nongovernmental organization net transfers	NTRNGO	3.2	3.3	2.6	2.3	2.0	3.3	2.1	1.4
Current account balance	CURBAL	-20.1	-12.8	-4.5	-5.6	57.9	58.0	-9.2	-9.5
Resource balance, including enclaves	RESBALENC	-29.9	-20.6	-15.9	-26.4	-27.8	-34.5	-14.2	-10.7
Net factor service income, including enclaves	NETFSYENC	-5.6	-4.4	-1.2	-2.8	-3.1	-4.8	-7.3	-6.4
Net transfers, including enclaves	NTRENC	15.4	12.1	12.7	23.7	87.2	95.3	12.8	8.1
Current account balance, including enclaves	CURBALENC	-20.1	-12.8	-4.5	-5.5	56.3	56.0	-8.7	-9.0

Source: Authors' merged-model simulations.

Table 12.18 Capital account of the balance of payments for the merged-model simulations, 1995–2002

Variable	Symbol	Share of GDP (percentage)							
		1995	1996	1997	1998	1999	2000	2001	2002
Current account balance	CURBAL	-20.1	-12.8	-4.5	-5.6	57.9	58.0	-9.2	-9.5
Change in private net foreign debt	DNFDP	19.4	12.8	13.0	2.8	3.1	5.5	2.4	2.2
Change in government net foreign debt	DNFDG	5.2	5.3	5.9	4.3	-59.5	-63.5	6.8	7.2
Change in foreign exchange reserves	DR	4.4	5.3	14.4	1.5	1.5	0.0	0.0	0.0

Source: Authors' merged-model simulations.

Table 12.19 Government budget for the merged-model simulations, 1995–2002

Variable	Symbol	Share of GDP (percentage)							
		1995	1996	1997	1998	1999	2000	2001	2002
Government tax revenue	TG	13.1	13.4	14.4	14.4	14.4	14.4	14.4	14.4
Government net foreign transfers	E*NTRG	12.2	8.8	10.1	9.3	72.6	82.2	11.4	7.1
Government consumption	P*CG	9.7	8.7	10.2	10.8	10.8	15.5	11.2	11.8
Government investment	P*IVG	16.6	14.2	15.2	14.7	14.3	14.8	17.3	13.9
Government transfers	GT	0.8	1.1	1.4	1.2	1.1	1.3	1.1	1.0
Government foreign interest payments	E*INFG	2.0	1.8	1.7	2.5	2.2	2.2	2.1	1.9
Government borrowing requirement	BRG	3.8	3.6	3.9	5.6	-58.5	-62.8	5.9	7.1

Source: Authors' merged-model simulations.

Table 12.20 Government finance for the merged-model simulations, 1995–2002

Variable	Symbol	Share of GDP (percentage)							
		1995	1996	1997	1998	1999	2000	2001	2002
Government domestic credit	DDCG	-1.4	-1.7	-2.0	1.3	1.0	0.7	-0.9	-0.1
Government net foreign debt	E*DNFDG	5.2	5.3	5.9	4.3	-59.5	-63.5	6.8	7.2
Government borrowing requirement	BRG	3.8	3.6	3.9	5.6	-58.5	-62.8	5.9	7.1

Source: Authors' merged-model simulations.

2001. Clearly, the projected government budget in 2002 reflects the longer–term trends for the convergence of the consumption and investment shares. The foreign interest payments would not decline as fast as envisioned in the optimistic scenario because of increased foreign borrowing. However, this scenario indicates that the increased interest payments from the additional debt burden could be manageable.

The projected financing of the increasing requirement in government borrowing indicates that the government could manage a natural disaster without putting unnecessary pressure on the domestic credit market (Table 12.20). Increasing aid inflows and use of foreign borrowing would allow the government to limit changes in domestic credit to the government to less than 1 percent of GDP. In terms of the money supply (Table 12.21), private domestic credit would drop strongly in response to the disaster. A decision to put a lid on any further accumulation of foreign exchange reserves, combined with restrained use of the credit market by the government, would allow the private sector to subsequently expand domestic credit even in the face of inflation-

Table 12.21 Money supply for the merged-model simulations, 1995–2002

Variable	Symbol	Year							
		1995	1996	1997	1998	1999	2000	2001	2002
Private domestic credit	DCP	14.7	13.7	17.0	17.0	17.2	12.8	16.7	18.7
Government domestic credit	DCG	-1.9	-2.9	-4.4	-2.5	-1.3	-0.5	-1.3	-1.1
Foreign exchange reserves	E*R	14.4	17.3	28.8	27.0	25.5	27.2	22.4	18.5
Money supply	MS	27.3	28.0	41.5	41.5	41.5	39.5	37.7	36.1

Source: Authors' merged-model simulations.

induced increases in the velocity of money circulation.

Conclusions

The optimistic scenario developed in this chapter shows that the continuation of the positive GDP growth path after economic stabilization was achieved had to be accompanied by high investment growth. Since government investment expenditures were projected to remain somewhat subdued because of revenue constraints, private investment would have to bear the brunt of promoting growth. Nevertheless, the private sector budget was growing slower than GDP because of the virtual standstill in remittances from mine workers in South Africa and the assumption that government transfers would remain constant in real terms. In spite of relatively modest interest payments, it follows that private consumption growth would have undercut real GDP growth during 1998–99. In spite of higher GDP growth rates, which were projected to begin to significantly affect gross private income during 2000–02, high foreign interest payments would have halted the expansion of disposable income. The private consumption share of GDP would be expected, therefore, to continue to fall throughout the simulation period. Moreover, this would give the government room to pursue an effective pro-development expansion of recurrent expenditures during these years.

Nevertheless, the government budget share of GDP was expected to decline as growth started to pick up because of budget constraints on the revenue side. Given that any major breakthrough on domestic revenue collection was not forthcoming, the relative development of the government budget was expected to be closely related to decisions of donor countries on aid allocations. An annual growth rate of 3 percent in terms of U.S. dollars would have reduced the relative importance of this government revenue item, and brought down aid dependency significantly. It would however, also have reduced relative investment allocations inside the government budget. Aid inflows were expected to represent the major financing component of government investment expenditures. Nevertheless, investment expenditures directed toward construction of physical and social infrastructure would continue to make up a large share of a significantly enlarged pie. On the financing side, debt reduction inside the HIPC initiative and continued access to overseas financial markets would enable the government to avoid exerting pressure on domestic capital markets.

The pessimistic scenario moderates the optimistic scenario in the sense that it incorporates a natural disaster in 2000. Such a disaster would temporarily affect most of the structural characteristics of the model. In the initial disaster year, an induced temporary decline in the aggregate savings rate would be partly compensated for by

increased aid inflows and foreign borrowing. Aggregate consumption could presumably be maintained at a reasonable level, since unaffected areas would continue to consume more. Strongly decreasing consumption in affected areas would be replaced partly by increasing government and NGO expenditures, supported by increased imports of relief supplies. Investment in general and private investment in particular would decline significantly to release resources for the emergency operation.

In the subsequent year, 2001, priorities were projected to change in favor of a reconstruction operation that would re-establish destroyed economic infrastructure. Continuing high donor support and further increases in foreign borrowing would be vital to such government investment expansion. Depending on the support of the government and NGOs, the heavily affected agricultural sector was projected to experience a significant rebound that would drive growth in 2001. Private consumption and investment were projected to rebound as well. Nevertheless, the reconstruction of economic infrastructure would allow for a grace period, where private investment growth would be lower than GDP growth. Accordingly, producers would be able to expand capacity utilization without further investment. Finally, the reconstruction effort was projected to bring the economy back to its initial positive growth path in the final year of the simulation period (2002).

Among the more persistent effects of the pessimistic scenario, the natural disaster was projected to spark an inflationary process, gradually worsening the external terms-of-trade. This would affect the government and NGOs negatively, since they depend strongly on foreign capital inflows for financing purposes. In contrast, the real appreciation would benefit the private sector, since imports would become relatively cheaper. Another persistent effect of the pessimistic scenario is that the government would increasingly have to resort to increased foreign borrowing. Nevertheless, given that the HIPC initiative was successfully carried through, the current scenario indicates that the additional interest payments would be sustainable if the economy quickly returned to its previous positive growth path. Nevertheless, the pessimistic scenario also indicates that this would require a decisive move by donors to support a large-scale relief and reconstruction operation.

CHAPTER 13

A Standard World Bank–IMF Simulation Framework with CGE Features

The merged model presented in Chapter 12 leaves much to be desired. Bringing the IMF's financial programming and World Bank's RMSM modeling approaches together entails the explicit inclusion of price indices for domestic and traded goods, but trajectories for the price indices are exogenously specified. There are no explicit links among projected economic growth, factor supplies, and total factor productivity; and no attempt is made to relate behavioral relationships or exogenously specified outcomes to decisions made by optimizing agents. Finally, distributional issues cannot be addressed. In contrast, these issues are central in the context of CGE models.

This chapter addresses the shortcomings of the merged model by integrating the CGE methodology with the World Bank and IMF approaches.[119] Thus, a combined SAM framework is established to form the basis of an integrated, dynamic CGE model with a financial sector. All variables are defined in Appendix C.

A Comprehensive SAM Framework

The structure of the static Mozambican CGE model formulated in Chapter 6 is based on the accounting framework summarized by the macroeconomic SAM in Table 5.2. This SAM has some dimensions that are particularly useful in relation to data handling for CGE models. The distinction between activities and commodities in the market for goods and services enables the production and retail levels in the marketing chain to be kept separate, and information on the specific structure of the "use" matrix of intermediate inputs and the "make" matrix of marketed domestic production to be retained.

The distinction between activities and commodities is also useful for other reasons. First, it enables accounts to be kept separately for domestic sectoral production, including production specific taxes, and for overall sectoral supplies, including other indirect taxes at the retail level. Second, it makes it possible to retain sector-specific information on the costs associated with marketing goods in a way that highlights that the costs constitute a wedge between producer and consumer prices. Third, it is a convenient way to keep separate account of sectoral

This chapter was written by Henning Tarp Jensen, and Finn Tarp.

[119]There are various examples of recursively linked frameworks between RMSM and the 1-2-3 model, including in particular those used by the World Bank and the IMF. For some examples, go to the World Bank's Website, http://www-wds.worldbank.org.

imports and the sectoral use of intermediate inputs. Imports are included among the supply of goods in the commodity account columns, while production activities demand intermediate inputs from the commodity account rows. A final reason for distinguishing between activity and commodity accounts is that it makes it possible to keep separate information on home consumption of own production and consumption of marketed goods.

Detailed accounts for the income flow from production factors to enterprises and households are another dimension of the SAM framework that handles data, which is especially useful for the CGE model. The standard CGE model is based on a set of production functions that functionally relate sectoral production to sectoral inputs of production factors. Several factors of production are typically included because factor intensities differ between production sectors. A standard CGE model also embodies optimizing agents that make sectoral production decisions on the basis of sectoral profit opportunities, and the model explicitly accounts for the sectoral distribution of production factors.

Because of the sectoral differences in factor intensities, relative factor prices change with sectoral production opportunities. Changes in relative factor prices are important to capture. They imply changes in the factorial distribution of income. Moreover, households differ in their relative supplies of factors, so changes in relative factor prices affect the distribution of household income. Finally, expenditure patterns also differ among households, so careful modeling of the income flow from production activities to households is important. Overall, separate factor, enterprise, and household accounts are important in the CGE-model framework. They form the basis for modeling the household income flow.

While the distinction between activities and commodities in the goods market and detailed information on the household income flow are useful for the CGE modeling approach, these features are not so important in standard macroeconomic models. Typically, they do not rely on the sectoral detail available in the use and make matrices of the SAM framework.[120] Moreover, attention is generally not paid to differential treatment of taxes, and marketing margins and home consumption of own production is not accounted for. Macroeconomic models typically operate with aggregate income numbers, where value-added, at market prices, is distributed directly among aggregate private and government sectors. Factor, enterprise, and household accounts do not need to be kept separately in the SAM framework for a standard macroeconomic model, which cannot be used for distributional analyses.

The above-mentioned distinguishing features of macroeconomic models are also characteristic of the merged model. In particular, the merged model relies on an aggregate resource balance, so this model operates with only one goods account. This shows that the activity and commodity accounts from the CGE-model framework correspond to a single aggregate goods account in the merged-model framework. In addition, the merged model distributes exogenously imposed income directly to the government and an aggregate private sector. The factor, enterprise, and household accounts from the CGE-model framework correspond to a single account for the private sector in the merged-model framework. Apart from these aggregate accounts, the dimensions of the real side of the merged model presented in a SAM

[120]As is clear from Chapter 12, the merged model does include some sectoral detail in relation to the specification of sectoral growth paths for real GDP and exports. However, such information does not rely on the distinction between activity and commodity accounts in the SAM framework.

Table 13.1 Real side of the merged model

Receipts		Expenditures							
		1.	2.	3.	4.	5.	6.	7.	8.
		Production sector	Private recurrent	Government recurrent	Government investment	NGO	Private investment	Rest of the world	Total
1.	Production sector		Private consumption	Government consumption	Government investment	NGO consumption	Non-government investment	Exports (FOB)	Final demand
2.	Private recurrent	Value-added at market price		Government transfers				Net transfers by workers	Private income
3.	Government recurrent		Direct and indirect taxes						Government Recurrent Receipts
4.	Government investment							Aid in government budget	Government aid receipts
5.	NGO							Aid in NGO budget	NGO aid receipts
6.	Private investment		Private gross savings	Government gross savings	Government investment budget deficit			Net capital inflow	Total savings
7.	Rest of the world	Imports (CIF)							Imports
8.	Total	Supply for final demand	Private income allocated	Government recurrent expenditure	Government investment	NGO expenditure	Private investment	Foreign exchange available	

Source: Authors' merged model.
Note: NGO means nongovernmental organization; FOB means free on board; and CIF means cost, insurance, and freight.

framework (Table 13.2) correspond closely to the dimensions of the CGE-model framework for the MACSAM (Table 5.2).

To arrive at a complete SAM framework for the merged model, the real-side SAM has to be supplemented with a financial-side SAM (Table 13.2). The financial sector of the merged model presented in a SAM framework can be summarized in terms of five categorized accounts: domestic capital market, foreign capital market, private investment, government investment, and savings-investment balance. While the savings–investment balance actually derives from the combined private and government investment accounts from the real-side SAM, the remaining four accounts are necessary to ensure consistency between savings, investment, and financial flows.

The private and government investment accounts ensure that sectoral imbalances between savings and investment are financed by borrowing in the foreign capital market or the domestic money market. In addition, the domestic money market and foreign capital market accounts ensure that private and government borrowing from domestic and foreign sources are consistent with changes in the money stock and the

balance of payments.[121] All domestic financial liabilities are therefore included into the broad money stock concept that forms part of the model. The domestic money market account (Table 13.2) indicates how this concept of broad money relates to the expansion of domestic credit and foreign exchange reserves.

The discussion above shows how the Mozambican static CGE model and the merged model are related. The real SAM underlying the CGE model can be reduced to correspond to the real side of the merged model and hence can be linked to the SAM for the financial side of the merged model. In sum, the combined SAM framework consisting of the real-side SAM (Table 5.2) and the financial-side SAM (Table 13.2), makes up a comprehensive set of SAMs for the two models.

The Integrated Model

In the merged model, the real-side variable relationships indicate that the difference between private income and expenditures is made up of net private savings (*SP*) and private foreign interest payments (*INFP*) (Table 13.3). Foreign interest payments are subtracted from gross savings to arrive at the net savings that enter the financial-side variable relationships (Table 13.4). The

Table 13.2 Financial side of the merged model

Receipts		Expenditures					
		1.	2.	3.	4.	5.	6.
		Domestic money market	Foreign capital market	Private investment	Government investment	Savings-investment balance	Total
1.	Domestic money market			Change in broad money			Change in money demand
2.	Foreign capital market	Change in foreign exchange reserves				Current account deficit	Change in foreign assets
3.	Private investment	Change in private domestic credit	Change in the private foreign debt plus revolution of foreign exchange reserves			Private savings	Demand for private assets
4.	Government investment	Change in government domestic credit	Change in the government foreign debt			Government savings plus net foreign transfers	Demand for government assets
5.	Savings–investment balance			Private investment expenditures	Government investment expenditures		Total investment
6.	Total	Change in money supply	Change in foreign liabilities	Supply of private assets	Supply of government assets	Total savings	

Source: Authors' merged model.

[121]The framework does not include any domestic capital market for longer-term domestic borrowing. This simplification is based on the observation that the Mozambican capital market is very thin.

same logic applies to the government investment account. Foreign interest payments do not explicitly enter the savings–investment balance in the financial sector of the merged model. In an accounting sense, they net out in the aggregation of the private and government investment accounts. Nevertheless, the foreign interest payments are accounted for implicitly in the current account (CURBAL).

The definitional relationship between increasing broad money (*MD*) and increasing domestic credit (*DCP* and *DCG*) and foreign exchange reserves (*E*R*) follows from the domestic money market account. Since broad money is an asset of the private sector only, the model assigns all seigniorage to the government sector. Intersectoral interest payments between the private and government sectors in relation to domestic credit taking are not included in the model. The allocation of credit is not an issue at the current level of aggregation in the merged model.[122] This is because the government has privatized all commercial banking activities and because the government takes little domestic credit.

The sources of broad money expansion also include the accumulation of foreign exchange reserves. The domestic currency value of reserves can change either from the building-up of foreign currency reserves

Table 13.3 Real-side variables in the merged model

Receipts		Expenditures							
		1.	2.	3.	4.	5.	6.	7.	8.
		Production sector	Private recurrent	Government recurrent	Government investment	NGO	Capital	Rest of the world	Total
1.	Production		P*CP	P*CG	P*IVG	P*CN	P*IVP	E*XPI*X	Net commodity demand
2.	Private sector	GDP		GT				E*(NFP+ NTRP)	Private income
3.	Government recurrent		TG						Government recurrent receipts
4.	Government investment							E*(NTRG– INFG)	Government aid receipts
5.	NGO							E*NTRNGO	NGO aid receipts
6.	Capital		SP+E*IN FP	SG+ E*INFG	– BRG-SG – E*INFG			E*(–INFP– CURBAL)	Total savings
7.	Rest of the world	E*MPI*M							Imports
8.	Total	Net commodity supply	Private income allocated	Government recurrent expenditure	Government investment	NGO expenditure	Private investment	Foreign exchange available	

Source: Authors' merged-model.
Note: See Appendix C for definitions of variables. NGO means nongovernmental organization.

[122]Clearly, interest rates in both formal and informal markets are high and important for credit allocation between private sector agents in Mozambique. This issue disappears with an aggregate private sector.

Table 13.4 Financial-side variables in the merged model

Receipts		Expenditures					
		1.	2.	3.	4.	5.	6.
		Domestic money market	Foreign capital market	Private investment	Government investment	Savings–investment balance	Total
1.	Domestic money market			MD			Money demand
2.	Foreign capital market	(E*R)				–E*CURBAL	Demand for foreign currency
3.	Private investment	DCP	E*NFDP+ E*R(–1)			SP	Demand for private assets
4.	Government investment	DCG	E*NFDG			SG + E*NTRG	Demand for government assets
5.	Savings–investment balance			P*IVP	P*IVG		Total investment
6.	Total	Money supply	Supply of foreign currency	Supply of private assets	Supply of government assets	Total savings	

Source: Authors' merged-model.
Note: See Appendix C for definitions of variables. NGO means nongovernmental organization.

(R) or from changes in the exchange rate *(E)*. In the merged model, the revaluation of foreign exchange reserves is assumed to fall into the hands of the private sector. A depreciating exchange rate generates private income from this source. Together with private and government foreign borrowing (*NFDP* and *NFDG*), the revaluation of foreign exchange reserves help to finance the deficit on the balance of payments.

Because some of the accounts on the real side of the merged model map into multiple accounts in the SAM framework for the CGE model, problems might arise in relating the financial sector of the merged model to the real sector in the CGE model (Table 13.5). However, this does not represent a problem with the current models. The investment accounts in the merged-model framework (Table 13.3) and in the CGE-model framework (Table 13.5) are almost similar in dimensions. The aggregation into one private sector account implies that enterprise and household savings (*ENTSAV* and *HHSAV*) are aggregated into gross savings in the merged model. This in turn implies that an equation has to be added in the integration of the two models that defines private net savings as the difference between the sum of enterprise and household savings, and private interest payments.

Altogether, the two SAM frameworks also show that simple relationships exist among the financial sector variables from the merged model and the real sector variables in the CGE model. First, enterprise and household savings in the CGE model add up to net private savings plus private net foreign interest payments in the merged model. Second, recurrent government savings (*GRESAV*) in the CGE model represent gross government savings, and add up to net government savings plus government net foreign interest payments in the merged-model framework. Third, foreign aid inflows into the government budget

(*FAIDGIN*) in the CGE model are net of foreign interest payments, so this flow amounts to the difference between net unrequited transfers to the government (*NTRG*) and government net interest payments in the merged model. Fourth, the foreign savings inflow into the private investment account (*FSAV*) in the CGE model is net of interest payments and therefore adds up to the difference between the current account deficit (*-CURBAL*) and private net foreign interest payments in the merged model. Fifth, the deficit on the government investment budget (*-GINSAV*) in the CGE model maps into the difference between the overall government borrowing requirement (*BRG*) and gross savings on the recurrent budget.

Four of the five relationships between variables in the investment accounts of the CGE model and the merged model outlined above are fundamental for the integration of the two models. The government borrowing requirement does not need to be defined explicitly in the integrated model, but two other relationships do need to be established between variables in the merged model and the CGE model: foreign aid inflows into the NGO budget (*FAIDNGO*) in the CGE model are equivalent to net transfers to NGOs (*NTRNGO*) in the merged model; and remittances (*REMIT*) in the CGE model are equivalent to net factor payments (*NFP*) in the merged model. Net transfers to privates (*NTRP*) are zero throughout the base years and the simulation period. In sum, six relationships among variables in the CGE and merged model need to be established to integrate the financial sector from the merged model with the real sector from the CGE model.

Once these six relationships have been established, they are supplemented by four equations to ensure that the accounting identities included in the SAM financial framework are fulfilled (Table 13.4). Accordingly, borrowing in the domestic money market and in the foreign capital market is consistent with the money stock and the balance of payments. Moreover, imbalances between savings and investment are financed both in the private and government sectors. The accounting identity defining the savings–investment balance in the merged model does not need to be included, since it amounts to the sum of the private and government investment accounts in the CGE model.

In addition to the 10 consistency relationships already defined, the financial sector of the integrated model is characterized by 5 more relationships. Two of these relationships define private and government foreign interest payments from their net foreign debt in the previous period. Finally, 3 technical and behavioral relationships close the model. The first defines the government net foreign debt as a fixed share of export earnings. This is a technical relationship that allows the analyst to implement the assumed impact of the HIPC initiative in a simple way.[123] The second behavioral relationship defines the accumulation of foreign exchange reserves as a linear function of changes in import expenditures. This specification tracks government objectives regarding the level of foreign exchange reserves.[124] The third behavioral relationship defines the demand for money from a simple quantity equation specification. Altogether, 15 equations are needed to integrate the financial sector of the merged model with the CGE model.

Simulations with the merged model are driven by exogenously specified growth paths for GDP and exports without

[123]At the time of writing, the HIPC initiative was assumed to reduce the government net foreign debt to 200 percent of aggregate export earnings in mid-1999.

[124]The government objective is to maintain foreign exchange reserves at a level that can finance five months of additional imports.

Table 13.5 CGE-model variables

Receipts		Expenditures											
		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12
		Activities	Commodities	Factors	Enterprises	Households	Recurrent government	Indirect taxes	Government investment	NGO	Capital	Rest of the world	Total
1.	Activities		PDC * DC			PDCH * DCH							Total sales
2.	Commodities	PC * INT				PC * CD	PC * CG	–EXPTAX	PC * GI	PC * NGOD	PC * CI	PE * E	Total marketed commodities
3.	Factors	WF * FDSC											Value-added at factor cost
4.	Enterprises			$(1–TF_{cap})$*WF* $FDSC_{cap}$			GOVTE						Enterprise income
5.	Households			$(1–TF_{lab})$ *WF* $FDSC_{cap}$	DISTR		GOVTH					EXR* REMIT	Household income
6.	Recurrent government		CONTAX	FACTAX	ENTTAX	HHTAX	INDTAX +TARIFF +EXPTAX						Government recurrent receipts
7.	Indirect taxes	INDTAX	TARIFF										Tariffs plus output taxes
8.	Government investment											EXR *FAIDGIN	Government aid receipts
9.	NGO											EXR *FAIDNGO	NGO aid receipts
10.	Capital				ENTSAV	HHSAV	GRESAV		GINSAV			EXR * FSAV	Total savings
11.	Rest of the world		PM * M										Imports
12.	Total	Total payments	Total commodity supply	Value-added at factor cost	Enterprise expenditure	Household income allocated	Tax-financed government expenditure	Indirect tax receipts less export subsidies	Government investment	NGO consumption	Non-government investment	Foreign exchange available	

Source: Authors' static CGE-model simulations.

Notes: See Appendix C for definitions of variables. NGO means nongovernmental organization.

considering the accumulation of factor stocks and productivity change.[125] However, this is not the case in the static CGE model where GDP growth is driven by the accumulation of factor supplies and total factor productivity growth, while exports are determined by GDP growth and relative prices.

To turn the static CGE model into a dynamic model, it is therefore necessary to specify updating formulas for the factor supplies that drive growth. Simple updating formulas with fixed growth rates were included for the updating of labor supplies. In contrast, the updating formula for the capital stock was related to total investment expenditures in the previous period. This formulation implies that government and private investment are added to the capital stock (after depreciation), which is subsequently allocated among production activities. However, the formulation suffers from a problem with units. The factor supplies are defined in terms of value-added, while investment is defined in terms of ordinary expenditures. In the current context this problem was solved by scaling down the investment aggregates before adding them to the capital stock[126] The final step in the specification of the integrated model was to provide all variables in the CGE model with a time index.[127]

Data and Calibration

The integrated model defined in the previous section was based on a comprehensive SAM financial framework. The data needed for calibrating the integrated model can therefore be identified from this framework. However, a financial SAM with the dimensions given here will not provide enough information for model calibration (Table 13.3). No information is available, for example, on the levels of financial aggregates. This is important, since foreign interest payments depend on the level of foreign debt in the previous period. In addition, the level of government domestic credit typically acts as a key target variable when Bank–Fund models are used to make simulations. To capture all variables of the model, base-year data were therefore organized inside a spreadsheet.

The real sector of the integrated model resembles the original static Mozambican model in most respects. The 1995 real SAM presented in Chapter 5, which formed the basis for the static CGE model in Chapter 6, can also be used as a basis for the integrated model in combination with a financial sector data set. It was decided that the forecast horizon for the simulations should cover 1998–2002, since reliable national accounts and financial sector data were available up until 1997. However, the real sector of the integrated model requires detailed sectoral information that is only available from the 1995 SAM. It was therefore decided to calibrate the integrated model to a complete 1995 data set, consisting of the 1995 real sector SAM presented in Chapter 5 and a consistent set of financial sector data. The goods accounts were aggregated into four production activities including agriculture, industry, services, and marketing services, and three retail commodities including agriculture, industry, and services. The factor and household accounts were left unchanged.

---

[125]Note that the merged model has other dynamic elements, including the relationship between GDP and investment, as well as financial relationships defining foreign interest payments and the accumulation of domestic credit, foreign debt, and foreign exchange reserves. The dynamic financial relationships are also included into the integrated model.

[126]The scaling factor is equal to the returns to capital. In the current Mozambican context, returns to capital are assumed to be 20 percent. This is close to the estimate provided in Chapter 6.

[127]The full set of integrated model equations are in Jensen (1999).

The dynamic CGE model is "calibrated" by running the model forward to replicate the 1996–97 base-year data. The running-forward of the model means that the value of many parameters changes between 1995 and 1997. Nevertheless, one set of structural details does not change as part of the targeting exercise—the set that defines technologies used in production activities from sectoral use of intermediate inputs and factorial distribution of sectoral value-added in the 1995 SAM.[128] The SAM data set implies that production sectors differ significantly in their relative use of intermediate inputs and primary factors. At one extreme, agricultural production, which is dominated by smallholder farmers, stands out as an extremely labor-intensive sector that uses few intermediate inputs. At the other extreme, marketing service production is very capital-intensive with a reasonably high input cost share of total production value. While the industry and service sectors require more or less equal amounts of primary factor inputs, they are both characterized by high intermediate input cost shares—exceeding 50 percent of production values. Indirect tax rates (that is, production subsidy rates) are also kept constant during the running-forward of the model. They are, however, virtually nonexistent and therefore not important for model behavior.

Another set of parameters that does not change during the running-forward of the model is the factorial income distribution. This implies that the distribution of factor income among households differs significantly from factor to factor. The majority of value-added by agricultural labor flows toward rural households—mainly smallholder farmers—while urban households receive only slightly more than half of value-added by nonagricultural labor. Nevertheless, urban households receive the vast majority of value-added by capital.

The updating of the base-year data is important, since significant changes have occurred during 1995–97, especially in relation to the import side, but the domestic propensity to save and inflows of foreign capital have also changed considerably. The targeting exercise does not allow for the complete replication of all nominal and real values. The running-forward of the model allows for the replication of all nominal values in the merged-model simulations, as well as real values of GDP and trade aggregates, and foreign currency values of capital inflows. Real consumption and investment aggregates, however, are not targeted. While NGO and government consumption overshoots by around 6 percent in 1997, the other major aggregates remain within 2 percent of actual national account numbers. The targeting exercise relies mainly on data available from the data set underlying the merged-model simulations in Chapter 12. However, sectoral aggregates are also targeted where additional data on national accounts are available. This is important for the tracking of aggregates of sectoral trade and GDP of the marketing services sector.

The targeting of nominal and real aggregates over the base-year period 1996–97 implies that certain parameters must be allowed to change. The parameters of the model can be divided into those that have been previously estimated, and those that are calibrated on the basis of data and estimated parameters.[129] The estimated parameters include trade elasticities and minimum consumption levels. While trade elasticities remain fixed during the targeting exercise,

[128]The only parts of the production technologies that are allowed to change as part of the targeting exercise are the productivity parameters.

[129]The static CGE model underlying the integrated model is based on estimated trade elasticities and minimum consumption levels for the linear expenditure system. These parameters were estimated on a sample covering 1991–96, as discussed in Chapter 6.

the running forward of the integrated model implies that updating the LES parameters is important. Accordingly, the estimated minimum shares at the consumption level were applied to the 1996 household consumption patterns to update minimum consumption levels and marginal consumption shares. The 1996 minimum consumption levels were subsequently imposed on 1997.[130]

The point of departure is to target real GDP for each of the four production activities. This is accomplished by allowing the productivity parameters of the production functions to vary. Trade aggregates—that is, exports and imports—are also targeted for each of the three retail sectors by varying share parameters of the CET export transformation functions and of the CES import aggregation functions. Subsequently, foreign savings inflows clear the external account by targeting remittances by workers as well as foreign aid inflows into the government and NGO accounts. Since implicit world market prices for imports and exports as well as the exchange rate are also tracked, all domestic currency flows in the external account are also targeted.

With the nominal variables, the targeting of nominal sectoral GDP is attained by varying the velocity of money circulation and sectoral rates of marketing margins. Since three different types of marketing margin rates are associated with each sector, restrictions need to be imposed on the variation of the margin rates. It was decided that margin rates should vary proportionately sectorwise, while the flat structure of import margin rates should remain constant.[131]

Targeting of government tax revenue was achieved by changing factor, enterprise, and household income tax rates through the inclusion of a uniform additive tax rate increment.[132] Because government foreign interest payments are also targeted, government savings are tracked; private net savings are implicitly targeted through total private consumption. A uniform increment was added to the savings rate to ensure an equal spread across both households and enterprises.

With the financial sector variables, private and government foreign interest payments are targeted by varying the effective interest rates applied to the stock of foreign debt from the previous period. The remaining financial sector variables can be targeted by targeting the three variables that are determined through technical and behavioral specifications, including the money stock, foreign exchange reserves, and government net foreign debt. These variables are targeted by allowing the coefficients of their respective functional forms to vary.

Simulations

The integrated model differs from the merged model as a simulation tool. It includes general-equilibrium features, such as price-clearing of goods and factor markets. The merged model is generally used as a check the consistency of an assumed growth path in relation to private and government spending needs and the availability of financial resources. In addition to these kinds of consistency checks, the integrated model allows additional checks on implied

[130]This is necessary because no reliable household consumption pattern was available for 1997 at the time of writing.

[131]The targeting of nominal GDP through the targeting of real GDP and money demand is necessary in targeting nominal sectoral GDP for services. This is so since services are not subject to marketing costs by definition.

[132]The terms were only added to nonzero tax rates. Specifically, this implies that the factor tax rate on agricultural labor remains zero.

changes in relative prices, implicitly assumed sectoral growth in factor productivity, and implied changes in the distribution of income among households. It follows that the integrated model allows for other points of reflection in addition to traditional target variables, such as government domestic credit expansion.

As noted in the previous section, the integrated model has been calibrated to target the 1995–97 data set underlying the merged-model simulations. It follows that the initial values for the integrated-model simulations and the merged-model simulations are basically the same. Furthermore, the current simulations are based on the exogenously specified growth paths for several variables as part of the closure of the model. These growth paths are taken from the optimistic scenario included in the merged-model simulations, implying that the integrated-model simulations will mimic the merged-model simulations. The current integrated-model simulations can therefore be viewed as a consistency check on the optimistic scenario from the merged-model simulations. Parameter values are generally fixed over the simulation period at the calibrated values for the 1997 base year.[133]

The closure of the model implies that real and nominal GDP as well as nominal consumption and investment expenditures by the government are targeted at their respective growth paths in the merged model. Nominal GDP is targeted by tracking the growth path for the money stock in the merged model and keeping the velocity of money circulation constant. Furthermore, the model closure implies that foreign capital inflows in the form of foreign remittances to households, net foreign transfers to the government and NGOs, and foreign savings inflows are all targeted to their respective growth paths in the merged model. The model closure also needs to include a numeraire price index to determine the basic price level for each year. The targeting of both real and nominal GDP at their growth paths in the merged model implies that the GDP deflator acts as price numeraire for the current integrated-model simulations. Both the GDP deflator and world market prices were targeted at their growth paths in the merged model.

With the factor market, labor supplies are assumed to grow at a constant 2.7 percent per year, which is in line with expected population growth. In contrast, the supply of capital is updated from a specification based on a yearly depreciation rate of 6.7 percent and a rate of return to capital of 20 percent. Since the current simulations track the growth path for real GDP in the merged model, the average productivity in the production activities must be allowed to vary. This is achieved by including a multiplicative productivity parameter that restricts sectoral productivity levels to vary proportionately. Since aggregate real GDP grows at around 9 percent per year and the capital stock grow around 10 percent per year, average productivity growth must be around 4 percent per year. This conclusion is different from the merged-model simulations, where productivity growth was not seen as a precondition for such growth rates. The integrated model requires strong productivity growth, since it has to make up for a slowly growing labor supply.

Capital-intensity of production implies that industry and service sector GDP grow around 10–11 percent per year. This is qualitatively similar to the merged-model

[133]The only parameters that do not reflect 1997 base-period values are the parameters that relate accumulation of government net foreign debt and foreign exchange reserves to export and import growth, respectively. Government debt accumulation is assumed to amount to 200 percent of export growth, while reserve accumulation is assumed to amount to five months of additional imports.

simulations, since growth rates in industry sector rates are higher than growth rates in the service sector. However, the merged-model simulations envision higher growth in the industry sector and lower growth in the service sector. The current simulations therefore seem to imply that the merged-model growth paths for sectoral GDP are inconsistent with future developments in the factor markets.[134] On the other hand, the simulations may also be taken as evidence that factor productivity growth should not be varying proportionately over time. Agricultural sector GDP is reasonably close to the merged-model growth path, since factor productivity growth of around 4 percent and labor supply growth of around 3 percent add up to sectoral GDP growth of around 7 percent.

In general, the closure implies that most variables mimic the merged-model simulations closely. This is particularly the case for the government account, where the overall government budget, including tax revenues, is tracked closely. The integrated-model simulations for imports and exports also remain very close to the merged-model growth paths. They only differ somewhat from the merged-model simulations because of a small depreciation in the real exchange rate of around 1 percent per year. Finally, because of the technical and behavioral relationships relating the accumulation of government foreign debt and foreign exchange reserves to export and import growth, simulations for foreign debt and domestic credit aggregates as well as other items of the balance of payments develop in a very similar way as well.[135] Having established that the two sets of simulations are comparable, the discussion now turns to relative prices and the distribution of income between households.

The relative price developments are needed, according to the current integrated-model simulations, to support the optimistic scenario of the merged-model simulations (Table 13.6). Agricultural price indices

Table 13.6 Price inflation for the integrated-model simulations, 1998–2002

	Growth rate (percentage)				
Prices	**1998**	**1999**	**2000**	**2001**	**2002**
Producer prices					
Agriculture	9.6	8.1	8.1	8.2	8.3
Industry	4.1	4.4	4.3	4.2	4.2
Ordinary services	4.4	4.6	4.4	4.3	4.3
Marketing services	2.8	3.5	3.4	3.3	3.3
Consumer prices					
Agriculture	6.8	6.3	6.3	6.4	6.5
Industry	4.2	4.6	4.6	4.6	4.6
Ordinary services	4.5	4.7	4.6	4.5	4.5
Exchange rate	2.5	2.8	3.0	3.1	3.1

Source: Authors' integrated-model simulations.

[134]Note that the factor markets are not explicitly included in the merged-model framework. However, they are supposed to be taken into account implicitly by the modeler.

[135]For computational reasons, the expected debt relief in mid-1999 is not included in the current integrated-model simulations. However, since effective interest rates have been changed comparably, this does not have any major impact on the comparability with the merged-model simulations. The government is still assumed to be able to borrow what amounts to 200 percent of additional export earnings each year.

generally increase faster than goods prices in other sectors. While agricultural producer prices increase twice as fast as industry and service sector prices, moderate price increases in the marketing service sector imply that agricultural consumer prices increase at a more moderate pace. Nevertheless, they still increase considerably faster than other prices. The strong agricultural price increase follows from increasing demand pressures combined with moderate expansions of agricultural goods supply. While imports of agricultural goods increase fast, they only constitute a fraction of total supply. Thus, domestic supply of agricultural products is constrained by the moderate expansion of agricultural labor supply, combined with the very rudimentary agricultural production technologies. The widening price differentials in the current simulations therefore indicate that bottlenecks can arise in relation to a future capital deepening of the economy.

Agricultural import prices expand much slower than domestic prices, underpinning the strong expansion of agricultural imports (Table 13.7). In contrast, agricultural export prices expand at much the same pace as domestic prices, serving to limit the expansion of agricultural exports. For industry goods and services, it generally follows that world market prices in domestic currency expand faster than domestic prices. The prices in the optimistic scenario therefore underpin the expansion of agricultural imports at the expense of industry and service sector imports. Furthermore, relative prices underpin the expansion of industry and service sector exports to generate foreign currency for the increasing imports. Clearly, relative import, export, and domestic prices are strongly affected by the exchange rate and the price of marketing services.

The factor prices reflect the assumed economic growth during the simulation period (Table 13.8). Demand pressures

Table 13.7 Inflation in domestic world market prices for the integrated-model simulations, 1998–2002

	Growth rate (percentage)				
Prices	**1998**	**1999**	**2000**	**2001**	**2002**
Import prices					
Agriculture	4.7	5.1	5.3	5.3	5.3
Industry	4.7	5.1	5.3	5.4	5.3
Ordinary services	5.5	5.8	6.1	6.2	6.2
Export prices					
Agriculture	7.6	7.5	7.9	8.0	8.0
Industry	6.1	6.3	6.5	6.7	6.7
Ordinary services	5.5	5.8	6.1	6.2	6.2

Source: Authors' integrated-model simulations.

Table 13.8 Growth in factor returns for the integrated-model simulations, 1998–2002

	Growth rate (percentage)				
Factor prices	**1998**	**1999**	**2000**	**2001**	**2002**
Agricultural labor	13.7	12.7	12.9	13.1	13.2
Nonagricultural labor	11.6	11.5	11.4	11.5	11.6
Capital	2.4	4.9	5.1	5.0	4.7

Source: Authors' integrated-model simulations.

following the expansion of economywide income imply that all demand components expand quickly. Together with factor productivity growth of around 4 percent per year, this causes a relatively strong expansion of factor prices. Moreover, the capital deepening of the economy during the simulation period implies that labor wages increase much faster than capital returns. Labor wages increase by between 11 and 13 percent per year, while capital returns increase by around 5 percent per year. The factor returns seem to indicate that rural households with high endowments of labor benefit the most from economic growth. Thus, rural households experience a strong income expansion in nominal terms. However, rural households also have very high budget shares of agricultural products. Their cost of living therefore expands relatively quickly as well.

The differences in the growth paths for factor returns and cost-of-living indices have implications for the distribution of welfare among households. This can be seen from the measures of equivalent variation (Table 13.9). The relatively strong nominal income expansion for rural households is not enough to offset the relative increases in living costs. While poor rural households do enjoy a significant improvement in welfare, it is smaller than the welfare improvement for urban households. On the one hand, the moderate increases in the price of marketing services allow agricultural producer prices to increase faster than agricultural consumer prices because of the high agricultural marketing margin rates. This benefits poor rural households, which are characterized by a high share of agricultural labor income and high budget shares of agricultural products. On the other hand, the intensification of capital in the economy and the associated increases in value-added by capital benefit the urban households even more. While urban household welfare increases the most, the economic growth path envisioned in the optimistic scenario of the merged-model simulations improves welfare for both types of households strongly.

Conclusions

As demonstrated in this chapter, the SAM framework can be used to integrate macroeconomic and general-equilibrium models. The integrated model used in this study combines the sectoral detail of the static CGE model in Chapter 6 with simple dynamics and the financial sector from the application of the merged model in Chapter 12. If economic growth paths from the optimistic scenario of the merged model are imposed as part of the integrated model closure, growth paths of macroeconomic aggregates are similar between the two sets of simulations. Thus, the optimistic scenario from the merged-model simulations appears quite plausible, even when considering issues related to factor markets, relative prices, and income distribution.

The implied productivity increases 4 percent per year on average, which is feasible at the current level of development in Mozambique. Moreover, the integrated-model simulations show that the relative producer prices change in favor of

Table 13.9 Equivalent variation for the integrated-model simulations, 1998–2002

Households	Base income (100 billion metical)	Growth rate (percentage)				
		1998	1999	2000	2001	2002
Urban households	121.0	8.6	15.7	21.6	26.5	30.5
Rural households	113.0	8.0	14.4	19.8	24.1	27.4

Source: Authors' integrated-model simulations.

agricultural products. Agricultural labor wages increase rapidly, which leads to relatively strong income growth for poor rural households. However, the integrated-model simulations also demonstrate that the optimistic scenario of the merged model may have undesirable distributional implications. The strong nominal income growth for rural households is accompanied by relatively significant increases in rural living costs. Producer price increases spill over into consumer prices for agricultural products, so the capital deepening of the economy, combined with rudimentary agricultural production technologies, implies that the distribution of welfare changes in favor of urban households. Against this background, it appears policies to ensure rural households can take advantage of increasing access to capital are strongly needed.

In sum, compared with the simple merged-model simulations of the World Bank and IMF, the explicit inclusion of CGE features in the integrated model enables the analyst to focus more directly on the preconditions regarding factor supplies and productivity underlying assumed growth paths. The impact on the distribution of income can also be derived. In general, the integrated model therefore appears to be a strong tool for identifying potential problems with strategies for the future. Increased detail comes at the expense of more difficult data requirements, but the growing availability of SAMs for a wide range of developing countries shows that in practice such data requirements in many cases can be fulfilled without major difficulty. Implementation of the integrated model as suggested in this chapter is therefore not only desirable but also a feasible operational proposal for moving beyond the simple World Bank–IMF framework.

CHAPTER 14

Lessons Learned

This study sought to respond to the fundamental economic development challenges facing Mozambique, identified in Chapters 2 and 3. After more than 10 years of structural adjustment, the reform program has essentially been implemented. However, as shown in Chapter 4, the more-or-less complete implementation of the structural adjustment program does not mean that sufficient conditions for sustained economic development are in place. Mozambique remains very poor, and the need for continuing economic development is clear.

The choice and design of an appropriate development strategy is by no means immediately evident. However, for a country with abundant arable land and scarce human and physical capital, like Mozambique, the role of agriculture is of particular interest. In keeping with this study's focus on agriculture, a 1995 social accounting matrix with significant agricultural sector detail was constructed. The SAM, presented in Chapter 5, captures two innovative but fundamental features of the Mozambican economy: high marketing costs for domestic, imported, and exported goods, and the significant prevalence of home consumption—particularly for rural households. While high marketing costs and home consumption are features of many African economies, there are no other African SAMs, to the knowledge of the authors, that incorporate these features.

The key importance of agricultural development emerged from a series of traditional SAM-based multiplier analyses. Agriculture has large sectoral multipliers relative to nonagriculture. In addition, this study introduced a new perspective on the multiplier for value-added by capital. This new measure indicates that agriculture is generally a more effective use of scarce capital compared with industry and services. Agricultural commodities with attractive features for promotion in the short to medium term include maize and rice as well as small-scale livestock and forestry.

The SAM also forms the basis for establishing a static CGE model in Chapter 6. Unlike most CGE studies, considerable effort was taken to establish a firm empirical foundation for the parameter values and structure of the model. Specifically, the study introduced a maximum entropy approach to parameter estimation for CGE models. The trade parameter estimates obtained using this approach point strongly to the need for development efforts to aid in the transformation of domestic products into export products. Export volumes are highly insensitive to changes in world market prices. In addition, import substitution elasticities for most commodities are low. On the other hand, transformation elasticities between imported and domestically produced primary food products are high. This result is consistent with the expansion

This chapter was written by Channing Arndt and Finn Tarp.

of domestic food production and rapid decline in imported food volumes experienced since 1992, following the drop in food aid. Overall, the CGE model was found to be capable of explaining many salient aspects of the performance of the Mozambican economy in the postwar period, and it was concluded that the model provided a reasonable basis for further analysis.

The CGE model was first used to analyze the high level of aid dependency. Reductions in aid inflows were shown in Chapter 7 to have significant welfare implications, reflecting in particular the limited scope for increased foreign borrowing to cushion the impacts of decreased aid. This lack of access to financial markets combined with a continuing lack of export market penetration and low export transformation elasticities implies that reductions in foreign aid inflows, without prior structural changes in relation to international creditworthiness or penetration of export markets, will be accompanied by forced reductions in absorption of imported and domestically produced goods. Private and government investment expenditures, which rely heavily on foreign financing, are particularly strongly affected.

It is widely held that the import-substituting economic policies of the past led to a significant bias against agriculture. Chapter 8 demonstrated reason to be cautious about mainstream views when accounting for the low tradability of agricultural goods and the importance of marketing margin wedges between producer and retail prices and associated home consumption of own production. While agricultural export taxes are relatively unimportant, given the low level of exports, nonagricultural import tariffs actually increase agricultural production incentives. While this study does not suggest a return to destructive import-substituting policies, it does cast light on the reason why simplistic trade liberalization policies have often been unsuccessful in promoting agricultural production and economic development.

The simultaneous inclusion of marketing margins and home consumption indicate that the CGE model could be used to study the interactions between agricultural development and infrastructure improvement. The simulations in Chapter 9 indicated that improved agricultural technology and lower marketing margins yield large welfare gains across the economy. In addition, a combined scenario revealed significant synergies, given gains in the combined scenario exceeded the sum of gains from the individual scenarios. The combined scenario also indicated that relative welfare improvements are higher for poor rural households. The magnitude and distribution of benefits show that priority should be given to simultaneous improvement in agricultural productivity, especially in small-scale farming.

An important dimension of the development process is the intrahousehold distribution of welfare gains between men and women. Using a version of the CGE model that incorporates risk-reducing behavior and gender roles in agricultural production, the simulations in Chapter 10 analyze the impact of improvements to agricultural technology and marketing margins. The results show that agricultural technology improvements benefit both men and women in rural households. Moreover, technological change in cassava appeared to be a particularly strong lever for increasing female and overall household welfare, especially when considering risk. Agricultural technology improvements were particularly compelling when combined with marketing system improvements.

One of the major risks facing small-scale farmers is the frequency of droughts. The impact of alternative schemes for distribution of food aid in response to drought was examined in Chapter 11. Clearly, drought negatively affects total welfare. Total welfare is least affected by drought when food aid is channeled through the government, but alternative distribution schemes have a more desirable impact on

the distribution of household welfare. Compared with monetization of food aid by government, direct household distribution strongly benefits rural households. These results indicate that, when improving the welfare of drought-stricken rural households is the primary goal of food aid, direct distribution of food aid is preferable. This conclusion would, however, be less convincing if the government were able to use food aid revenue in a manner strictly targeted to drought-stricken rural households.

The simulations in Chapters 7-11, summarized above, were designed to shed light on an important set of policy issues facing the Mozambican economy. It is clear that the static CGE analytical framework applied in these chapters is indeed useful in drawing conclusions of practical significance for structural policymaking in the medium term. Overall, the results suggest a strong potential for agriculture-led development with attractive distributional implications, provided adequate policy measures are taken. Moreover, the negative effects of unavoidable natural calamities can be minimized if appropriate schemes for food aid distribution are established.

Another critical dimension of policy analysis, which cannot be addressed with the static CGE model, concerns budgetary planning within a medium-term framework. A set of coherent macroeconomic medium-term scenarios for Mozambique was therefore developed in Chapter 12 on the basis of a simple merged version of standard World Bank and IMF simulation tools. Among the key insights of these simulations was the importance of debt reduction on a large scale inside the HIPC initiative and of Mozambique's continued access to overseas financial markets. This is necessary to enable the government to avoid exerting excessive pressure on domestic credit markets. The crucial role of donor action in times of major natural disaster was clearly indicated under the more pessimistic scenario.

The merged-model simulations do not provide information on distributional issues and relative prices. A simple SAM methodology for integrating macroeconomic and CGE models was therefore developed in Chapter 13. It was subsequently applied to integrate the merged and static CGE-model frameworks into a dynamic CGE model with an aggregated financial sector. The integrated model represents a simulation tool that accounts for relative prices and income distribution. The optimistic scenario from the merged-model simulations was applied to the integrated model to assess its implications. While relative price changes generally benefit poor rural households, the expansion of the economy's capital stock benefits urban households in relative terms. The integrated-model simulations therefore indicate that the merged-model simulations overlook an undesirable—but likely—distributional impact.

Overall, this study confirmed that the agricultural sector is key to any satisfactory development process in Mozambique. Agricultural development has the potential to achieve the twin goals of growth and improved income distribution. Nevertheless, this study also showed that the successful implementation of such a strategy relies heavily on both appropriate government action and active donor support. This report summarizes what can be learned from making better use of available knowledge, tools, and data systems in one of the poorest countries in the world. Nevertheless, while the analyses are specific to Mozambique, the basic analytical approach is replicable and could be brought to bear on a series of countries both within and outside Africa.

APPENDIX A

The CGE-Model Specification

Indices

Index		Variable definition
j	Activities	
	Aliases of j: activ, activ1	
	Subsets of j:	
	iaga	Agricultural activities
	iagr	Risk-constrained agricultural activities
	pactiv	Productive activities
	imr	Marketing activities
	iagn	Nonagricultural activities
i	Commodities	
	Aliases of i: comm, comm1	
	Subsets of i:	
	im	Imported commodities
	imn	Nonimported commodities
	ie	Exported commodities
	ien	Nonexported commodities
f	Factors of production	
	Subsets of f:	
	aglabo	Agricultural labor[136]
	naglabo	Nonagricultural labor
h	Households	

[136]The gender-based experiments in Chapter 10 introduce a further disaggregation of agricultural labor.

Parameters

Parameter	Symbol	Definition
a(comm,activ)		Input-output coefficients
ac(comm)	a^C_i	Shift parameter for Armington function
ad(activ)	a^D_j	Shift parameter for production function
af	a^f	Shift parameter for constant elasticity of transformation (CET) labor function
alpha(f,activ)	a_i	Factor share parameter for production function
at(comm)	$a^T i$	Shift parameter for CET export function
betah(comm,hh)		Linear expenditure system (LES) marginal consumption level of home-produced goods
betam(comm,hh)		LES marginal consumption level of marketed commodities
cpiwtsh(comm)		Price index weights for home-consumed goods in the consumer price index (CPI)
cpiwtsm(comm)		Price index weights for marketed goods in CPI
delta(comm)		Share parameter for Armington function
esr0		Enterprise savings rate
eta(comm)		Price elasticity of export demand
etr0		Enterprise tax rate
exrb		Base exchange rate
gamma(comm)	γ_i	Share parameter of CET export function
gammah(comm,hh)		LES minimum consumption level of home-produced goods
gammam(comm,hh)		LES minimum consumption level of marketed commodities
qd(activ)		Dummy variable for computing ad(activ)
gles(comm)		Government consumption share
imake(activ,comm)		"Make" row coefficients
makef(activ,comm)		"Make" flow matrix
mrd(comm)		Domestic margin coefficient
mrdf(comm)		Value of margins on domestics
mre(comm)		Export margin coefficient
mref(comm)		Value of margins on exports
mrm(comm)		Import margin coefficient
mrmf(comm)		Value of margins on imports
pcb(comm)		Base final consumption price of commodity goods
pdab(activ)		Base domestic price
pdcb(comm)		Base domestic supply price for marketed goods
pdchb(comm)		Base domestic supply price for home-consumed goods
ppiwts(activ)		Price index weights for producer price index
pqab(activ)		Base composite activity price
pqqb(comm)		Base composite consumption price
pqxb(comm)		Base composite commodity price
pweb(comm)		Base export price
pwmb(comm)		Base import price
pvb(activ)		Base value-added price
rhoc(comm)	ρ^C_i	Exponent for Armington function

Parameter	Symbol	Definition
rhof	ρ^{f}	Exponent for CET labor function
rhot(comm)	ρ^{T_i}	Exponent for CET export function
risklow(activ)		Lower bound on production for risk
rmd(comm)		Ratio of imports to domestic sales
sdistr(hh)		Distributed profit shares
sremit(hh)		Remittance shares
strans(hh)		Government transfer shares
SUPERNUM(hh)		Household supernumerary income
tau	τ	Share parameter for CET labor function
tcb(comm)		Base consumption tax rate
tc0(comm)		Consumption tax (+) or subsidy (-) rates
te(comm)		Export tax (+) or subsidy (-) rates
teb(comm)		Base export tax
tf(f)		Factor tax rates
th(hh)		Household tax rate
thmul0		Uniform household tax-rate multiplier
tm(comm)		Tariff rates on imports
tmb(comm)		Base tariff rate
txb(activ)		Base indirect tax
tx0(activ)		Output tax rates
ymap(instp,f)		Factors to private institutions map

Variables

Prices

Variable	Definition
EXR	Exchange rate
PC(comm)	Consumption price of composite goods
PDC(comm)	Domestic price for marketed commodity goods
PDCH(comm)	Domestic price for home commodity goods
PE(comm)	Price of exports
PINDEX	Producer prices or GDP index
PM(comm)	Price of imports
PQA(activ)	Average production price of composite activity
PQQ(comm)	Price of composite consumption goods
PQX(comm)	Average production price for composite commodities
PV(activ)	Value-added price
RISK(activ)	Risk premium complementarity

Production

Variable	Definition
DC(comm)	Marketed consumption of commodities
DCH(comm)	Home consumption of commodities
E(comm)	Exports
M(comm)	Imports
QQ(comm)	Demand for composite goods
QX(comm)	Domestic output of composite commodities
QA(activ)	Domestic output of composite activities

Factors

Variable	Definition
FDSC(f,activ)	Factor demand by sector
FS(f)	Factor supply
FSLAB	Aggregate labor supply
WF(f)	Average factor price
WFDIST(f,activ)	Sectoral proportionality ratios for factor price
WFLAB	Aggregate average labor return
YFCTR(f)	Factor income

Income and Expenditure

Variable	Definition
CAPINV	Total private investment
CDH(comm,hh)	Final demand for home-produced commodities
CDM(comm,hh)	Final demand for marketed commodities
CI(comm)	Final demand for private productive investment
CONTAX	Consumption tax revenue
DISTR	Distributed profits
ENTSAV	Enterprise savings
ENTTAX	Enterprise tax
ESR	Enterprise savings rate
ETR	Enterprise tax rate
EXPTAX	Export subsidy payments
FACTAX	Factor tax revenue
FAIDGIN	Aid in government budget
FAIDNGO	Aid in nongovernment organization budget
FSAV	Net foreign savings
GD(comm)	Final demand for government consumption
GDTOT	Total government recurrent consumption
GI(comm)	Final demand for government productive investment
GININV	Total government investment

Variable	Definition
GINREV	Revenue from government investment account
GINSAV	Savings from government investment account
GOVTH	Government transfers to households
GOVTE	Government transfers to enterprises
GRESAV	Government recurrent account savings
GREREV	Government recurrent account revenue
HHSAV	Total household savings
HHTAX	Household tax revenue
ID(comm)	Final demand for productive investment
INDTAX	Indirect tax revenue
INT(comm)	Intermediates uses
INVEST	Nominal private investment
MPS(hh)	Marginal propensity to save by household type
NGOD(comm)	Final demand for nongovernment organization consumption
NGOREV	Account revenue for nongovernmental organizations
REMIT	Remittances
SAVING	Nominal private savings
TARIFF	Tariff revenue
THMUL	Uniform multiplier for household tax rate
WALRAS1	Slack variable for private savings-investment balance
YE	Enterprise income
YH(hh)	Household income
Yinstp(instp)	Private institutional income

GDP and Other Derived Variables

Variable	Definition
ABSORB	Absorption in market prices
GDPVA	Value-added in market prices
GOVRABS	Government recurrent expenditure-to-absorption ratio
GOVIABS	Government investment-to-absorption ratio
INVGDP	Investment to GDP ratio
RGDP	Real GDP

Taxes

Variable	Definition
TC(comm)	Consumption tax rate
TX(activ)	Output tax rate

Other Variables

Variable	Definition
FOODAID(comm)	Food aid in form of composite commodity
TRADM(activ)	Demand for import commerce service by trade

Equations

Prices

Equation Number	Equation	Definition
A1	$PE_{ie} = pwe_{ie} \cdot (1 - te_{ie}) \cdot EXR - MRE_{ie} \cdot \sum_{imr} PQA_{imr}$	Export prices
A2	$PM_{im} = pwm_{im} \cdot (1 + tm_{im}) \cdot EXR + MRM_{im} \cdot \sum_{imr} PQA_{imr}$	Import prices
A3	$PDC_i = PDCH_i + MRD_i \cdot \sum_{imr} PQA_{imr}$	Marketed commodity prices
A4	$PQQ_i = \frac{PDC_i \cdot DC_i + PM_i \cdot M_i}{QQ_i}$	Composite commodity prices
A5	$PQX_i = \frac{PDCH_i \cdot (DC_i + DCH_i) + PE_i \cdot E_i}{QX_i}$	Producer commodity prices
A6	$PC_i = PQQ_i \cdot (1 + tc_i)$	Consumer prices
A7	$PQA_{pactiv} = \sum_i imake_{pactiv,i} \cdot PQX_i$	Producer activity prices
A8	$PV_j = PQA_j \cdot (1 - tx_j) - \sum_i PC_i \cdot a_{ij}$	Value-added prices net of output taxes
A9	$WFLAB \cdot FSLAB = \sum_{lab} FS_{lab} \cdot WF_{lab}$	Composite wage
A10	$PINDEX = \sum_i cpiwts_i \cdot \left(\frac{PC_i}{pindex0} \right)$	Consumer price index (CPI)

Quantities

Equation Number	Equation	Definition
A11	$QA_j = a_j^D \cdot \prod_f FDSC_{j,f}^{\alpha_{j,f}}$	Cobb-Douglas production function
A12	$FDSC_{fj} = \frac{RISK_j \cdot QA_j \cdot PV_j \cdot \alpha_{fj}}{WF_f \cdot WFDIST_{fj}}$	Demand function for primary factors (profit maximization)
A13	$INT_i = \sum_j a_{ij} \cdot QA_j$	Total intermediate use
A14	$QA_{imr} \geq risklow_{imr}$	Risk related minimum production
A15	$FSLAB = a^f \cdot \left[\tau \, FS_{aglabo}^{\rho^f} + (1-\tau) \, FS_{naglabo}^{\rho^f} \right]^{\frac{1}{\rho^f}}$	Composite labor
A16	$FS_{aglab} = FS_{naglab} \cdot \left(\frac{WF_{naglab}}{WF_{aglab}} \right) \cdot \left(\frac{\tau}{1-\tau} \right)^{\left(\frac{1}{1-\rho^f} \right)}$	Agricultural labor supply
A17	$QA_{imr} = \sum_{im} M_{im} \cdot MRM_{im} + \sum_{ie} E_{ie} \cdot MRE_{ie} + \sum_i DC_i \cdot MRD_i$	Commodity-marketing services relationship
A18	$QX_i = \sum_{pactiv} imake_{pactiv,i} \cdot QA_{pactiv}$	Commodity-activity relationship
A19	$QX_{ie} = a_{ie}^T \cdot \left[\gamma_{ie} E_{ie}^{\rho_{ie}^T} + (1-\gamma_{ie}) \, (DC_{ie} + DCH_{ie})^{\rho_{ie}^T} \right]^{\frac{1}{\rho_{ie}^T}}$	Total production as a composite good-CET function for traded goods
A20	$E_{ie} = (DC_{ie} + DCH_{ie}) \cdot \left(\frac{PDCH_{ie} \cdot \gamma_{ie}}{PE_{ie} \cdot (1-\gamma_{ie})} \right)^{\left(\frac{1}{1-\rho_i^T} \right)}$	F.O.C. for profit maximization for export transformation of production
A21	$QX_{ien} = DC_{ien} + DCH_{ien}$	Total (marketed and nonmarketed) production of nonexported goods
A22	$QQ_{im} = a_{im}^C \cdot \left[\delta_{im} \, M_{im}^{-\rho_{im}^C} + (1-\delta_{im}) \, DC_{im}^{-\rho_{im}^C} \right]^{-\frac{1}{\rho_{im}^C}}$	Marketed supply as a composite good-CES function for traded goods
A23	$M_{im} = DC_{im} \cdot \left(\frac{PDC_{im} \cdot \delta_{im}}{PM_{im} \, (1-\delta_{im})} \right)^{\frac{1}{1+\rho_{im}^C}}$	F.O.C. for cost minimization for import demand
A24	$QQ_{imn} = DC_{imn}$	Total marketed supply for nonimported goods

Income

Equation Number	Equation	Definition
A25	$YFCTR_f = \sum_j WF_f \cdot FDSC_{fj} \cdot \left(\frac{WFDIST_{fj}}{RISK_j} \right)$	Factor income
A26	$Yinstp_{instp} = \sum_f ymap_{instp,f} \cdot YFCTR_f$	Private institutional income
A27	$YE = Yinstp_{enterp} + GOVTE$	Enterprise income
A28	$YH_{hh} = Yinstp_{hh} + sdistr_{hh} \cdot DISTR + sremit_{hh} \cdot REMIT \cdot EXR + strans_{hh} \cdot GOVTH$	Household income
A29	$INDTAX = \sum_{activ} tx_{activ} \cdot PQA_{activ} \cdot QA_{activ}$	Indirect taxes on domestic production
A30	$EXPTAX = \sum_{ie} te_{ie} \cdot E_{ie} \cdot pwe_{ie} \cdot EXR$	Export tax (subsidy) payments
A31	$TARIFF = \sum_{im} tm_{im} \cdot M_{im} \cdot pwm_{im} \cdot EXR$	Tariff revenue
A32	$CONTAX = \sum_{comm} tc_{comm} \cdot PQQ_{comm} \cdot QQ_{comm}$	Consumption taxes
A33	$FACTAX = \sum_f tf_f \cdot YFCTR_f$	Factor tax
A34	$ENTTAX = ETR \cdot YE$	Enterprise tax
A35	$HHTAX = \sum_{hh} th_{hh} \cdot YH_{hh} \cdot THMUL$	Total household tax collected by government
A36	$ENTSAV = ESR \cdot (YE - ENTTAX)$	Enterprise savings
A37	$HHSAV = \sum_{hh} MPS_{hh} \cdot YH_{hh} \cdot (1 - th_{hh} \cdot THMUL)$	Household savings
A38	$GREREV = INDTAX + EXPTAX + TARIFF + CONTAX + FACTAX + ENTTAX + HHTAX$	Government recurrent account revenue
A39	$GINREV = FAIDGIN \cdot EXR$	Government investment account revenue
A40	$NGOREV = FAIDNGO \cdot EXR$	Nongovernment organization account revenue
A41	$SAVING = HHSAV + ENTSAV + GRESAV + GINSAV + FSAV \cdot EXR$	Total savings

Expenditure

Equation Number	Equation	Definition
A42[137]	$PC_{comm} \cdot CDM_{comm,hh} = PC_{comm} \cdot gammam_{comm,hh} + betam_{comm,hh} \cdot ((1 - MPS_{hh} \cdot YH_{hh}) \cdot (1 - th_{hh} \cdot THMUL) - \sum_{comm1} PC_{comm1} \cdot gammam_{comm1,hh} - \sum_{comm1} PDCH_{comm1} \cdot gammah_{comm1,hh})$	Private consumption for marketed commodities
A43	$PDCH_{comm} \cdot CDH_{comm,hh} = PDCH_{comm} \cdot gammah_{comm,hh} + betah_{comm,hh} \cdot ((1 - MPS_{hh}) \cdot YH_{hh} \cdot (1 - th_{hh} \cdot THMUL) - \sum_{comm1} PC_{comm1} \cdot gammam_{comm1,hh} - \sum_{comm1} PDCH_{comm1} \cdot gammah_{comm1,hh})$	Private consumption behavior for home consumption
A44	$GD_{comm} \cdot PC_{comm} = gles_{comm} \cdot (GDTOT + (\frac{gdtot_0}{gininv_0 + gdtot_0}) \cdot \sum_{comm1} PC_{comm1} \cdot FOODAID_{comm1})$	Government consumption
A45	$GREREV = GDTOT + GOVTE + GOVTH + GRESAV$	Government recurrent budget constraint
A46	$GI_{comm} \cdot PC_{comm} = gishr_{comm} \cdot (GININV + (\frac{gininv_0}{gininv_0 + gdtot_0}) \cdot \sum_{comm1} (PC_{comm1} \cdot FOODAID_{comm1}))$	Real government investment

[137]Equations A42 and A43 form a single LES and as such could be written as a single equation. They are separated here for modeling convenience.

Equation Number	Equation	Definition
A47	$GINREV = GININV + GINSAV$	Government investment budget constraint
A48	$YE = DISTR + ENTTAX + ENTSAV$	Enterprise expenditure
A49	$NGOD_{comm} \cdot PC_{comm} = ngoshr_{comm} \cdot NGOREV$	Nongovernment organization consumption
A50	$CI_{comm} \cdot PC_{comm} = cishr_{comm} \cdot INVEST$	Real private investment
A51	$ID_{comm} = CI_{comm} + GI_{comm}$	Investment by sector of origin
A52	$INVEST = \sum_{comm} PC_{comm} \cdot CI_{comm}$	Total private investment at market prices

Marketing Clearing

Equation Number	Equation	Definition
A53	$QQ_{comm} + FOODAID_{comm} = INT_{comm} + \sum_{hh} CDM_{comm,hh} + GD_{comm} + NGOD_{comm} + ID_{comm}$	Commodities market equilibrium
A54	$DCH_{comm} = \sum_{hh} CDH_{comm,hh}$	Nonmarketed goods equilibrium
A55	$\sum_{activ} FDSC_{f,activ} = FS_f$	Factor market equilibrium
A56	$\sum_{im} pwm_{im} \cdot M_{im} = \sum_{ie} pwe_{ie} \cdot E_{ie} + FSAV + FAIDGIN + FAIDNGO + REMIT$	Current account balance
A57	$SAVING = INVEST + WALRAS1$	Savings-investment equilibrium

APPENDIX B

The CGE-Model Specification

Merged-Model Equations

$$GDP_t = \Sigma_i\, GDPS_{i,t} \quad \text{(C1)}$$

$$GDPS_{i,t} = (1+\gamma_{i,t})*GDPS_{i,t-1} \quad \text{(C2)}$$

$$GDPTOT_t = GDP_t+(ENCIV_t+ENCX_t-ENCM_t)/PD_t \quad \text{(C3)}$$

$$X_t = \Sigma_i\, XS_{i-t} \quad \text{(C4)}$$

$$XS_{i,t} = (1+\lambda_{i,t})*XS_{i,t-1} \quad \text{(C5)}$$

$$XTOT_t = X_t+ENCX_t/(E_t*XPI_t) \quad \text{(C6)}$$

$$IV_t = \kappa_0 GDP_{t-1}+ \kappa_1\,(GDP_t-GDP_{t-1}) \quad \text{(C7)}$$

$$IV_t = IVP_t+IVG_t \quad \text{(C8)}$$

$$IVTOT_t = IV_t+(ENCIV_t+ \beta_t*MADD_t)/P_t \quad \text{(C9)}$$

$$log(M_t) = \alpha_0+A_1 log(GDP_t)+ A_2 log(E_t*MPI_t/PD_t) \quad \text{(C10)}$$

$$MTOT_i = M_t+(ENCM_t+MADD_t)/(E_t*MPI_t) \quad \text{(C11)}$$

$$P_t*CP_t = (1-\beta_t)*GDY_t \quad \text{(C12)}$$

$$P_t*(CTOT_t+IVTOT_t) = PD_t*GDPTOT_t-E_t*RESBAL_t \quad \text{(C13)}$$

$$RESBAL_t = (XPI_t*XTOT_t-MPI_t*MTOT_t) \quad \text{(C14)}$$

$$CTOT_t = C_t+(1-\beta_t)*MADD_t/P_t \quad \text{(C15)}$$

$$C_t = CP_t+CG_t+CN_t \quad \text{(C16)}$$

$$GDY_t = PD_t*GDP_t+E_t*NFP_t+E_t*NTRP_t+(GT_t-TG_t) \quad \text{(C17)}$$

$$INFG_t = NFDG_{t-1}*IRFG_t \quad \text{(C18)}$$

$$BRG_t = P_t*(CG_t+IVG_t)+(GT_t-TG_t)+E_t*(INFG_t-NTRG_t) \quad \text{(C19)}$$

$$BRG_t = Et*(NFDG_t-NFDG_{t-1})+(DCG_t-DCG_{t-1}) \quad \text{(C20)}$$

$$INFP_t = NFDP_{t-1}*IRFP_t \quad \text{(C21)}$$

$$CURBAL_t = RESBAL_t+NETFSY_t+NTRG_t+NTRP_t+NTRNGO_t+NTRENC_t \quad \text{(C22)}$$

$$NETFSY_t = NFP_t+NFPENC_t-INFG_t-INFP_t \quad \text{(C23)}$$

$$R_t-R_{t-1} = CURBAL_t+(NFDG_t-NFDG_{t-1})+(NFDP_t-NFDP_{t-1}) \quad \text{(C24)}$$

$$R_t-R_{t-1} = D_t(MPI_t*M_t-MPI_{t-1}*M_{t-1}) \quad \text{(C25)}$$

$$P_t = \frac{(PD_t*GDP_t+E_t*[MPI_t*M_t-XPI_t*X_t])/}{(PD_{1995}*GDP_t+E_{1995}*[MPI_{1995}*M_t-XPI_{1995}*X_t])} \quad \text{(C26)}$$

$$MD_t = (1/v_t)*GDPN_t \quad \text{(C27)}$$

$$GDPN_t = PD_t\, GDP_t \quad \text{(C28)}$$

$$MS_t-MS_{t-1} = E_t*(R_t-R_{t-1})+(DC_t-DC_{t-1})+(E_t-E_{t-1})*R_{t-1} \quad \text{(C29)}$$

$$DC_t = DCG_t+DCP_t \quad \text{(C30)}$$

$$MS_t = MD_t \quad \text{(C31)}$$

$$P_t*CN_t = E_t*NTRNGO_t \quad \text{(C32)}$$

$$NFDG_t = G_t*XPI_t*X_t \quad \text{(C33)}$$

Merged-Model Variables

Variable	Definition
C	Total real consumption
CP	Private real consumption
CG	Government real consumption
CN	NGO real consumption
IV	Total real investment
IVP	Private real investment
IVG	Government real investment
X	Real exports
M	Real imports
GDP	Real GDP
GDPN	Nominal GDP
GDY	Nominal private disposable income
TG	Government transfers to the private sector
GT	Government tax revenues
BRG	Government borrowing requirement
SP	Private savings
SG	Government savings
INFP	Payments of private net foreign interest
INFG	Payments of government net foreign interest
NFP	Net factor payments
NTRP	Private net foreign transfers from abroad
NTRG	Government net foreign transfers from abroad
NTRNGO	NGO net transfers from abroad
DC	Total domestic credit
DCP	Private domestic credit taking
DCG	Government domestic credit taking
R	Foreign exchange reserve holdings
MS	Money stock
MD	Money demand
NFDP	Private net foreign debt
NFDG	Government net foreign debt
PD	GDP deflator
P	Absorption deflator
E	Exchange rate
XPI	World market price deflator for exports
MPI	World market price deflator for imports
XS	Sectoral exports
GDPS	Sectoral GDP

Variable	Definition
CTOT	Total real consumption, including private consumption from enclave income
IVTOT	Total real investment, including private investment from enclave income
XTOT	Total real exports, including enclave exports
MTOT	Total real imports, including enclave imports and private imports from enclave income
GDPTOT	Total real GDP, including enclave income
RESBAL	Resource balance, including flows of enclave net resources flows
NTRENC	Enclave net transfers from abroad
NFPENC	Net factor payments, including repatriation of enclave profits
NETFSY	Net factor service income, including flows of enclave net factor-income
CURBAL	Current account balance, including flows of enclave current-account
ENCIV	Real investment by enclaves
ENCX	Real exports by enclaves
ENCM	Real imports by enclaves
MADD	Nominal private income from enclaves, or additional private imports from enclave income

APPENDIX C

Variable Definitions in Chapter 13

Merged-Model Equations

Variable	Description
CP	Private real consumption
CG	Government real consumption
CN	Nongovernmental organization (NGO) real consumption
IVP	Private real investment
IVG	Government real investment
X	Real exports
M	Real imports
GDP	Real GDP
TG	Government transfers to the private sector
GT	Government tax revenues
BRG	Government borrowing requirement
SP	Private savings
SG	Government savings
INFP	Private net foreign interest payments
INFG	Government net foreign interest payments
NFP	Net factor payments
NTRP	Private net foreign transfers from abroad
NTRG	Government net foreign transfers from abroad
NTRNGO	NGO net transfers from abroad
CURBAL	Current account balance
DCP	Private domestic credit taking
DCG	Government domestic credit taking
R	Foreign exchange reserve holdings
MD	Money stock
NFDP	Private net foreign debt
NFDG	Government net foreign debt
PD	GDP deflator
P	Absorption deflator
XPI	World market price deflator for exports
MPI	World market price deflator for imports
E	Exchange rate

CGE-Model Variables

Variable	Description
CD	Private real consumption
CG	Government real consumption
NGOD	NGO real consumption
CI	Private real investment
GI	Government real investment
E	Real exports
M	Real imports
INT	Real intermediate consumption
DC	Marketed production
DCH	Home-consumed production
FDSC	Factor demand
DISTR	Distributed profits
GOVTE	Government transfers to enterprises
GOVTH	Government transfers to households
INDTAX	Indirect taxes
CONTAX	Consumption taxes
FACTAX	Factor taxes
ENTTAX	Enterprise taxes
HHTAX	Household taxes
EXPTAX	Export taxes
TARIFF	Import tariffs
ENTSAV	Enterprise savings
HHSAV	Household savings
GRESAV	Government recurrent budget savings
GINSAV	Government investment budget savings
REMIT	Remittances from workers abroad
FAIDGIN	Foreign aid in the government budget
FAIDNGO	Foreign aid in the NGO budget
FSAV	Foreign savings
PDC	Retail price
PDCH	Farmgate price
PC	Consumer price
PE	Export price in domestic currency
PM	Import price in domestic price
EXR	Exchange rate

Acronyms and Abbrevations

BCM	*Banco Commercial de Moçambique*
BM	*Banco de Moçambique*
BMP	*Banco Popular de Desenvolvimento*
CES	Constant elasticity of substitution
CET	Constant elasticity of transformation
CGE	Computable general equilibrium
CPI	Consumer price index
ESRP	Economic and Social Rehabilitation Program
ESS	Error sum of squares
FEER	Fundamental equilibrium exchange rate
Frelimo	*Frente de Libertação de Moçambique*
GDP	Gross domestic product
GNP	Gross national product
HIPC	Heavily indebted poor countries
ICM	*Instituto de Cereais de Moçambique*
IMF	International Monetary Fund
LES	Linear expenditure system
M1	Narrow money supply
MACSAM	Mozambique macroeconomic social accounting matrix
MERRISA	Macroeconomic reforms and regional integration in southern Africa project
MOZAM	Mozambican social accounting matrix
MPF	Ministry of Planning and Finance
NDP	National Directorate of Planning
NGO	Nongovernmental organization
NIS	National Institute of Statistics
OER	Official exchange rate
OLS	Ordinary least squares
PPP	Purchasing power parity
Renamo	*Resistencia Nacional de Moçambique*
RMSM	Revised minimum standard model
SAM	Social accounting matrix
Semoc	*Sementes de Moçambique*
TSS	Total sum of squares
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UNICEF	United Nations Children's Fund
VAT	Value–added tax
WDI	World Development Indicators

Bibliography

Adam, Y., and H. Coimbra. 1996. *Género e pobreza: Investigação sobre a pobreza em Moçambique.* Maputo: Eduardo Mondlane University, Center for Population Studies.

Addison, Doug. 1989. *The World Bank revised minimum standards model.* PPR Working Paper Series 231. Washington, D.C.: World Bank.

Adekanye, T. O. 1985. Innovation and rural women in Nigeria: Cassava processing and food production. In *Technology and rural women: Conceptual and empirical issues,* ed. T. O. Adekanye. London: Allen and Unwin.

Agenór, P.-R., and P. J. Montiel. 1996. *Development macroeconomics.* Princeton, N.J., U.S.A: Princeton University Press.

Alaouze, C. M. 1976. *Estimation of the elasticity of substitution between imported and domestically produced intermediate inputs.* IMPACT Project Paper OP–07. Melbourne, Australia: Monash University IMPACT Project.

_____. 1977. *Estimates of the elasticity of substitution between imported and domestically produced goods classified at the input-output level of aggregation.* IMPACT Project Paper O–13. Melbourne, Australia: Monash Univerity IMPACT Project.

Alaouze, C. M., J. S. Marsden, and J. Zeitsch. 1977. *Estimates of the elasticity of substitution between imported and domestically produced commodities at the four-digit asic level.* IMPACT Project Paper OP–11. Melbourne, Australia: Monash University IMPACT Project.

Arneberg, Marie W. 1996. *Theory and practice in the World Bank and IMF economic policy models.* Oslo: Statistics Norway.

Arndt, C., A. Cruz, H. T. Jensen, S. Robinson, and F. Tarp. 1998. *Social accounting matrices for Mozambique:* 1994–95. Trade and Macroeconomics Division Discussion Paper No. 28. Washington, D.C.: International Food Policy Research Institute.

Arndt, C., H. T. Jensen, S. Robinson, and F. Tarp. 2000. Marketing margins and agricultural technology in Mozambique. *Journal of Development Studies* 37 (1): 121–137.

Arndt, C., H. T. Jensen, and F. Tarp. 2000a. Stabilisation and structural adjustment in Mozambique: An appraisal. *Journal of International Development* 12 (3): 299–323.

_____. 2000b. Structural characteristics of the economy of Mozambique: A SAM based analysis. *Review of Development Economics* 4 (3): 292–306.

Arndt, C., S. Robinson, and F. Tarp. 2002. Parameter estimation for a computable general equilibrium model: A maximum entropy approach. *Economic Modelling* 19 (3): 375–398.

Arndt, C., and F. Tarp. 2000. Agricultural technology, risk, and gender: A CGE analysis of Mozambique. *World Development* 28 (7): 1307–1326.

_____. 2001. Who gets the goods: A general equilibrium perspective on food aid in Mozambique. *Food Policy* 26 (2): 107–119.

Bacou, M. 2000. Unpublished thesis. Economywide effects of climate variability and climate prediction in Mozambique. Purdue University, Department of Agricultural Economics, West Lafayette, Ind., U.S.A.

Banco de Moçambique. Various years. *Statistical Bulletin 1995–1997.* Maputo.

Bardalez, J. 1997. *Mocambique: Projeccoes da populacao total do pais a nivel provincial, distrital e cidades periodo* 1991–2000. Technical Report. Maputo: National Institute of Statistics.

Bautista, R. M., S. Robinson, F. Tarp, and P. Wobst. 2001. Policy bias and agriculture: Partial and general equilibrium measures. *Review of Development Economics* 5 (1): 89–104.

Bay, A. 1996. Managing Director, SEMOC. Personal communication.

_____. 1998. Mozambique country study, agricultural technology component. Trade and Macroeconomics Division, International Food Policy Research Institute, Washington, D.C. Mimeo.

Benfica, R. M. 1998. Analysis of the contributions of micro and small enterprises to rural household income in central and northern Mozambique. M. Sc. thesis, Michigan State University, Department of Agricultural Economics, East Lansing, Mich., U.S.A.

Benson, C., and E. Clay. 1998. *The impact of drought on Sub-Saharan African economies—A preliminary examination.* Technical Paper No. 401. Washington, D.C.: World Bank.

Bhagwati, J. 1985. Food aid, agricultural production and welfare. In *Dependence and interdependence,* Vol. 2, *Essays in development economics,* ed. Gene Grossman Cambridge, Mass., U.S.A., and Oxford, U.K.: MIT Press and Blackwell.

Brixen, P., and F. Tarp. 1996. South Africa: Macroeconomic perspectives for the medium term. *World Development* 24 (6): 989–1001.

Cagatay, N., D. Elson, and C. Grown. 1995. Introduction. *World Development* 23 (11): 1827–63.

Castro, R. 1995. *Mozambique, impediments to industrial sector recovery.* Report No. 13752–MOZ. Washington, D.C.: World Bank.

Chenery, H., S. Robinson, and M. Syrquin. 1986. *Industrialization and growth: A comparative study.* New York: Oxford University Press for the World Bank.

_____. 1996. Industrialization and growth: A comparative Study. New York: Oxford University Press for the World Bank.

Chenery, H., and M. Syrquin. 1975. *Patterns of development*, *1950–1970*. New York: Oxford University Press for the World Bank.

Chenery, H., and M. Syrquin, M. 1986. Typical patterns of transformation. In *Industrialization and growth: A comparative Study*, ed. H. Chenery, S. Robinson, and M. Syrquin. New York: Oxford University Press for the World Bank.

CIAT (International Center for Tropical Agriculture). 1999. Improved cassava for the developing world. <http://www.ciat.cgiar.org/about_ciat/cassava.htm>. Updated October 2002 (accessed 1998).

Cock, J. H. 1985. *Cassava: New potential for a neglected crop.* Boulder, Colo., U.S.A.: West View Press.

Colding, B., and P. Pinstrup-Andersen. 2000. Food aid as a development assistance instrument: Past, present, and future. In *Foreign aid and development: Lessons learnt and directions for the future,* F. Tarp, ed. London: Routledge.

Cornia, A. G., and G. E. Helleiner, ed. 1994. *From adjustment to development in Africa: Conflict, controversy, convergence, consensus?* Houndsmills, U.K.: Macmillan.

Coulter, J. P. 1996. *Maize marketing and pricing study—Mozambique.* Greenwich, U.K.: Natural Resources Institute.

Datt, G., K. Simler, S. Mukherjee, and G. Dava. 1999. *Determinants of poverty in Mozambique.* Food Consumption and Nutrition Division Discussion Paper No. 78, Washington, D.C.: International Food Policy Research Institute.

Defourny, J., and E. Thorbecke. 1984. Structural path analysis and multiplier decomposition with a social accounting matrix framework. *Economic Journal* 94: 111–36.

de Maio, L., F. Stewart, and R. van der Hoeven. 1999. Computable general equilibrium models, adjustment and the poor in Africa. *World Development* 27 (3): 453–70.

Dervis, K., J. de Melo, and S. Robinson. 1982. *General equilibrium models for development policy.* New York: Cambridge University Press.

De Sousa, C. 1997. Analysing living standards in rural Mozambique. Ph.D. dissertation, Department of Economics, University of Warwick, Coventry, U.K.

Devarajan, S. D., S. Go, J. D. Lewis, S. Robinson, and P. Sinko. 1997. Simple general equilibrium modeling in applied methods for trade policy analysis. In *Applied methods for trade policy analysis: A handbook,* J. F. Francois and K. A. Reinert, ed. Cambridge, U.K: Cambridge University Press.

Dirkse, S. P., and M. C. Ferris. 1995. The PATH solver: A non-monotone stabilization scheme for mixed complementarity problems. *Optimization Methods and Software* (5): 123–156.

Dixon, P. B., B. R. Parmenter, and M. T. Rimmer. 1997. *The Australian textiles, clothing and footwear sector from 1986–87 to 2013–14: Analysis using the Monash model.* Melbourne, Australia: Monash University, Centre of Policy Studies and IMPACT Project.

NDRD (National Directorate of Rural Development). 1992. *Mulheres majores contribuintes na produção agraia, direcção nacional de desenvolvimento rural.* Maputo: Ministry of Agriculture and Fisheries.

Donovan, C. 1996. Effects of monetized food aid on local maize prices in Mozambique. Ph.D. dissertation, Michigan State University, East Lansing, Mich., U.S.A.

Economist Intelligence Unit. 1996. *Country profile: Mozambique.* London.

_____. 1997. *Mozambique country profile, 1997–98.* London.

Elson, D. 1989. The impact of structural adjustment on women: Concepts and issues. In *The IMF, the World Bank, and the African debt: The social and political impact,* B. Onimode, ed. London: Zed Books.

FAO (Food and Agriculture Organization of the United Nations). 1977. *Mozambique: State farms Projects.* Identification/Reconnaissance Report No. 34/77 DDC Moz. 2. Rome.

_____. 1982. The agricultural economy of Mozambique, FAO, Maputo. Mimeo.

Frelimo. 1977. *Directivas economicas e sociais.* Maputo: Department for Ideological Work of Frelimo.

_____. 1982. *Projecto das teses para o 4^0 Congresso do Partido Frelimo.* Maputo.

_____. 1983. *Frelimo party program and statutes.* Maputo.

Gehlhar, M. J. 1994. Economic growth and trade in the pacific rim: An analysis of trade patterns. Ph.D. dissertation, Department of Agricultural Economics, Purdue University, West Lafayette, Ind., U.S.A.

Golan, A., G. Judge, and D. Miller. 1996. *Maximum entropy econometrics: Robust estimation with limited data.* Chichester, U.K.: Wiley.

Goodman, S. H. 1973. Overview of the CIA trade flow model project. Paper presented to the Winter Meeting of the Econometric Society, December 27–30. Central Intelligence Agency, Office of Economic Research, Washington, D.C.

Government of Mozambique. 1981. *Linhas fundamentais do plano prospectivo indicativo para 1981–1990.* Maputo: National Press of Mozambique.

_____. 1998. A view to the future. Unpublished policy framework paper, Maputo.

Green, R. 1991. *The struggle against absolute poverty in Mozambique.* Maputo: National Directorate of Planning.

Haddad, L. 1999. The income earned by women: Impacts on welfare outcomes. *Agricultural Economics,* 20 (1): 135–141.

Haddad, L., J. Hoddinott, and H. Alderman, ed. 1997. *Intra-household resource allocation in developing countries: Models, methods, and policy.* Baltimore, Md., U.S.A.: Johns Hopkins University Press.

Hansen, L. P., and J. J. Heckman. 1996. The empirical foundations of calibration. *Journal of Economic Perspectives* 10 (1): 87–104.

Hirschman, A. O. 1958. The strategy of economic development. New Haven, Conn., U.S.A.: Yale University Press.

Hoddinott, J., and L. Haddad. 1995. Does female income share influence household expenditures? Evidence from Cote d'Ivoire. *Oxford Bulletin of Economics and Statistics* 57 (1): 77–96.

IMF (International Monetary Fund). 1987. *Theoretical aspects of the design of fund-supported adjustment programs.* Occasional Paper No. 55. Washington, D.C.

_____. 1998. Unpublished data from IMF country mission. Washington, D.C.

_____. 1999. Enhanced structural adjustment facility policy framework paper for 1998–2000. <www.imf.org/external/np/pfp/mozam/moz.htm>. The Government of Mozambique, the IMF, and the World Bank.

Jaynes, E. T. 1957a. Information theory and statistical mechanics II. *Physics Review* 108: 171–190.

_____. 1957b. Information theory and statistical mechanics I. *Physics Review* 106: 620–630.

Jensen, H. T. 1999. Macroeconomic and CGE modelling of the Mozambican economy. M. Sc. thesis, University of Copenhagen.

Johnson, J. 1995. A development plan for the national accounts. Special report Mozambique, 1995 (3). Stockholm: Statistics Sweden.

Jorgenson, D. 1984. Econometric methods for applied general equilibrium analysis. In *Applied general equilibrium analysis,* ed. H. E. Scarf and J. B. Shoven. New York: Cambridge University Press.

Jorgenson, D. W., and D. T. Slesnick. 1997. General equilibrium analysis of economic policy. In *Welfare,* vol. 2, ed. D. W. Jorgenson. Cambridge, Mass., U.S.A.: MIT Press.

Kapur, J. N., and H. K. Kesavan. 1992. *Entropy optimization principles with applications.* Boston: Academic Press.

Kehoe, T. J., C. Polo, and F. Sancho. 1995. An evaluation of the performance of an applied general equilibrium model of the Spanish economy. *Economic Theory* 6: 115–141.

Khan, M. S., P. Montiel, and N. U. Haque. 1990. Adjustment with growth. *Journal of Development Economics* 32: 155–179.

Krueger, A. O., M. Schiff, and A. Valdes. 1988. Agricultural incentives in developing countries: Measuring the effect of sectoral and economywide policies. *The World Bank Economic Review* 2 (3): 255–271.

Lewis, A. W. 1954. Economic development with unlimited supplies of labor. *The Manchester School of Economic and Social Studies* 22: 191–291.

Lewis, B. D., and E. Thorbecke. 1992. District-level linkages in Kenya: Evidence based on a small regional social accounting matrix. *World Development* 20: 881–897.

Liberman, G. 1989. *Agricultura, mulher e extensão rural*. Maputo: National Directorate of Rural Development/United Nations Children's Fund.

Lofgren, H., R. L. Harris, R. Robinson. 2001. A standard computable general equilibrium model in GAMS. Trade and Macroeconomics Division Discussion Paper 75. Washington D.C.: International Food Policy Research Institute.

Lofgren, H. S., and S. Robinson. 1999. Nonseparable farm household decisions in a computable general equilibrium model. *American Journal of Agricultural Economics* 81 (3): 663–670.

Low, J., and J. Massingue. 2000. *Orange-flesh sweet potato: Promising partnerships for assuring the integration of nutritional concerns into agricultural research and extension.* Flash 20E. Maputo: Ministry of Agriculture and Rural Development.

Marrule, J. 1998. Land poor in a land-abundant setting: Unravelling a paradox in Mozambique. M.Sc. thesis, Michigan State University, East Lansing, Mich., U.S.A.

McFadden, D. 1963. Constant elasticity of substitution production functions. *Review of Economic Studies* 30: 73–83.

McKitrick, R. R. 1998. The econometric critique of computable general equilibrium modeling: The role of parameter estimation. *Economic Modelling* 15: 543–573.

Mellor, J. W. 1976. *The new economics of growth: A strategy for India and the developing world.* Ithaca, N.Y., U.S.A., and London: Cornell University Press.

Ministry of Agriculture and Fisheries/Michigan State University. 1992. *The determinants of household income and consumption in rural Nampula province: Implications for food security and agricultural policy reform.* Working Paper No. 6E. Maputo: Ministry of Agriculture and Fisheries, National Directorate of Economics.

_____. 1994. *Who eats yellow maize? Some preliminary results of a survey of consumer maize meal preferences in Maputo.* Working Paper No. 18. Maputo: Ministry of Agriculture and Fisheries, National Directorate of Economics.

_____. 1997. *Micro and small enterprises in central and northern Mozambique: Results of a 1996 survey.* Working Paper No. 27. Maputo: Ministry of Agriculture and Fisheries, National Directorate of Economics.

MPF (Ministry of Planning and Finance). Various years. *Anuário Estatístico.* Maputo: Ministry of Planning and Finance, National Directorate of Planning.

_____. 1996. *Pauta Aduaneira.* Electronic publication obtained on disk. Republic of Mozambique.

MPF/EMU/IFPRI (Ministry of Planning and Finance/Eduardo Mondlane University/International Food Policy Research Institute). 1998. *1997 National Household Survey, Ministry of Planning and Finance.* Maputo: Eduardo Mondlane University/International Food Policy Research Institute.

Moll, P. 1993. Farm efficiency in Mozambique. Division AF1AE, World Bank, Washington, D.C. Mimeo.

Moll, P. 1996. Division AF1AE, World Bank. Personal interview, November.

Naeraa-Nicolajsen, T. 1998. Agricultural household behavior and labor markets component. Macroeconomic Reforms and Regional Integration in Southern Africa project, Development Economics Research Group, University of Copenhagen. Mimeo.

National Planning Commission. 1994. *Metodologia de Estimação das Contas Nacionais.* Maputo.

Nehru, V., and A. Dhareshwar. 1993. A new database on physical capital stock: Sources, methodology and results. *Revista de Analisis Economico* 8 (1): 37–59.

NIS (National Institute of Statistics). 1997. National accounts data (disk). Also available as *Sistema de Contas Nacionais* 1991–96. Maputo.

_____. 1998. National accounts data (disk). Maputo.

_____. 1999. II *recenseamento geral da população e habitação: Resultados preliminares, vitais e sociais.* Maputo: NIS, Directorate of Demographic Statistics.

Parikh, A., and E. Thorbecke. 1996. Impact of rural industrialization on village life and economy: A social accounting matrix approach. *Economic Development and Cultural Change* 44: 351–77.

Paris, Q., and R. E. Howitt. 1998. An analysis of ill-posed production problems using maximum entropy. *American Journal of Agricultural Economics* 80 (1): 124–138.

Pehrsson, K. 1993. Country gender analysis for Mozambique. Maputo: Swedish International Development Authority.

Pitcher, A. 1996. *Conflict and co-operation: Gendered roles and responsibilities amongst cotton households in northern Mozambique.* Hamilton, N.Y., U.S.A.: Colgate University, Department of Political Science.

Riaz, K. 1992. Food aid as a development resource: Performance, potential, and prospects. In World food in the 1990s: *Production, trade, and aid,* ed. B. Fletcher-Lehman. Boulder, Colo., U.S.A.: Westview Press.

Robinson, S., and K. Thierfelder. 1999. A note on taxes, prices, wages, and welfare in general equilibrium models. Trade and Macroeconomics Division Discussion Paper No. 39. Washington, D.C.: International Food Policy Research Institute.

SADC/FSU (Southern African Development Community/Food Security Unit). 1999. Food Security Data Base. <http://www.sadc-fanr.org.zw/>. Updated October 2002 (accessed February 1997).

Sadoulet, E., and A. de Janvry. 1992. Agricultural trade liberalization and low income countries: A general equilibrium multimarket approach. *American Journal of Agricultural Economics* 74 (2): 268–80.

_____. 1995. *Quantitative development policy analysis.* Baltimore, Md., U.S.A.: John Hopkins University Press.

Sahn, D., P. Dorosh, and S. Younger. 1996. *Structural adjustment reconsidered: Economic policy and poverty in Africa.* Cambridge, U.K.: Cambridge University Press.

Schmalensee, R., T. M. Stoker, and R. A. Judson. 1998. World carbon dioxide emission: 1950–2050. *The Review of Economics and Statistics* 80 (1): 15–27.

Sen, A. K. 1963. Neo-classical and neo-Keynesian theories of distribution. *Economic Record* 39: 53–66.

Shannon, C. E. 1948. A mathematical theory of communication, *Bell System Technical Journal* 27: 379–423.

Shiells, C. R. 1991. Errors in import-demand estimates based upon unit-value indexes. *Review of Economic and Statistics* 73: 378–382.

Shiells, C. R., and K. A. Reinert. 1991. Armington models and terms-of-trade effects—Some econometric evidence for North America. *Canadian Journal of Economics* 26: 299–316.

Shiells, C. R., D. W. Roland-Holst, and K. A. Reinert. 1993. Modeling a North-American free-trade area—Estimation of flexible functional forms. *Weltwirschaftliches Archiv* 129: 55–77.

Shiells, C. R., R. M. Stern, and A. V. Deardorff. 1989. Estimates of the elasticities of substitution between imports and home goods for the United States: Reply. *Weltwirtschaftliches Archiv* 125: 371–374.

Sowa, A. 1996. *Evaluating the impact and effectiveness of the Enterprise Restructuring Program*. Washington, D.C.: World Bank, Private Sector Finance Technical Unit.

Subramanian, S., and E. Sadoulet. 1990. The transmission of production fluctuations and technical change in a village economy: A social accounting matrix approach. *Economic Development and Cultural Change* 39: 131–173.

Tarp, F. 1984. Agrarian transformation in Mozambique. *Land Reform, Land Settlement and Cooperatives Bulletin* (1–2): 1–28.

_____. 1990. Prices in Mozambican agriculture. *Journal of International Development* 2 (2): 172–208.

_____. 1993. Stabilization and structural adjustment: *Macroeconomic frameworks for analysing the crisis in sub-Saharan Africa.* London and New York: Routledge.

Taylor, L., ed. 1990. *Socially relevant policy analysis: Structuralist computable general equilibrium models for the developing world.* Cambridge, Mass., U.S.A., and London: MIT Press.

Tschirley, D., C. Donovan, and M. T. Weber. 1996. Food aid and food markets: Lessons from Mozambique. *Food Policy* 21 (2): 189–209.

Tschirley, D. L., and M. T. Weber. 1994. Food security strategies under extremely adverse conditions: The determinants of household income and consumption in rural Mozambique. *World Development* 22 (2): 159–173.

UNICEF (United Nations Children's Fund). 1989. *Children on the frontline—The impact of apartheid, destabilization and warfare on children in southern and South Africa.* New York.

Uzawa, H. 1962. Production functions with constant elasticities of substitution. *Review of Economic Studies* 29: 291–199.

Walters, B. 1995. Engendering macroeconomics: A reconsideration of growth theory. *World Development* 23 (11): 1869–1880.

Waterhouse, R. 1997. *Gender relations and the allocation and control of land and agricultural resources in Ndixe Village: A case study of Ndixe Village,* Maputo Province, southern Mozambique. Maputo: Action Aid.

World Bank 1982. *Accelerated development in Sub-Saharan Africa: An agenda for action.* Washington D.C.

_____. 1995a. *Memorandum of the President of the International Development Association to the Executive Directors on a country assistance strategy of the World Bank Group for the Republic of Mozambique.* Washington, D.C.

_____. 1995b. *The World Bank atlas.* Washington, D.C.

_____. 1996. *Mozambique Agricultural Sector memorandum, AFTA1.* Washington, D.C.

_____. 1997a. *Mozambique Agricultural Sector memorandum, volume II: Main report.* Report No. 16529 MOZ. Washington, D.C.

_____. 1997b. *World development indicators 1997*. Washington, D.C.

_____. 1998. *World development indicators 1998.* Washington, D.C.

World Bank/Republic of Mozambique. 1996. *Mozambique: Policy framework paper 1996–98.* Maputo: Republic of Mozambique

_____. 1997. *Mozambique: Policy framework paper 1997–99.* Maputo: Republic of Mozambique.

ZADP (Zambézia Agricultural Development Project). 1997. *A participatory rural appraisal of seven communities in Namacurra and Gurue Districts of Zambézia Province.* Maputo.

Zellner, A. 1988. Optimal information processing and Bayes theorem. *American Statistician* 42: 278–284.