

PN ARS-670
90411

AUGUST 1994
WORKING PAPER 71

Adjustment, External Shocks and Poverty in Lesotho: A Multiplier Analysis

Paul A. Dorosh

CORNELL FOOD AND NUTRITION POLICY PROGRAM



**ADJUSTMENT, EXTERNAL SHOCKS AND POVERTY
IN LESOTHO: A MULTIPLIER ANALYSIS**

Paul A. Dorosh*

* The author gratefully acknowledges the helpful comments and technical support by Emanuel Skowfias, Neeta Sirur, and Seth Vordzorghe. Special thanks are due to Steven Haggblade whose earlier work on linkages analysis provides the foundation for the model used here.

The Cornell Food and Nutrition Policy Program (CFNPP) was created in 1988 within the Division of Nutritional Sciences, College of Human Ecology, Cornell University, to undertake research, training, and technical assistance in food and nutrition policy with emphasis on developing countries.

CFNPP is served by an advisory committee of faculty from the Division of Nutritional Sciences, College of Human Ecology; the Departments of Agricultural Economics, Nutrition, City and Regional Planning, Rural Sociology; and from the Cornell Institute for International Food, Agriculture and Development. Graduate students and faculty from these units sometimes collaborate with CFNPP on specific projects. The CFNPP professional staff includes nutritionists, economists, and anthropologists.

CFNPP is funded by several donors including the Agency for International Development, The World Bank, UNICEF, the United States Department of Agriculture, the New York State Department of Health, The Thrasher Research Fund, and individual country governments.

Preparation of this document was financed by the U.S. Agency for International Development-Lesotho under project 632/0510, and was prepared as a component of a Poverty Assessment for The World Bank.

© 1994 Cornell Food and Nutrition Policy Program

ISBN 1-56401-171-2

This Working Paper series provides a vehicle for rapid and informal reporting of results from CFNPP research. Some of the findings may be preliminary and subject to further analysis.

This document was word processed by Mary Getsey. The text was formatted by Gaudencio Dizon. The cover was produced by Brent Beckley.

For information about ordering this manuscript and other working papers in the series contact:

CFNPP Publications Department
3M28 Martha Van Rensselaer Hall
Cornell University
Ithaca, NY 14853
607-255-8093

CONTENTS

LIST OF TABLES	v
LIST OF FIGURES	v
1. INTRODUCTION	1
Lesotho's Economy	1
2. MODELING ECONOMIC LINKAGES	3
The Social Accounting Matrix (SAM)	3
Overview of the Model	4
Underlying Premises	11
3. SECTORAL LINKAGES IN LESOTHO'S ECONOMY	13
4. IMPACTS OF STRUCTURAL ADJUSTMENT, DROUGHT, AND EXTERNAL FACTORS ON POVERTY	18
Reduced Government Expenditures	18
Drought	18
Migrant Remittances	22
Lesotho Highlands Water Project	22
5. CONCLUSIONS	24
Appendix A — Construction of the 1987 Social Accounting Matrix (SAM)	25
Consistency of the National Accounts and the 1986/87 Household Budget Survey	25
The 1987 Lesotho SAM	26
Appendix B — The Formal SIO Model	31
Objectives	31
Linearity Assumptions	31
Production Accounts (X^j)	31

Commodity Accounts (Z^1)	31
Household Accounts (Y^h)	34
Institutions (N)	35
Government G	35
Rest of the World (R)	36
Capital (S)	37
Parameter Restrictions	38
System Summary	38
Solving the Basic Model	38
Extensions	39
Reducing Urban Demand Linkages	39
Endogenous Investment	39

REFERENCES	44
-------------------	-----------

LIST OF TABLES

1	—	Production Activities in Lesotho, 1987	5
2	—	Household Expenditures, 1987 Survey Results	6
3	—	Lesotho: Value-Added Multipliers	14
4	—	Distributional Impacts of Increases in Sectoral Output (SIO Base Model)	15
5	—	Distributional Impacts of Increases in Sectoral Output (SIO Based Model, Reduced Urban Linkages)	17
6	—	Lesotho: Trends in Sectoral Aggregates, 1980-1992	19
7	—	Household Incomes in Lesotho: Policy Simulations (Base SIO Model)	20
8	—	Household Incomes in Lesotho: Policy Simulations (Base SIO Model with Reduced Urban Linkages)	21

APPENDIX TABLES

A.1	—	Activities in the 1987 Lesotho SAM	27
B.1	—	Model Equations	39
B.2	—	Input-Output Model	41
B.3	—	Semi-Input-Output Model	42

LIST OF FIGURES

1	—	Graphic Representation of Multiplier Effects	9
B.1	—	SAM Structure	32

1. INTRODUCTION

For most countries in sub-Saharan Africa, the decade of the eighties was marked by adverse external shocks and significant policy reform on the macro-economic and sectoral level. Stabilization programs brought about macroeconomic equilibrium at the cost of reduced outputs and incomes; structural adjustment reforms dismantled many government controls on production, marketing and prices, at times resulting in retrenchment of workers and removal of subsidies. How the poor have fared as a result of these changes and what policy measures are available to improve their welfare have been major concerns of governments and donors.

Lesotho is no exception. Uncertainties regarding possible declines in workers' remittances and growing fiscal imbalances led to the adoption of a structural adjustment program in 1988 that focused on cuts in government spending and increases in taxes. More recently, a severe drought in 1991 and 1992 reduced agricultural production and necessitated massive inflows of food aid and commercial imports. This paper examines how poor households in Lesotho have been affected by these external shocks and policy changes and explores policy options for alleviating poverty.

LESOTHO'S ECONOMY

Perhaps the most important characteristic of Lesotho's economy is its strong dependence on the Republic of South Africa, which completely envelopes it geographically. Workers' remittances from employment of Basotho laborers in South Africa's mines account for half the country's national income. Lesotho is part of the Rand zone, with the loti (plural maloti) tied to the South African rand at a fixed 1:1 exchange rate. As a member of the Southern African Customs Union (SACU), Lesotho's trade taxes are collected by the RSA government. SACU payments accounted for 51.5 percent of budgetary revenues (excluding grants) between 1988/89 and 1992/93. Finally, given the relative sizes of the two economies (the GDP of the RSA is more than x times that of Lesotho), the open borders permitting free trade and the linked currencies, prices in Lesotho of most goods are effectively determined by prices in its larger neighbor.

Agriculture and livestock dominate the rural economy, but account for less than one quarter of GDP. Soil erosion, drought and overgrazing have reduced productivity of these sectors despite government efforts at increasing output. The industrial sector is very small, although recent foreign investments in textiles have led to rapid growth. Construction on the Lesotho Highlands Water Project (LHWP) began in 1991 generating construction jobs in the local economy. Beginning in 1998, the project is expected to generate revenues from water exports to the RSA.

Most of the population (87.4 percent) lives in rural areas, with the highest rural population density in the lowland and foothill regions. Poverty is concentrated in rural areas with average expenditures per capita less than half those in cities. Rural households without income from workers' remittances account for nearly half of all households.

In order to understand how changes in economic policies and external shocks have affected poor households in Lesotho, this paper uses a semi-input-output (SIO) model of the economy to trace linkages between production activities, payments to factors, household incomes and household expenditures. The base data is a social accounting matrix (SAM), a consistent set of accounts showing economic flows across sectors and various actors in the economy. The SAM used in this study shows economic flows for 1987, just before the onset of the major structural adjustment policy reforms in Lesotho, and is constructed from an earlier SAM for 1984/85 by Carvalho (1988) and data from the national household budget survey of 1986/87 (Bureau of Statistics 1988).

Chapter 2 presents the model and the social accounting matrix, describing the methodology and assumptions. In Chapter 3, sectoral linkages in the Lesotho economy are described using the SIO model. Impacts on poverty of structural adjustment reforms, drought, changes in remittances and other factors are analyzed in Chapter 4. Policy implications are discussed in the concluding chapter.

2. MODELING ECONOMIC LINKAGES

Production, payments to labor and capital, household incomes and expenditures, and government spending and revenues are interrelated parts of an economy. Changes in output imply variations in wages and returns to land and capital which in turn determine household incomes. With their earnings, households purchase commodities and services for final consumption. Demand for intermediate goods also varies with output. Government expenditures help determine total demand in the economy and include wage payments to households. Taxes reduce real incomes for households while raising revenues for the government.

These relationships between production, incomes and expenditures are captured in a social accounting matrix (SAM), a consistent set of accounts describing economic flows in an economy during a fixed period of time. Adding behavioral equations linking changes in production, incomes and expenditures, defines a model of the economy with which the impacts of policy changes and exogenous shocks can be analyzed. In particular, by disaggregating households according to their sources and levels of income, it is possible to determine the effects of policies and other shocks on poor households.

In this chapter, a social accounting matrix for Lesotho is presented, highlighting salient features of the Lesotho economy, particularly the characteristics of lower income household groups. The methodology for constructing the SAM is described in broad terms; the appendix contains the details. A discussion of the semi-input-output (SIO) model follows.

THE SOCIAL ACCOUNTING MATRIX (SAM)

The social accounting matrix used in the multiplier analysis (see Appendix 1) derives from the Lesotho national accounts sectoral aggregates for 1987, data from the 1986/87 household budget survey,¹ and an earlier SAM for 1984/85 (Carvalho 1988). The 1987 social accounting matrix for Lesotho includes 24 activities producing the same number of commodities, 14 factors of production, 12 household groups, 5 accounts for nongovernment institutions (both private firms and various parastatals), government recurrent expenditures and separate accounts for the customs union, indirect taxes and direct taxes, a combined capital account, and two foreign accounts, showing trade and capital flows with the Republic of South Africa and with the Rest of World.

Table 1 shows the production activities included in the SAM. Agriculture and livestock together account for only 111 billion maloti, 17.8 percent of value

¹ Data on household characteristics and expenditures from the household budget survey were generated by Emmanuel Skoufias, a member of the Poverty Assessment team.

added, a low figure by sub-Saharan African standards. The construction sector is almost as large, 99 billion maloti. Public administration is in fact the largest sector in the economy, with a value-added of 143 billion maloti, 22.8 percent of the total. Not shown in the table are workers' remittances, equal to 706 million, greater than all production activities combined. With the large inflow of earnings from overseas, there is a corresponding large component of imports in total supply of commodities.

The 12 household groups in the 1987 Lesotho SAM are classified according to three major criteria: location (urban/rural), access to workers' remittances, and gender of the head of household (see Table 2). Only 12.6 percent of the population resides in urban areas, where household expenditures per capita are more than twice those of the average rural household. On average, households in the rural uplands regions (including the Senqu River Valley) are 20 percent poorer than their lowland neighbors in terms of per capita expenditures. Households with migrant incomes are generally significantly better off than those without migrant incomes. The exceptions are male-headed households in urban areas. Finally, female-headed households are significantly poorer than male-headed households in all cases except for rural uplands households without migrant income.

OVERVIEW OF THE MODEL²

Investment in productive sectors of the economy, changes in export demand and variations in workers' remittances all have effects which reverberate throughout the economy. As sectoral output increases, demand for intermediate production inputs rises. Wage incomes and returns to capital also increase, leading to greater demand for consumer goods. Changes in export demand can also result in increases in output of sectors where excess capacity exists. Similarly, variations in workers' remittances affect household incomes, their demand for goods and services, domestic production and imports.

Where domestic supply is inelastic in the short run, increased demand leads to reduced exports or increased imports. Where excess capacity exists, an increase in demand, either intermediate demand or final demand, leads to increased production. This in turn leads to an additional increase in domestic incomes, another increase in demand and further increases in production.

The measurement of these indirect effects requires a model that relates sectoral output, household income, consumer demand, and interindustry input linkages. A key determinant of the magnitude of these multiplier effects is the extent to which domestic productive sectors are able to increase domestic output when demand rises.

² This section is based on Dorosh and Haggblade (1992).

Table 1 — Production Activities in Lesotho, 1987

	Production	Value Added
	(Million maloti)	
Agriculture	76.258	52.488
Field crops	59.987	40.158
Vegetables	8.795	5.400
Fruits	7.476	6.930
Livestock	81.602	58.615
Cattle	24.920	19.752
Other livestock	33.029	16.253
Wool, mohair production	23.653	22.610
Mining	2.725	1.881
Meat processing	26.210	7.425
Dairy	0.000	0.000
Milling	172.145	22.168
Other food processing	46.401	22.637
Weaving, leather	11.047	3.900
Handicrafts	6.556	1.600
Textiles	47.713	19.000
Agricultural tools	4.057	1.474
Other manufactures	14.466	10.826
Electricity, water	5.678	4.747
Building, construction	135.375	98.542
Trade	106.499	60.000
Hotels, restaurants	21.807	11.839
Transport	26.970	13.658
Private services	76.575	53.758
Housing	47.268	38.300
Public administration	142.697	142.697
Total	1,052.049	625.556

Source: Bureau of Statistics, National Accounts computer files (1993); Carvalho (1988); and author's calculations.

Table 2 — Household Expenditures, 1987 Survey Results

	Number of Households (thousands)	Share of Households	Population		Average Household Size	Expenditures	
			('000)	Share		Per Capita	Per Household
Urban	46.3	14.1	183.5	12.6	3.962	91.9	364.0
Female households	14.6	4.4	53.0	3.7	3.639	68.0	247.4
With migrant income	2.0	0.6	9.7	0.7	4.753	59.1	281.0
Without migrant income	12.5	3.8	43.3	3.0	3.457	70.0	241.9
Male households	31.7	9.7	130.5	9.0	4.111	101.6	417.5
With migrant income	9.5	2.9	41.8	2.9	4.415	86.1	380.3
Without migrant income	22.3	6.8	88.6	6.1	3.981	108.9	433.4
Rural lowlands	191.2	58.2	855.5	58.9	4.473	47.6	213.1
Female households	50.9	15.5	198.7	13.7	3.907	34.1	133.1
With migrant income	14.3	4.3	74.1	5.1	5.197	40.5	210.6
Without migrant income	36.6	11.1	124.6	8.6	3.405	30.2	102.9
Male households	140.4	42.8	658.8	45.3	4.679	51.7	242.1
With migrant income	75.4	23.0	368.2	25.4	4.881	63.2	308.5
Without migrant income	64.9	19.8	288.5	19.9	4.443	37.1	164.8
Rural uplands	90.8	27.6	412.4	28.4	4.543	37.6	170.9
Female households	23.6	7.2	84.4	5.8	3.580	36.4	130.1
With migrant income	5.0	1.5	23.9	1.6	4.821	36.2	174.4
Without migrant income	18.6	5.7	60.5	4.2	3.250	36.4	118.4
Male households	67.2	20.5	328.0	22.6	4.881	38.0	185.3
With migrant income	27.3	8.3	138.8	9.6	5.085	47.0	238.8
Without migrant income	39.9	12.2	189.2	13.0	4.741	31.4	148.7
All Lesotho	328.3	100.0	1,451.3	100.0	4.421	50.3	222.2

Source: Bureau of Statistics 1987 Household Budget Survey computer data files (1988b), and author's calculations.

One option, the input-output model, embodies the classic approach to this question. It sets total supply in each sector (Z) equal to the two sources of demand, interindustry input demand (AZ) and final consumption demand (F). Final demand includes consumption by households (BY) and exogenous sources of demand such as exports (E). The value-added share (v) in gross commodity output (Z) determines income (Y).

$$\begin{aligned} Z &= AZ + F \\ &= AZ + \beta Y + E \\ &= AZ + \beta v Z + E \end{aligned} \quad (1)$$

Presuming supply to be perfectly elastic in all sectors, total output and incomes become determined by the level of exogenous demand (E).

$$Z = (I - M)^{-1} E \quad (2)$$

Because they assume perfectly elastic supply in all sectors, input-output models overestimate output responses following from any intervention or exogenous shock. Yet in reality, in most developing countries some sectors face supply constraints. This is especially true for agriculture, where land, labor, rainfall and technology frequently limit output, and formal manufacturing where physical capital and skilled labor are limiting factors. By ignoring supply constraints altogether, input-output models typically overstate multiplier effects. For example, agricultural growth multipliers are overstated by a factor of two to ten (Haggblade, Hammer, and Hazell 1991).

A more realistic alternative is to use a semi-input-output (SIO) model. While retaining many of the basic assumptions of the IO approach, the SIO model differs in that it introduces supply rigidities in some sectors. The following two equations, contrasted with (1) and (2) above, capture the SIO model's essential distinction. By classifying all economic sectors as either supply-constrained (Z_1) or perfectly elastic in supply (Z_2), the SIO model permits output responses only in some sectors (Z_2). In supply-constrained sectors (Z_1), increases in domestic demand merely reduce net exports (E_1), which then become endogenous to the system.

$$\begin{aligned} Z_1 &= A_1 Z + \beta_1 v_1 Z + E_1 \\ Z_2 &= A_2 Z + \beta_2 v_2 Z + E_2 \end{aligned} \quad (3)$$

$$\begin{bmatrix} E_1 \\ Z_2 \end{bmatrix} = (I - M^*)^{-1} \begin{bmatrix} Z_1 \\ E_2 \end{bmatrix} \quad (4)$$

For a formal exposition of the SIO model, see Appendix B.

The semi-input-output (SIO) model is described graphically in Figure 1. For simplicity of exposition, the figure shows only three aggregated categories: (Z_1) textile factories; (Z_2) other supply-constrained commodities: tradables such as foodgrains, livestock, other formal manufacturing; and (Z_3) commodities highly elastic in supply: nontradables such as services, informal industries, perishable agriculture.

Consider first the consequences of public investments in production of textiles, e.g. through the construction of a new factory. The immediate impact of the intervention is to increase output of textiles.

In Round 1, this directly raises national income by 0.398 loti for every one loti of increased textile output. This direct injection triggers a series of responses that increase income even more.

In Round 2, the economy registers increased demand for the inputs used in textile production plus increased household spending on consumer goods. These twin channels increase domestic demand for textiles, other supply-constrained tradables and the highly elastic supply of nontradable domestic services, informal manufactures and perishable agricultural commodities. For textiles and other supply-constrained tradables, this increase in demand does not stimulate further domestic production. It merely decreases net exports. In contrast, because of the elastic supply of nontradables, increased demand leads to higher output and higher domestic incomes in these other sectors.

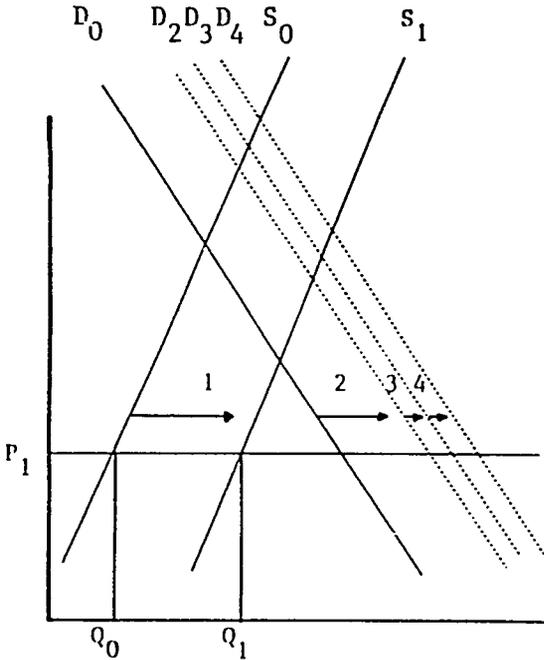
The increased production of commodities with elastic supply (Z_3) once again raises demand for production inputs and consumer goods. In Round 3, this increases demand in all three sectors. As before, production of textiles and other supply-constrained commodities does not increase. Instead, net exports decrease still more. For this reason, as Equation (4) indicates, exports in these supply-constrained sectors become endogenous to the model. Yet once again, output and incomes rise in the activities with highly elastic supply. This induces further rounds of successively dampening demand increases.

In total, the indirect effects of the investment in textile production, from Rounds 2 on, stimulate another 0.457 maloti in national income. Thus the total increase resulting from textile investments equals $0.398 + 0.457 = 0.855$.

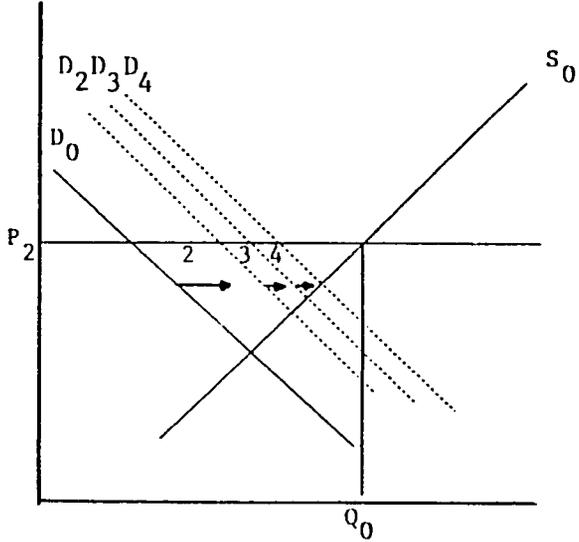
An increase in worker remittances will generate a similar sequence of events. They differ mainly in that the shock, the increase in household incomes due to worker remittances, does not entail an initial increase in domestic supply. The second round demand shifts thus are based only on increased consumption, with no gains due to increased demand for intermediate inputs. Also because the change in incomes across households is different from that resulting the gain in textile production, the composition and magnitude of the demand effects will differ. Ultimately, the total income gain will also be different.

Figure 1 - Graphic Representation of Multiplier Effects

Textiles



Field Crops and other Supply-constrained Tradables



Sectors with Perfectly Elastic Supply

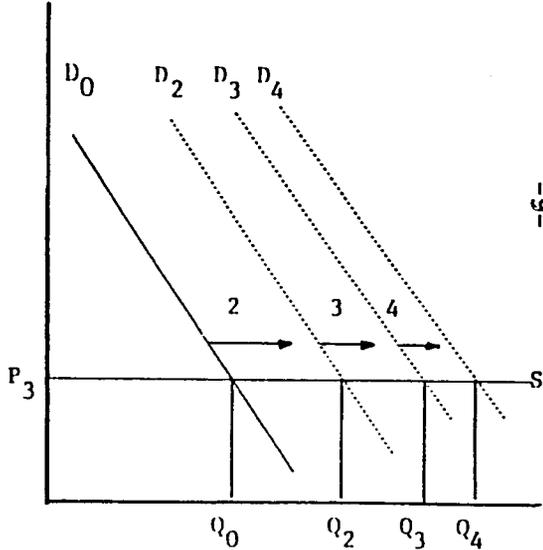


Figure 1 (continued)

Textiles	Field crops	Services
(Inelastic supply, imported good)	(Inelastic supply, exported good)	(Nontraded goods, perfectly elastic supply)
Round 1		
Invest in textiles - increase in supply - increase in farmer income		
Round 2		
Increased demand (final and intermediate goods); supply fixed at Q^1 - exports decrease - income unchanged	Increased demand (final and intermediate goods); supply fixed at Q^0 - exports decrease - domestic output and income unchanged	Increased demand (final and intermediate goods) - increased output - increased income
Rounds 3 and 4		
Increased demand (final and intermediate goods); supply fixed at Q^1 - exports decrease - domestic output and income unchanged	Increased demand (final and intermediate goods); supply fixed at Q^0 - exports decrease - domestic output and income unchanged	Increased demand (final and intermediate goods) - increased output - increased income

UNDERLYING PREMISES

Two key assumptions underlay the semi-input-output (SIO) model: linearity and fixed prices. As with many kinds of economic models, the SIO requires that all relationships be expressed as linear functions. For intermediate inputs, this standard assumption suggests that increases in output require additional inputs in fixed proportions. For household consumption, it requires that consumption expenditures rise in tandem with income. Although marginal expenditures or input demands may differ from the average, the increments must be expressed as linear functions of output and income.

In general, this simplification does not pose great problems. Nonlinear systems can be approximated by linear functions in the short run. And they offer considerable conveniences in computing model solutions.

Fixed prices likewise vastly simplify computational requirements by side-stepping cumbersome issues of substitution in production and consumption. Input-output coefficients and marginal budget shares, which remain fixed in a fixed-price world, become endogenous variables in a model where relative prices vary. While computational convenience is not a strong rationale for imposing fixed prices, it does offer a strong incentive to investigate the plausibility of such an assumption.

Lesotho is an almost ideal case for a fixed price model because of its open borders and monetary union with the RSA. For tradable goods, the markets in the RSA determine the price level of these goods in Lesotho to a large extent. For nontraded goods, such as services, informal manufactured goods and many perishable agricultural commodities, fixed prices depend on firms' ability to increase output at constant cost. Formally, this requires a perfectly elastic output supply. Because of the considerable unemployment and excess capacity present in Lesotho, the constant cost assumption appears to be a reasonable approximation of reality. Moreover, given the monetary union, there is little scope for changes in the general price level of nontradables in Lesotho relative to those in the RSA.

The proximity of Maseru and other major urban centers to the border with the Republic of South Africa poses other problems — almost no goods or services are truly nontradable for urban consumers. Urban Basotho purchase fresh vegetables imported from South Africa in local markets. Households also cross the border to make purchases of goods and services. To account for these purchases, which in terms of the multiplier analysis, represent a leakage from Lesotho's economy, a version of the SIO model is used in which a fixed fraction (70 percent) of urban households' marginal consumption expenditures are imported.

At some point, as expansion and liberalization proceed, supply constraints may develop in some of Lesotho's nontradable sectors. If this occurs, the SIO model will overstate multipliers resulting from changes in investment and demand. Consequently, some sort of adjustment will be required to capture the income-dampening effects of the price increases that will follow. Recent experiments suggest that in the face of upward-sloping nontradable supply, SIO

models overstate true income multipliers by 10 to 25 percent (Haggblade, Hammer, and Hazell 1991). So the simplest accommodation would involve rule-of-thumb discounting based these results.

A much more involved alternative would be to create a computable general equilibrium model with endogenous prices. This type of model would also enable analysis of changes in the real exchange rate vis à vis countries other than the RSA, which could affect the real price of certain tradable goods. Given the heavy data requirements, the small size of non-RSA trade, and the relatively small role of price changes for economy policy in Lesotho, this latter approach is probably not cost effective.

3. SECTORAL LINKAGES IN LESOTHO'S ECONOMY

Table 3 provides measures of sectoral linkages in Lesotho's economy under various assumptions regarding investment and elasticity of supply. In column 1, multipliers using the basic SIO model are given. Here, investment and government spending are held fixed as is the production of the 11 sectors assumed to have inelastic supplies. Leakages from the economic system occur in three ways: through the share of demand of goods with elastic supplies allocated to imports, through increases in net imports of goods with inelastic supplies, and through savings and tax revenues which accumulate but do not lead to increased investment or government spending.

Because these leakages from the domestic economy are very large, the value added multipliers (the additional value added generated after the initial shock per unit of value added from the shock itself), for Lesotho are quite small. Using value added by activity as weights, the average value added multiplier is only 0.527. Value-added multipliers in other countries typically range from 1.3 to 1.5 in other African countries (Haggblade, Hazell, and Brown 1989; Haggblade and Hazell 1990; Lewis and Thorbecke 1990).

Only three sectors — mining, milling, and handicrafts — have value-added multipliers greater than 1.1. Value-added multipliers are particularly low in agriculture, ranging from 0.09 to 0.17. The multiplier for workers' remittances is also very low, 0.159, given that there are no backward linkages involved in generating this income. Only demand-side forward linkages are generated with increases in workers' remittances.

The multipliers are only somewhat lower if greater leakages from urban spending are modeled (column 2). Under the assumption that 70 percent of urban consumption of "nontradables" is spent on goods and services produced in the Republic of South Africa, the average multiplier falls to 0.482, a decrease of 8.5 percent. The decline in the multiplier is rather small due to the fact that large leakages are already modeled in the SIO framework, given that demand for goods that are inelastically supplied is met through an increase in imports.

Allowing savings generated to augment aggregate demand by allowing investment to be endogenous increases the multipliers slightly, to an average of 0.699. These multipliers capture only the demand-side effects of investment, not any gain in productive capacity that leads directly to increased production and incomes. Savings generated in the Lesotho economy does not necessarily lead to investment in Lesotho, of course. Capital flight may also occur, in which case there would be little, if any, gain in investment demand.

In Table 4, the breakdown in value-added paid to households is presented for multipliers for key commodities and for changes in workers' remittances.

Table 3 — Lesotho: Value-Added Multipliers

	Inelastic Supply (*)	SIO Model	SIO Model with Reduced Urban Demand	SIO Model with Endogenous Investment
Field crops	*	0.149	0.136	0.232
Vegetables		0.091	0.062	0.225
Fruits		0.165	0.157	0.228
Cattle	*	0.149	0.135	0.229
Other livestock	*	0.141	0.125	0.228
Wool, mohair production	*	0.131	0.113	0.227
Mining	*	1.955	1.890	2.269
Meat processing		0.736	0.686	0.941
Dairy		1.155	1.092	1.480
Milling		0.652	0.591	0.903
Other food processing	*	1.021	0.957	1.201
Weaving, leather		0.832	0.780	0.978
Handicrafts		1.148	1.098	1.325
Textiles	*	0.667	0.615	0.909
Agricultural tools	*	0.209	0.174	0.357
Other manufactures	*	0.155	0.106	0.281
Electricity, water	*	0.811	0.785	1.148
Building, construction		0.764	0.717	1.012
Trade		0.793	0.725	1.014
Hotels, restaurants		0.670	0.620	0.911
Transport		1.034	0.969	1.264
Private services		0.264	0.210	0.326
Housing	*	0.173	0.111	0.229
Public administration				
Weighted average		0.527	0.482	0.699
Workers' remittances		0.159	0.155	0.219

Source: Model simulations.

**Table 4 —Distributional Impacts of Increases in Sectoral Output
(SIO Base Model)**

	Effect of a 1 Loti Increase in Value Added						
	Field Crops*	Cattle*	Handi- crafts	Textiles*	Other Manufactures*	Construc- tion	Migrant
Remittances							
Household income							
Urban							
Male households							
With migrant income	0.045	0.039	0.239	0.208	0.106	0.080	0.029
Without migrant income	0.070	0.074	0.254	0.256	0.183	0.136	0.015
Female households							
With migrant income	0.008	0.008	0.037	0.034	0.020	0.015	0.005
Without migrant income	0.031	0.037	0.068	0.088	0.087	0.063	0.005
Rural lowlands							
Male households							
With migrant income	0.108	0.106	0.105	0.131	0.035	0.071	0.694
Without migrant income	0.271	0.265	0.299	0.370	0.080	0.166	0.010
Female households							
With migrant income	0.014	0.014	0.014	0.018	0.006	0.010	0.087
Without migrant income	0.089	0.089	0.101	0.129	0.042	0.064	0.004
Rural uplands							
Male households							
With migrant income	0.029	0.029	0.029	0.037	0.012	0.021	0.181
Without migrant income	0.151	0.148	0.167	0.208	0.048	0.095	0.006
Female households							
With migrant income	0.004	0.004	0.004	0.005	0.002	0.003	0.025
Without migrant income	0.062	0.061	0.070	0.087	0.022	0.040	0.002
Urban	0.154	0.158	0.598	0.586	0.396	0.294	0.054
Male households	0.115	0.113	0.492	0.464	0.289	0.216	0.044
Female households	0.039	0.045	0.105	0.122	0.107	0.078	0.010
Rural	0.729	0.717	0.789	0.985	0.248	0.470	1.009
Male households	0.559	0.549	0.600	0.746	0.175	0.353	0.891
Female households	0.170	0.168	0.189	0.239	0.072	0.117	0.118
Poor	0.591	0.582	0.655	0.817	0.200	0.379	0.134
Nonpoor	0.292	0.293	0.732	0.754	0.443	0.386	0.929
Total	0.883	0.875	1.387	1.571	0.643	0.764	1.063
Share of income to households							
Poor	0.670	0.665	0.472	0.520	0.312	0.495	0.126
Nonpoor	0.330	0.335	0.528	0.480	0.688	0.505	0.874

Source: Model simulations.

Note: * indicates sectors with inelastic supply.

Increases in value added from handicrafts, textiles, and agriculture (e.g., field crops, cattle) generate the largest gains in income for poor households (0.591-0.817). Benefits to the poor from increases in construction output are slightly less (0.379). By contrast, a 1 loti increase in output of manufacturing benefits poor households little (0.200 M). Likewise, a change in the wage rate paid to workers employed in South Africa has only a small effect on poor households, since households receiving remittances are not considered poor (by definition), and the multiplier effects are small. The magnitudes of the multipliers are only slightly reduced with the reduced urban linkages version of the SIO model (Table 5).

The share of income that accrues to poor households as a result of an equal 1 maloti increase in output or demand of the sectors shown varies. About two-thirds of the income generated from increases in field crops and cattle accrue to the poor. Incomes generated from increases in demand for handicrafts and construction or and increase in textiles output are split evenly between poor and nonpoor. For other manufacturing and migrant remittances, however, the nonpoor accumulate the largest share of increased incomes (69 and 87 percent, respectively, in the base SIO model runs).

Two basic conclusions arise from these model simulations. First, linkages in Lesotho's economy are weak, so that the direct effects of changes in supply generally outweigh the multiplier effects. A large percentage of goods in the economy are tradable to some extent, and increased demand for these goods is met largely by a rise in net imports. For nontradables, some investments in processing and marketing may be necessary to make these goods tradable and open the South African market. Investments in processing and marketing of asparagus are an example of transforming an essentially nontradable, perishable product into an exportable one. Most important, the effective long-run multipliers could be substantially higher if increased incomes lead to more local investment in and increased production of tradables.

Second, since the multiplier effects are generally small, investments in sectors which pay a large share of their value added to the poor will tend to have the largest impacts in reducing poverty. Because the majority of the poor reside in rural areas, increases in agricultural incomes have a large potential for reducing overall poverty in Lesotho.

**Table 5 —Distributional Impacts of Increases in Sectoral Output
(SIO Base Model, Reduced Urban Linkages)**

	Effect of a 1 Loti Increase in Value Added						
	Field Crops*	Cattle*	Handi- crafts	Textiles*	Other Manufactures*	Construc- tion	Migrant
Remittances							
Household income							
Urban							
Male households							
With migrant income	0.044	0.037	0.233	0.202	0.102	0.078	0.029
Without migrant income	0.069	0.072	0.247	0.250	0.178	0.132	0.014
Female households							
With migrant income	0.008	0.007	0.037	0.033	0.019	0.014	0.004
Without migrant income	0.030	0.037	0.065	0.085	0.085	0.062	0.005
Rural lowlands							
Male households							
With migrant income	0.108	0.106	0.103	0.129	0.034	0.070	0.694
Without migrant income	0.270	0.264	0.294	0.365	0.077	0.164	0.010
Female households							
With migrant income	0.014	0.014	0.014	0.018	0.006	0.010	0.087
Without migrant income	0.089	0.089	0.099	0.127	0.041	0.063	0.004
Rural uplands							
Male households							
With migrant income	0.029	0.029	0.028	0.036	0.012	0.020	0.181
Without migrant income	0.150	0.147	0.165	0.205	0.047	0.094	0.006
Female households							
With migrant income	0.004	0.004	0.004	0.005	0.002	0.003	0.025
Without migrant income	0.062	0.061	0.069	0.086	0.021	0.040	0.002
Urban							
Male households							
With migrant income	0.112	0.110	0.480	0.452	0.280	0.210	0.043
Without migrant income	0.038	0.044	0.102	0.119	0.105	0.077	0.009
Female households							
With migrant income	0.004	0.004	0.004	0.005	0.002	0.003	0.025
Without migrant income	0.062	0.061	0.069	0.086	0.021	0.040	0.002
Rural							
Male households							
With migrant income	0.725	0.713	0.776	0.972	0.239	0.464	1.008
Without migrant income	0.557	0.546	0.590	0.736	0.169	0.348	0.890
Female households							
With migrant income	0.169	0.168	0.186	0.236	0.070	0.116	0.117
Without migrant income	0.169	0.168	0.186	0.236	0.070	0.116	0.117
Poor							
With migrant income	0.589	0.579	0.645	0.806	0.193	0.373	0.133
Without migrant income	0.287	0.288	0.714	0.736	0.431	0.377	0.928
Nonpoor							
With migrant income	0.287	0.288	0.714	0.736	0.431	0.377	0.928
Without migrant income	0.287	0.288	0.714	0.736	0.431	0.377	0.928
Total							
With migrant income	0.876	0.867	1.358	1.543	0.624	0.750	1.060
Without migrant income	0.876	0.867	1.358	1.543	0.624	0.750	1.060
Share of income to households							
Poor							
With migrant income	0.672	0.667	0.475	0.523	0.310	0.498	0.125
Without migrant income	0.328	0.333	0.525	0.477	0.690	0.502	0.875
Nonpoor							
With migrant income	0.328	0.333	0.525	0.477	0.690	0.502	0.875
Without migrant income	0.328	0.333	0.525	0.477	0.690	0.502	0.875

Source: Model simulations.

Note: * indicates sectors with inelastic supply.

4: IMPACTS OF STRUCTURAL ADJUSTMENT, DROUGHT, AND EXTERNAL FACTORS ON POVERTY

In this section, key aspects of policy changes and external shocks on Lesotho's economy in recent years are simulated in order to shed light on the likely impacts on poor households. The analysis focuses on the impact of reduced fiscal expenditures as part of the structural adjustment program initiated in the late eighties, drought, changes in workers' remittances and increases in construction activities associated with the Lesotho Highland Water Project (LHWP).

Each simulation presented uses the SIO model developed in Chapter 2 to analyze the effects of changes in policies and external shocks. Government spending is exogenous in these simulations as is the level of output of the public administration. It is important to keep in mind that the results represent averages for household groups and there may be a wide variance in experience of individual households within groups.

REDUCED GOVERNMENT EXPENDITURES

As part of efforts to reduce the government budget deficit, government consumption was cut by 5.8 percent in real terms in 1989 (Table 6). Since then, real government consumption has risen by 13.7 percent. Despite this recent increase, government spending is below the trend levels prior to the structural adjustment program when it rose by 26.5 percent in real terms between 1983 and 1988 (an average of 4.8 percent per year). The actual level of government consumption in 1992 is 13.1 percent below the earlier trend.

The first simulation shows the impact of a 13.1 percent cut in real government output. This reduction in spending strikes government workers the most as wages and salary payments were reduced. Overall, the reduction in spending reduces real household incomes by 1.63 percent, using the base SIO model (Table 7), with the reduced urban demand linkage version of the model, the reduction in real household incomes is 1.58 percent (Table 8). The brunt of these policies is borne by urban groups, whose incomes fall by 2.25 to 5.90 percent with the base SIO model (Table 7). Rural households with migrant income are essentially untouched by the policy since multiplier effects are small. Because earnings from rural government employment are spread across rural households, especially those without migrant incomes, some rural households suffer a decline in income.

DROUGHT

The drought in 1991 and 1992 led to reduced real output of field crops by 77.6 percent compared to 1990 output (Table 6). The value of production in 1990 was unusually high, however, 78 percent greater than in 1987. Compared to 1987,

Table 6 —Lesotho: Trends in Sectoral Aggregates, 1980-1992

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Agriculture: Crops, vegetables, fruits													
Current prices	28.8	33.7	30.6	27.5	32.1	41.2	43.4	52.5	86.6	82.8	126.2	69.1	26.1
Constant prices	28.8	27.3	22.0	17.8	19.4	22.8	22.2	22.0	34.4	30.7	39.2	18.6	8.8
Agriculture: Livestock													
Current prices	23.9	35.3	30.3	39.6	50.3	47.9	57.1	58.6	103.7	131.9	113.3	96.4	122.2
Constant prices	23.9	27.5	21.5	24.5	28.4	24.0	29.5	24.7	27.3	35.7	28.8	30.1	25.9
Factor income from abroad, net													
Current prices	205.0	254.8	372.9	423.1	487.2	514.3	583.3	705.9	829.7	927.8	1101.8	1238.8	1266.4
Constant prices	205.0	227.3	284.9	285.1	289.1	265.8	254.8	271.7	285.3	264.9	266.1	258.5	224.9
Government consumption													
Current prices	74.0	81.0	89.9	91.7	98.6	135.9	159.3	171.5	215.6	222.2	234.6	314.2	380.5
Constant prices	74.0	74.3	78.4	76.7	79.7	84.5	93.2	94.5	97.0	91.3	92.7	98.5	103.8
Construction													
Current prices	33.1	36.0	56.2	39.8	50.8	78.3	71.5	98.5	134.3	214.2	291.7	352.0	422.4
Constant prices	33.1	31.4	41.6	24.9	29.3	38.4	30.3	36.0	41.5	63.2	76.2	78.8	85.7
Gross fixed capital formation, building and construction													
Current prices	74.7	79.9	125.8	84.7	109.9	171.2	158.1	215.7	317.2	634.2	957.7	1089.2	1359.6
Constant prices	74.7	69.7	93.1	52.7	62.0	84.8	64.6	77.3	102.2	180.8	239.6	239.6	262.2

Source: Bureau of Statistics, National Accounts computer files (1993).

Table 7 —Household Incomes in Lesotho: Policy Simulations
(Base S10 Model)

	Reduced Government Spending (1)	Drought (2)	Reduced Migrant Incomes (3)	Subtotal (4)	LHWP (5)	Total (6)
Urban						
Male households						
with migrant income	-5.90	-1.09	-3.31	-10.30	6.10	-4.20
without migrant income	-4.88	-1.63	-1.63	-8.13	9.80	1.67
Female households						
with migrant income	-5.44	-1.22	-3.19	-9.85	7.03	-2.81
without migrant income	-2.25	-2.22	-1.72	-6.19	14.19	8.00
Rural lowlands						
Male households						
with migrant income	-0.22	-0.53	-15.81	-16.56	1.08	-15.49
without migrant income*	-2.53	-7.69	-1.33	-11.55	14.73	3.18
Female households						
with migrant income*	-0.22	-0.55	-15.62	-16.39	1.24	-15.15
without migrant income*	-2.20	-6.97	-1.44	-10.60	15.53	4.93
Rural uplands						
Male households						
with migrant income	-0.22	-0.54	-15.67	-16.43	1.20	-15.23
without migrant income*	-2.48	-7.58	-1.35	-11.40	14.86	3.46
Female households						
with migrant income*	-0.22	-0.56	-15.50	-16.28	1.34	-14.94
without migrant income*	-2.51	-7.87	-1.46	-11.83	15.94	4.11
Urban	-5.37	-1.37	-2.45	-9.19	8.00	-1.19
Male households	-3.27	-1.90	-2.19	-7.36	11.89	4.53
Female households						
Rural	-0.62	-1.78	-13.25	-15.65	3.50	-12.15
Male households	-1.02	-3.14	-10.17	-14.34	6.79	-7.55
Female households						
Poor	-1.78	-5.42	-5.71	-12.90	10.82	-2.08
Nonpoor	-1.59	-0.80	-11.92	-14.31	3.31	-11.00
Total	-1.63	-1.87	-10.49	-13.99	5.05	-8.94

Source: Model simulations.

Note: * indicates "poor" households.

Table 8 — Household Incomes in Lesotho: Policy Simulations
(Base SIO Model with Reduced Urban Linkages)

	Reduced Government Spending (1)	Drought (2)	Reduced Migrant Incomes (3)	Subtotal (4)	LIWP (5)	Total (6)
Urban						
Male households						
with migrant income	-5.78	-1.06	-3.26	-10.10	5.90	-4.20
without migrant income	-4.74	-1.59	-1.56	-7.88	9.56	1.67
Female households						
with migrant income	-5.32	-1.19	-3.13	-9.63	6.82	-2.81
without migrant income	-2.09	-2.18	-1.64	-5.91	13.91	8.00
Rural lowlands						
Male households						
with migrant income	-0.21	-0.53	-15.81	-16.55	1.06	-15.49
without migrant income*	-2.42	-7.66	-1.27	-11.35	14.53	3.18
Female households						
with migrant income*	-0.21	-0.54	-15.62	-16.37	1.22	-15.15
without migrant income*	-2.07	-6.93	-1.38	-10.38	15.31	4.93
Rural uplands						
Male households						
with migrant income	-0.21	-0.54	-15.66	-16.42	1.18	-15.23
without migrant income*	-2.56	-7.54	-1.29	-11.20	14.66	3.46
Female households						
with migrant income*	-0.21	-0.56	-15.49	-16.26	1.32	-14.94
without migrant income*	-2.38	-7.83	-1.40	-11.61	15.72	4.11
Urban						
Male households	-5.25	-1.33	-2.39	-8.96	7.77	-1.19
Female households	-3.13	-1.86	-2.12	-7.11	11.64	4.53
Rural						
Male households	-0.60	-1.77	-13.23	-15.60	3.46	-12.15
Female households	-0.97	-3.12	-10.15	-14.24	6.60	-7.55
Poor	-1.69	-5.39	-5.67	-12.75	10.68	-2.07
Nonpoor	-1.54	-0.79	-11.90	-14.24	3.23	-11.00
Total	-1.58	-1.85	-10.46	-13.89	4.95	-8.94

Source: Model simulations.

Note: * indicates "poor" households.

output in 1992 was down by 60 percent. In contrast, production of livestock in 1992 was almost identical to that of 1987. In simulation 2, only a 60 percent decline in output of field crops is modeled.

Because agricultural crop production accounts for less than 20 percent of GDP (less than 10 percent of national income), the drought has only a slightly larger impact on household incomes (-1.87 percent) in aggregate than the reduction in government spending (Table 7). The poor are especially hard hit, however, suffering a decline in real incomes of 5.42 percent. Rural households without migrant income see a decline of 6.97 to 7.87 percent.

MIGRANT REMITTANCES

Migrant workers remittances fell by 17.2 percent in real terms between 1987 and 1992, sharply reducing national income over the period. In simulation 3, incomes of rural households with remittance earnings fall by 15.5 to 15.8 percent. Urban households with migrant incomes see a smaller percentage decline in household income other earnings sources make their households less dependent on remittances. Overall, the decline in remittance earnings affects mostly the nonpoor households, whose incomes fall by 11.9 percent. Rural households without remittances see a decline in incomes of less than 1.5 percent.

Combining the effects of reduced government spending, drought and lower migrant remittances, simulation 4 shows an average decline of 14.0 percent in household income. Hardest hit are households with migrant incomes, but nonmigrant rural households also see declines of 10.7 to 11.8 percent.

LESOTHO HIGHLANDS WATER PROJECT

Fortunately, investment activity associated with the Lesotho Highlands Water Project began during this period. Value added generated in the construction sector increased by 138 percent as gross fixed capital formation rose by a similar magnitude. Assuming that this construction spending followed the same structure as that of 1985 in terms of domestic labor,³ the increase in construction generates demand for labor and sharply raises the incomes of households without migrant workers' earnings.⁴ Urban households benefit more than do rural households, though the gain in incomes of female headed households

³ To the extent that this construction demand resulted in greater demand for non-Basotho workers, the positive effects on domestic households are reduced.

⁴ Historically, as reflected in the 1987 SAM, households with migrant workers remittances generally earned little income from other sources. Since the SIO model allocates shares of labor income according to the pattern observed in 1987, migrant worker households receive only a small portion of the gains in domestic labor incomes in this simulation.

may be overstated if they are unable to obtain greater wage earnings from construction sector activities.⁵

Combining the effects of all four shocks (column 6 of Table 7), the importance of construction activities of the LHWP in preventing a substantial decline in incomes of the poor is highlighted. Without the increased earnings emanating from the increased investment spending, average incomes of the poor fall by 12.9 percent as a result of policy changes and external shocks. Incomes of the poor fall only by 2.1 percent once the impact of the LHWP spending is included.

⁵ Since many construction activities involve manual labor, female headed households without males of working age may not have gained wage earnings directly from the construction sector. Further disaggregation of the structure of households would shed some light on this issue, but without further disaggregation of labor in the SAM (for which little data exists), only limited refinements of the model analysis are possible.

24

5. CONCLUSIONS

Linkages across sectors in Lesotho's economy are generally very small. Open borders, monetary arrangements and labor flows knit the economy of Lesotho tightly together with South Africa. These arrangements help to stabilize prices, encourage trade and raise household incomes from migrant remittances, but they also result in large leakages from the domestic economy and low multiplier effects within Lesotho. One implication is that development projects cannot count on large spread effects through second-round multipliers. The large neighboring market offers the potential for exports of goods for which productivity in Lesotho is high because of special land characteristics, existing investments or skilled labor.

The impacts of structural adjustment in Lesotho on household incomes have been relatively small given the limited policy measures undertaken (no devaluations, only limited tightening of fiscal policy). The poor, who largely reside in rural areas, do not appear to have been affected greatly by cuts in government spending, in part because of the linkage effects across sectors are small. Of greater importance has been the drought which reduced incomes of the poor by 5.4 percent relative to 1987 (and by a greater magnitude relative to 1990). The decline in workers' remittances has affected mostly the nonpoor on average, reducing their incomes by 11.9 percent. However, among those households who lost remittance earnings entirely, the impacts are likely to have been much larger.

Fortunately, the direct impact of construction activities appear to have raised household incomes to offset to a large extent the adverse shocks of drought, reduced migrant earnings and fiscal conservatism. Greater spinoffs from the LHWP are possible if future government revenues are used to help establish permanent enterprises.

Finally, a word of caution. The analysis of impacts of policy changes and external shocks on households focus on household averages, using patterns of expenditures and sources of revenue estimated for 1987. The rather optimistic picture suggested by the simulations for average household incomes hides large adverse changes experienced by individual households, who unlike the average household, may have lost a crop or job and thus suffered a far greater income decline. For these households and others who gained little from the spinoffs of increased construction activities, targeted poverty alleviation measures may be justified.

APPENDIX A: CONSTRUCTION OF THE 1987 SOCIAL ACCOUNTING MATRIX (SAM)

The original social accounting matrix (SAM) for Lesotho, hereafter referred to as the 1985 SAM, was constructed as part of a Ph.D. thesis by Joe Carvalho in 1988 (Carvalho 1988). This SAM is not consistent with the current national accounts figures for 1985 for two reasons. First, national accounts figures are now reported on a calendar year basis rather than on a fiscal year (April-March) basis, while the 1985 SAM was constructed to be consistent with the 1984/85 national accounts.⁶ Second, the base by which output and value added of several sectors are calculated has changed as data from the October 1986-September 1987 Household Budget Survey have been incorporated in the methodology.

Lesotho's national accounts are calculated without an input-output (IO) table. Value-added is estimated based on production, known inputs and for some sectors, assumed value-added/output coefficients (Bureau of Statistics 1990). The IO table constructed by Carvalho (1988) is not used.

CONSISTENCY OF THE NATIONAL ACCOUNTS AND THE 1986/87 HOUSEHOLD BUDGET SURVEY

An attempt has been made by the Bureau of Statistics to reconcile the data on household consumption in the national accounts for 1987 with the total expenditure data from the 1986/87 Household Budget Survey. A number of adjustments to the survey data for cash and in-kind household consumption (equal to 828.9 million malotis) are made including:⁹

1. Underreporting of consumption of alcoholic beverages and tobacco (M 70.0 million), meat and chicken from the household's own production (M 35.0 million), and food in kind from the Work for Food Programme (M 25.0 million),⁹

⁶ The Central Statistics Office began producing national accounts on a calendar year basis in 1987 and has since produced a revised calendar year series for 1980 to the present (1992).

⁷ The sectors for which production and value added estimates are in part derived from the 1986/87 Household Budget Survey include vegetables, fruits, small-scale manufacturing, construction, wholesale and retail trade, restaurants and hotels, transport, real estate and business services, health and other services.

⁸ These adjustments are described in even greater detail in Bureau of Statistics (1990, pp.94-99).

⁹ The estimates of underreporting are based on national accounts estimates of total supply available for these commodities less reported consumption in the household budget survey.

2. Subtractions for expenditures on building materials (M 51.2 million), fodder and animals (together M 26.0 million) which are considered intermediate consumption in own-account construction, intermediate consumption in the production of livestock and investment in livestock, respectively, and
3. Additions of expenditures on legal aid charges and funerals reported in the survey as domestic nonconsumption expenditures (M 3.1 million).

These adjustments total a net of M 55.9 million (6.7 percent of HBS total).

In addition, the total for cash and in kind production is increased by the amount of direct purchases abroad and imports of migrant workers (M 125.3 million). Finally, an adjustment to transform the data to a calendar year basis is made (estimating fourth quarter consumption of 1987 based on the survey results for the fourth quarter of 1986 using the estimated growth rate of total consumption between 1986 and 1987 from the national accounts, 5.9 percent, and changes in prices.)¹⁰

Given these manipulations, the final result (M 1051.8 million) is only M 4.2 million (0.4 percent), from the national accounts figure of M 1056.0 million. The closeness of the result speaks to the degree to which results from the Household Budget Survey are incorporated into the methodology for constructing the national accounts.

THE 1987 LESOTHO SAM

The 1987 Lesotho SAM takes as its starting point the production and total income data from the national accounts. The input-output coefficients implied in the table of intermediate consumption from Carvalho (1988) are used in the new 1987 SAM. The mapping between the 24 activities in the 1987 SAM and the 48 activities of the 1984/85 SAM are given in Appendix Table 1.

A few adjustments are made in aggregating the 1984/85 SAM. Dummy accounts for sheep and goats, skins and hides, and livestock feeds are collapsed into the accounts for activities and uses of commodities. Accounts for government purchases by category (education, health, other government expenditures and public debt) and investment by institution (public investment, private domestic investment, private investment (RSA), and private investment by the rest of world) are aggregated into summary columns which correspond to the other government and capital accounts rows. Negative entries in expenditure columns in Carvalho's SAM which represent sources of funds are replaced by positive entries in the corresponding rows.

¹⁰ Not all expenditure items were adjusted. The actual calendar year adjustment amounted to only 4.7 percent.

Appendix Table A.1 — Activities in the 1987 Lesotho SAM

1987 SAM	1984/95 SAM
1. Field crops	3. Field crops (traditional) 4. Field crops (improved) 5. FSSP products
2. Vegetables	1. Horticultural crops
3. Fruits	2. Fruit
4. Cattle	9. Cattle production 10. Cattle (feedlot) 11. Dairy cow
5. Other livestock	6. Poultry layers 7. Poultry broilers
6. Wool, mohair production	8. Wool, mohair production
7. Mining	46. Mining and quarrying production
8. Meat processing	12. Butchery products
9. Dairy	13. Dairy products
10. Milling	18. Milling products
11. Other food processing	17. Processed fruit and vegetables 22. Brewing products (traditional) 23. Brewing products (modern) 24. Other beverages
12. Weaving, leather	14. Processed wool and mohair 15. Weaving with wool and mohair 16. Leather goods 21. Footwear
13. Handicrafts	25. Jewelry 26. Pottery 27. Other handicrafts
14. Textiles	28. Other clothing goods
15. Agricultural tools	19. Agricultural tools and equipment
16. Other manufactures	29. Wood products 30. Bricks 31. Steel or metal products 32. Other manufactured products 33. Fuel
17. Electricity, water	45. Electricity and water
18. Building, construction	37. Building and construction
19. Trade	20. Wholesale and retail

20. Hotels, restaurants
21. Transport

22. Private services

23. Housing
24. Public administration

38. Catering (hotels and restaurants)
35. Air transport
36. Road and rail transport

34. Sales and repairs of autos
39. Financial and insurance services
40. Printing services
41. Real estate and business services
42. Commercial, social and personal
services

44. Communications and posts
47. Domestic services

43. Ownership of dwellings
48. Government services

Source: 1987 Lesotho SAM and Carvalho (1988).

In constructing the 1987 SAM, the input-output coefficients from the aggregate 1984/85 SAM are used to generate intermediate consumption and total production given the value added figures from the national accounts.¹¹ No import data by commodity type is available for 1987 (the latest published figures are for 1986!), so the share of imports for each commodity from the 1984/85 SAM is used to break down the total imports figure for 1987. Similarly, import tariffs and indirect taxes on commodities from 1984/85 are scaled up by the increase in overall import tariffs and indirect taxes between 1984/85 and 1987, using data from the IMF (IMF, 1992). Exports by commodity are taken from the Lesotho Statistical Yearbook 1993 (Bureau of Statistics 1993). Total investment and government recurrent expenditures on commodities and services are from the national accounts; the approximate breakdown of expenditures by commodities from 1984/85 again provide the information on shares of expenditure by commodities. An adjustment is made to consumption of services and manufactured goods by the government and as investment goods so that private consumption of services (the residual) is not negative. Accounts for the payments of factor incomes to institutions and transfers by institutions are calculated using the shares from the 1984/85 SAM.

The amount of food aid (donated food) is given in the national accounts tables in the Lesotho Statistical Yearbook for 1992. Like in the 1984/85 SAM, this is shown as a transfer from the Rest of World directly to households.¹²

Direct taxes are assumed to be paid only by urban households, in proportion to their total incomes. Sales taxes are allocated to households in proportion to total consumption expenditures. Savings rates of rural households without remittances are assumed to be 5 percent. Savings rates of all other households are equal to 11 percent, and are derived as a residual.

Expenditures and income sources of each household group were estimated as part of the final balancing of the SAM. Expenditures on individual commodities by each household group are based on data from the 1986/87 household budget survey. The survey data on total expenditures of each household group was adjusted to account for unrecorded consumption of imported goods by households with remittance incomes (see above) and to achieve consistency with data on

¹¹ For the meat sector, a different methodology is required, given the very high value added per unit of output implied in the national accounts worksheets (43.3 percent) compared with the 1984/85 SAM (10.7 percent). Intermediate inputs per unit of value added from the 1984/85 SAM are used for all commodities except the raw inputs of cattle, sheep and goats and other animals, where the values from the national accounts worksheets for the livestock sector are used instead.

¹² There is also food aid which is donated by the rest of world and milled in Lesotho before being sold on the open market. Carvalho (1988) included this as a purchase of grain by parastatals, but this does not then end up being milled. In the current SAM donated grain which is later milled enters as part of food imports.

income sources. Household incomes were calculated using the mapping of factor payments to households in the 1984/85 SAM and then splitting factor payments related to agricultural activities and remittances so as to produce income differentials approximately in line with the observed expenditure differentials across households observed in the household budget survey. Both the household expenditure matrix and the factor payments to households matrix were balanced using the RAS technique.

Allocating factor payments to households as above, however, resulted in inconsistencies between the household expenditure data and estimated incomes. Incomes of both urban households and households receiving remittances were too large relative to their expenditures, indicating either a relative underreporting of expenditures by these households in the survey, a substantial change in the distribution of factor payments as compared with the 1984/85 SAM, or substantial interhousehold transfers. In order to achieve a better consistency between incomes and expenditures by households, total consumption by urban households and all households with remittance incomes were each increased by 20 percent. These figures were chosen so that the share of nonremittance incomes in total income for rural households receiving remittances (94 percent) approximated the share in the 1984/85 SAM (91 percent).

APPENDIX B: THE FORMAL SIO MODEL¹³

OBJECTIVES

This model aims to predict how all SAM accounts will change in response to a series of exogenous shocks. To do this requires several steps. First, all SAM row accounts must be written as linear functions of one another. Second, the modeler must make some decisions about what variables are endogenous to the system.

Appendix Figure B.1 describes the organization of the SAM and the variable labels adopted in this formulation.

LINEARITY ASSUMPTIONS

Production Accounts (X_j). All production activities (X_j) produce a series of commodities ($D_{j,i}$) as outputs:

$$X_j = \sum_i D_{j,i}. \quad (1)$$

Initially, assume that each activity produces a fixed share of each commodity's output. This assumption can be relaxed later:

$$D_{j,i} = d_{j,i} Z_i. \quad (2)$$

This leads to the following linear relationship between activity (X_j) and commodity (Z_i) accounts:

$$X_j = \sum_i D_{j,i} = \sum_i d_{j,i} Z_i. \quad (3)$$

Commodity Accounts (Z_i). Commodities supply their wares as inputs in production activities ($A_{i,j}$); add commercial margins to other commodity accounts ($C_{i,r}$); supply households ($C_{i,h}$), institutions ($C_{i,n}$), and government ($C_{i,g}$) with final consumption goods; and sell exports (E_i) to the rest of the world and investment goods (I_i) to capital accounts:

¹³ Adapted from Dorosh and Haggblade (1992).

Appendix Figure B.1 — SAM Structure

	Activities j	Commodities i	Households h	Institutions n	Government	Rest of world	Capital	Row sums
Activities j		Dji						xj
Commodities i	INTERMEDIATES		FINAL CONSUMPTION			Exports	Invest.	Zi
	Aij	Cij	Cih	Cin	Cig	Ei	Ii	
Households h	Vhj		TRANSFERS TO HOUSEHOLDS			Rh		Yh
			Bhh	Bhn	Bhg			
Institutions n	Vnj		TRANSFERS TO INSTITUTIONS			Rn		Nn
			Bnh	Bnn	Bng			
Government	Tj	Ti	Th	Tn		Rg		G
Rest of world		Mi	TRANSFERS TO R.O.W.					R
			Brh	Brn	Brg			
Capital			SAVINGS			Rk		S
			Sh	Sn	Sg			
Column sums	Xj	Zi	Yh	Nn	G	R	S	

$$Z_i = \sum_j A_{ij} + \sum_1 C_{i1} + \sum_h C_{ih} + \sum_n C_{in} + C_{ig} + E_i + I_i. \quad (4)$$

Assume that intermediates (A_{ij}) remain a fixed share of gross output in each sector (Z_i), the classic Leontief assumption:

$$A_{ij} = a_{ij} X_j, \quad (5)$$

and that commercial margins (C_{i1}) likewise remain a fixed share of final commodity value (Z_i).

$$C_{i1} = c_{i1} Z_i. \quad (6)$$

Assume also that household consumption (C_{ih}) is a linear function of household expenditure (household income [Y_h] less transfers paid [$B_{.h}$] less direct taxes paid by the household [T_h] less household savings [S_h]):¹⁴

$$C_{ih} = \alpha_{ih} + \beta_{ih} (Y_h - B_{.h} - T_h - S_h), \quad (7)$$

where

$$\bar{B}_{.h} = \sum_h \bar{B}_{h,h} + \sum_n \bar{B}_{nh} + \bar{B}_{rh};$$

that institutional (C_{in}) and government (C_{ig}) consumption of final goods and services remain a fixed proportion of final output,

$$\begin{aligned} C_{in} &= c_{in} N_n \\ C_{ig} &= c_{ig} G; \end{aligned} \quad (8)$$

and, initially, that investment remains fixed exogenously:

$$I_i = \bar{I}_i. \quad (9)$$

¹⁴ The notation $\bar{B}_{.h}$ indicates transfers paid by households (h) to all sources (*), including other households ($\bar{B}_{h,h}$), nongovernment institutions (\bar{B}_{nh}), and the rest of world (\bar{B}_{rh}).

Substituting and combining like terms yields the following summation of the commodity accounts:

$$(1 - \sum_i c_{i1})Z_1 = \sum_j a_{1j}X_j + \sum_h \beta_{1h}(Y_h - T_h - S_h) + \sum_h \alpha_{1h} + C_{1n}N + C_{1g}G + E_1 + \bar{I}_1. \quad (10)$$

Household Accounts (Y_h). Households (Y_h) earn income from value-added payments by activities (V_{hj}) and from transfers they receive from other households (B_{hh}), from institutions (B_{hn}), from government (B_{hg}) and from the rest of the world (B_{hr}):

$$Y_h = \sum_j V_{hj} + \sum_{h'} B_{hh'} + \sum_n B_{hn} + B_{hg} + B_{hr}. \quad (11)$$

As with intermediates, value-added payments to households (V_{hj}) remain a fixed proportion of activity output (X_j), while all transfers are taken as fixed:

$$V_{hj} = \lambda_{hj}X_j, \quad (12)$$

$$\begin{aligned} B_{hh} &= \bar{B}_{hh} \\ B_{hn} &= \bar{B}_{hn} \\ B_{hg} &= \bar{B}_{hg} \\ B_{hr} &= \bar{B}_{hr}. \end{aligned} \quad (13)$$

Substituting Equations 12 and 13 into Equation 11 leads to the following relationship between household income (Y_h) and activity output (X_j):

$$Y_h = \sum_j \lambda_{hj}X_j + \bar{B}_h, \quad (14)$$

where

$$\bar{B}_h = \sum_{h'} \bar{B}_{hh'} + \sum_n \bar{B}_{hn} + \bar{B}_{hg} + \bar{B}_{hr}.$$

Institutions (N). Institutions (N), like households, earn income from value-added payments by activities (V_{nj}) and from transfers they receive from households (B_{nh}), from institutions (B_{nn}), from government (B_{ng}), and from the rest of the world (B_{nr}):

$$N = \sum_j V_{nj} + \sum_h B_{nh} + \sum_{n^*} B_{nn^*} + B_{ng} + B_{nr}. \quad (15)$$

As with intermediates, value-added payments to households (V_{nj}) remain a fixed proportion of activity output (X_j), while all transfers are taken as fixed:

$$V_{nj} = \lambda_{nj} X_j, \quad (16)$$

$$\begin{aligned} B_{nh} &= \bar{B}_{nh} \\ B_{nn^*} &= \bar{B}_{nn^*} \\ B_{ng} &= \bar{B}_{ng} \\ B_{nr} &= \bar{B}_{nr}. \end{aligned} \quad (17)$$

Substituting Equations 20 and 21 into Equation 19 leads to the following relationship between institutions' income (N) and activity output (X_j):

$$N = \sum_j \lambda_{nj} X_j + \sum_h \bar{B}_{nh} + \bar{B}_{nn} + \bar{B}_{ng}. \quad (18)$$

Government G. Government receives indirect taxes from activities (T_j) and commodities (T_i) as well as income taxes from households (T_h) and institutions (T_n) and transfers from rest of the world (R_g):

$$G = \sum_j T_j + \sum_i T_i + \sum_h T_h + \sum_n T_n + R_g. \quad (19)$$

Assume that indirect taxes remain a fixed proportion of activity and commodity output,

$$T_j = t_j X_j, \quad (20)$$

$$T_i = t_i Z_i; \quad (21)$$

that income and profits taxes increase linearly with household and institutions' earnings,

$$T_h = t_h^\circ + t_h Y_h, \quad (22)$$

$$T_n = t_n^\circ + t_n N; \quad (23)$$

and that transfers from the rest of the world remained fixed:

$$R_g = \bar{R}_g. \quad (24)$$

Substitution among these relationships into (23) yields the following relationship between government revenues and the remaining SAM accounts:

$$\begin{aligned} G &= \sum_j t_j X_j + \sum_i t_i Z_i + \sum_h (t_h^\circ + t_h Y_h) + t_n^\circ + t_n N + \bar{R}_g \\ &= \sum_j t_j X_j + \sum_i t_i Z_i + \sum_h t_h Y_h + t_n N + \sum_h t_h^\circ + t_n^\circ + \bar{R}_g. \end{aligned} \quad (25)$$

Rest of the World (R). The rest of the world account receives payments for commodity imports (M_i) and receives transfers from households (B_{rh}), institutions (B_{rn}), and government (B_{rg}):

$$R = \sum_i M_i + \sum_h B_{rh} + \sum_n B_{rn} + B_{rg}. \quad (26)$$

Assume that imports (M_i) remain a fixed proportion of commodity output (Z_i) and, as before, that transfers remain fixed:

$$M_i = m_i Z_i, \quad (27)$$

$$\begin{aligned}
 B_{rh} &= \bar{B}_{rh} \\
 B_{rn} &= \bar{B}_{rn} \\
 B_{rg} &= \bar{B}_{rg}.
 \end{aligned}
 \tag{28}$$

Total rest of the world earnings (R) then become

$$R = \sum_i m_i Z_i + \sum_h \bar{B}_{rh} + \bar{B}_{rn} + \bar{B}_{rg}.
 \tag{29}$$

Capital (S). Total savings (S) equals the sum of savings by households (S_h), institutions (S_n), government (S_g), and capital transfers from the rest of the world (R_k):

$$S = S_h + S_n + S_g + R_k.
 \tag{30}$$

Assume that transfers remain fixed but that all domestic sources savings goes up linearly with their earnings:

$$S_h = \sigma_h Y_h + \bar{s}_h^o,
 \tag{31}$$

$$S_n = \sigma_n N + \bar{s}_n^o,
 \tag{32}$$

$$S_g = \sigma_g G + \bar{s}_g^o,
 \tag{33}$$

$$R_k = \bar{R}_k.
 \tag{34}$$

Total savings can then be expressed as a function of household income (Y_h), institutional earnings (N), and government revenue (G):

$$S = \sum_h \sigma_h Y_h + \sigma_n N + \sigma_g G + \sum_h \bar{s}_h^o + \bar{s}_n^o + \bar{s}_g^o + \bar{R}_k.
 \tag{35}$$

Parameter Restrictions. For the SAM to remain balanced, increased revenue must generate an equivalent increase in expenditure. For expenditures to equal revenue, the sum of all column coefficients in the M matrix must equal 1.

In particular,

$$\sum_i a_{ij} + \sum_h \lambda_{hj} + \lambda_{nj} + t_j = 1, \text{ for all } j, \quad (36)$$

$$\sum_j d_{ji} + \sum_i c_{ii} + t_i + m_i = 1, \text{ for all } i, \quad (37)$$

$$\sum_i \beta_{ih} = 1, \text{ for all } h, \quad (38)$$

$$\sum_i c_{in} + t_n + \sigma_n = 1; \quad \therefore \sigma_n = 1 - \sum_i c_{in} - t_n, \quad (39)$$

$$\sum_j c_{ig} + \sigma_g = 1; \quad \therefore \sigma_g = 1 - \sum_i c_{ig}. \quad (40)$$

System Summary. Appendix Table B.1 summarizes this system of equations in matrix form. In doing so, it divides the commodity accounts into two groups, (Z_1) and (Z_2), depending on their supply elasticity. The first group, (Z_1), represents all sectors with upward-sloping supply curves. In the Lesotho model, 11 sectors are modeled with inelastic supply, including field crops, livestock, textiles, and other manufacturing (see Table 3). For the remaining commodities (Z_2), producers can increase output at constant unit cost. Hence, their supply is perfectly elastic.

Since the Z_1 commodities are tradable, the world price imposes the fixed-price requirement of the SIO model. The (Z_2) commodities achieve fixed prices by virtue of their perfectly elastic supply.

SOLVING THE BASIC MODEL

The relationships defined above translate the SAM row accounts into a set of equations, one for each of the activities, commodities, households, and other institutions in the SAM.

In the standard input-output (IO) model, exports, investments, and all transfers are exogenous, and the model solves for production, income and consumption as described in the equations above. In this formulation, where

Appendix Table B.1 — Model Equations

$$\begin{bmatrix}
 1 & -D_1 & -D_2 & 0 & 0 & 0 & 0 & 0 \\
 A_1 & 1-C_{11} & -C_{12} & -\beta_1 [1-t_h - \sigma_h] & -C_{1n} & -C_{1g} & 0 & 0 \\
 A_2 & -C_{21} & 1-C_{22} & -\beta_2 [1-t_h - \sigma_h] & -C_{2n} & -C_{2g} & 0 & 0 \\
 A_h & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\
 A_n & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
 -t'_j & -t'_1 & -t'_2 & -t'_n & -t'_n & 1 & 0 & 0 \\
 0 & -m'_1 & -m'_2 & 0 & 0 & 0 & 1 & 0 \\
 0 & 0 & 0 & -\sigma_h & -\sigma_n & -\sigma_g & 0 & 1
 \end{bmatrix}
 \times
 \begin{bmatrix}
 X \\
 Z_1 \\
 Z_2 \\
 Y \\
 V \\
 G \\
 R \\
 S
 \end{bmatrix}
 =
 \begin{bmatrix}
 0 \\
 E_1 + I_1 + [\alpha_1 - \beta_1 K] i \\
 E_2 + I_2 + [\alpha_2 - \beta_2 K] i \\
 \overline{B}_{h.} + \overline{R}_n \\
 \overline{B}_{n.} + \overline{R}_n \\
 \overline{T}_{h1} + \overline{T}_n + \overline{R}_g \\
 \overline{B}_{rh} + \overline{B}_{rn} + \overline{B}_{rg} \\
 \overline{S}_{h1} + \overline{S}_n + \overline{S}_g + R_k
 \end{bmatrix}$$

where K is a diagonal matrix with $T_h^\circ + S_h^\circ + \overline{B}_{h.}$ as each diagonal element,
 i is a column vector of 1's,
 I is an identity matrix.

transfers and investments are taken as exogenous, commodity export demand becomes the prime determinant of system change. Appendix Table B.2 displays the resulting input-output (IO) model after differentiation.

The semi-input-output (SIO) model differs only in its choice of exogenous variables. Since (Z_1) commodities are supply constrained, their output is fixed in a fixed-price world. So supply, not exports, become exogenous in these equations. With output fixed and domestic demand determined by changes in incomes, exports (E_1), rather than supply (Z_1), become endogenous in the equations. Appendix Table B.3 rewrites the SAM model in SIO form.¹⁵

EXTENSIONS

Two extensions of the basic SIO model in Appendix Table B.3 are used in this paper: reducing urban demand linkages; and, making investment endogenous.

Reduced Urban Demand Linkages

Given the proximity of urban centers in Lesotho to the border, many "nontradable" goods and services purchased by urban households in Lesotho originate from the Republic of South Africa. These expenditures represent a leakage from Lesotho's national economy, necessitating a modification of the base SIO model. To account for these purchases, the marginal propensities to consume domestic nontradables (β_{in} 's) are reduced by 70 percent for urban households. In order to maintain the adding-up condition for household expenditures (equation 38), the marginal propensity to consume imports from the RSA is increased to offset the change in the other β_{in} 's.

Endogenous Investment

To make investment endogenous requires adding additional equations to explain aggregate investment and distribution across commodities.

Using the accounting relationship that aggregate investment (I) equals aggregate savings, or equivalently, that changes in investment (dI) are equal to changes in savings (dS),

$$\sum_i dI_i = dI = dS., \quad (41)$$

¹⁵ In the model simulations presented in this paper, government spending is also held fixed ($dG = 0$). Thus changes in tax revenues do not lead to changes in spending.

Appendix Table B.2 — Input-Output Model

$$\begin{bmatrix}
 1 & -D_1 & -D_2 & 0 & 0 & 0 & 0 & 0 \\
 A_1 & 1-C_{11} & -C_{12} & -\beta_1[1-t_h-\sigma_h] & -C_{1n} & -C_{1g} & 0 & 0 \\
 A_2 & -C_{21} & 1-C_{22} & -\beta_2[1-t_h-\sigma_h] & -C_{2n} & -C_{2g} & 0 & 0 \\
 A_h & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\
 A_n & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
 t'_j & -t'_1 & -t'_2 & -t'_h & -t'_n & 1 & 0 & 0 \\
 0 & -m'_1 & -m'_2 & 0 & 0 & 0 & 1 & 0 \\
 0 & 0 & 0 & -\sigma'_h & -\sigma'_n & -\sigma'_g & 0 & 1
 \end{bmatrix}
 \times
 \begin{bmatrix}
 dX \\
 dZ_1 \\
 dZ_2 \\
 dY \\
 dN \\
 dG \\
 dR \\
 dS
 \end{bmatrix}
 =
 \begin{bmatrix}
 0 \\
 1 \\
 0 \\
 0 \\
 0 \\
 0 \\
 0 \\
 0
 \end{bmatrix}
 dE_1
 +
 \begin{bmatrix}
 0 \\
 0 \\
 1 \\
 0 \\
 0 \\
 0 \\
 0 \\
 0
 \end{bmatrix}
 dE_2$$

Appendix Table B.3 — Semi-Input-Output Model

$$\begin{bmatrix}
 1 & 0 & -D_2 & 0 & 0 & 0 & 0 & 0 \\
 -A_1 & -1 & -C_{12} & -\beta_1[1-t_h-\sigma_h] & -C_{1n} & -C_{1g} & 0 & 0 \\
 -A_2 & 0 & 1-C_{22} & \beta_2[1-t_h-\sigma_h] & -C_{2n} & -C_{2g} & 0 & 0 \\
 -A_{hj} & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\
 -A_{nj} & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
 -t'_j & 0 & -t'_2 & -t'_h & -t'_n & 1 & 0 & 0 \\
 0 & 0 & -m'_2 & 0 & 0 & 0 & 1 & 0 \\
 0 & 0 & 0 & -\sigma'_h & -\sigma'_n & -\sigma'_g & 0 & 1
 \end{bmatrix}
 \times
 \begin{bmatrix}
 dX \\
 dE_1 \\
 dZ_2 \\
 dY \\
 dN \\
 dG \\
 dR \\
 dS
 \end{bmatrix}
 -
 \begin{bmatrix}
 D_1 \\
 -(1-C_{11}) \\
 C_{z1} \\
 0 \\
 0 \\
 t'_1 \\
 m'_1 \\
 0
 \end{bmatrix}
 dZ_1
 +
 \begin{bmatrix}
 0 \\
 0 \\
 1 \\
 0 \\
 0 \\
 0 \\
 0 \\
 0
 \end{bmatrix}
 dE_2$$

* To make investment endogenous, replace "0" with $c_1k + c_2k$.

To explain how investors allocate their purchases across commodity groups, assume proportionality constant according to past investment shares (C_{ik}):

$$dI_i = c_{ik} dI = c_{ik} dS. \quad (42)$$

Since $dI = dS$, these relationships can be substituted directly into the commodity equations as described in Appendix Table B.3.

REFERENCES

- Bureau of Statistics. 1993. *Lesotho Statistical Yearbook 1993*. Maseru: Bureau of Statistics.
- Bureau of Statistics. 1993. National Accounts Computer Files.
- _____. 1990. *The Agricultural Census in Lesotho 1989/1990*. Maseru: Bureau of Statistics.
- _____. 1988a. *Incomes, Expenditures and Consumption of Basotho Households*. Two Volumes. Maseru: Bureau of Statistics.
- _____. 1988b. 1987 Household Budget Survey Computer Data Files.
- Carvalho, Joe William. 1988. "Agriculture and Economic Development in Lesotho: Analysis Using a Social Accounting Matrix." Doctoral Dissertation. Department of Agricultural Economics. Washington State University.
- Dorosh, Paul A., and Steven Haggblade. 1992. *Agricultural Growth Linkages in Madagascar*. Working Paper 22. Ithaca, NY: CFNPP.
- Haggblade, Steve, Jeffrey Hammer, and Peter Hazell. 1991. "Modeling Agricultural Growth Multipliers." *American Journal of Agricultural Economics*. 73(2): 361-374.
- Haggblade, Steve, and Peter Hazell. 1990. *Rural-Urban Growth Linkages in India*. Working Paper WPS 430. Washington, DC: World Bank, Agriculture and Rural Development Department.
- Haggblade, Steve, Peter Hazell, and James Brown. 1989. "Farm-NonFarm Linkages in Rural Sub-Saharan Africa." *World Development*. 17(8): 1173-1201.
- International Monetary Fund. 1992. *Government Financial Statistics Yearbook*. Washington, DC: IMF.
- Lewis, Blane, and Erik Thorbecke. 1992. "District-Level Economic Linkages in Kenya: Evidence Based on a Small Region Social Accounting Matrix." *World Development*: 20(6): 881-898.

CFNPP WORKING PAPER SERIES

- | | | | |
|---|----|---|-------------------------------------|
| # | 1 | NUTRITIONAL STATUS IN GHANA AND ITS DETERMINANTS
ISBN 1-56401-101-1 | Harold Alderman |
| # | 2 | THE IMPACT OF EXPORT CROP PRODUCTION ON NUTRITIONAL STATUS IN COTE D'IVOIRE
ISBN 1-56401-102-X | David Sahn |
| # | 3 | STRUCTURAL ADJUSTMENT AND RURAL SMALLHOLDER WELFARE: A COMPARATIVE ANALYSIS FROM SUB-SAHARAN AFRICA
ISBN 1-56401-103-8 | David Sahn &
Alexander Sarris |
| # | 4 | A SOCIAL ACCOUNTING MATRIX FOR CAMEROON
ISBN 1-56401-104-6 | Madeleine Gauthier &
Steven Kyle |
| # | 5 | THE USES AND LIMITATIONS OF INFORMATION IN THE IRINGA NUTRITION PROGRAM, TANZANIA
ISBN 1-56401-105-4 | David Pelletier |
| # | 6 | A SOCIAL ACCOUNTING MATRIX FOR MADAGASCAR: METHODOLOGY AND RESULTS
ISBN 1-56401-106-2 | Paul Dorosh et al. |
| # | 6 | UNE MATRICE DE COMPTABILITÉ SOCIALE POUR MADAGASCAR: MÉTHODOLOGIE ET RÉSULTATS
ISBN 1-56401-200-X | Paul Dorosh et al. |
| # | 7 | DEVELOPING COUNTRIES IN SUGAR MARKETS
ISBN 1-56401-107-0 | Cathy Jabara &
Alberto Valdés |
| # | 8 | MONETARY MANAGEMENT IN GHANA
ISBN 1-56401-108-9 | Stephen Younger |
| # | 9 | DEVELOPMENT THROUGH DUALISM? LAND TENURE, POLICY, AND POVERTY IN MALAWI
ISBN 1-56401-109-7 | David Sahn &
Jehan Arulpragasam |
| # | 10 | PRICES AND MARKETS IN GHANA
ISBN 1-56401-110-0 | Harold Alderman &
Gerald Shively |
| # | 11 | THE ECONOMICS OF CAIN AND ABEL: AGRO-PASTORAL PROPERTY RIGHTS IN THE SAHEL
ISBN 1-56401-111-9 | Rogier van den
Brink et al. |

4/5

- | | | | |
|---|----|---|--|
| # | 12 | COMPETITIVE ALLOCATION OF GLOBAL CREDIT
CEILINGS
ISBN 1-56401-112-7 | Stephen D. Younger |
| # | 13 | AN ECONOMETRIC MODEL FOR MALAWI: MEASURING
THE EFFECTS OF EXTERNAL SHOCKS AND POLICIES
ISBN 1-56401-113-5 | Yves Van Frausum &
David E. Sahn |
| # | 14 | THE TAMIL NADU INTEGRATED NUTRITION PROJECT:
A REVIEW OF THE PROJECT WITH SPECIAL EMPHASIS
ON MONITORING AND INFORMATION SYSTEM
ISBN 1-56401-114-3 | Meera Shekar |
| # | 15 | THE MICROECONOMICS OF AN INDIGENOUS AFRICAN
INSTITUTION: THE ROTATING SAVINGS AND CREDIT
ASSOCIATION
ISBN 1-56401-115-1 | Rogier van den
Brink & Jean-Paul
Chavas |
| # | 16 | INCOME DISTRIBUTION, POVERTY, AND CONSUMER
PREFERENCES IN CAMEROON
ISBN 1-56401-116-X | Sarah G. Lynch |
| # | 17 | AID AND THE DUTCH DISEASE: MACROECONOMIC
MANAGEMENT WHEN EVERYBODY LOVES YOU
ISBN 1-56401-117-8 | Stephen D. Younger |
| # | 18 | A SOCIAL ACCOUNTING MATRIX FOR NIGER:
METHODOLOGY AND RESULTS
ISBN 1-56401-118-6 | Paul A. Dorosh &
B. Essama Nssah |
| # | 19 | THE ENCLOSURES REVISITED: PRIVATIZATION,
TITLING, AND THE QUEST FOR ADVANTAGE IN
AFRICA
ISBN 1-56401-119-4 | Rogier van den Brink &
Daniel W. Bromley |
| # | 20 | A SOCIAL ACCOUNTING MATRIX FOR THE GAMBIA
ISBN 1-56401-120-8 | Cathy L. Jabara, Mattias
K. A. Lundberg, &
Abdoulie Sireh Jallow |
| # | 21 | A USER'S MANUAL FOR CONDUCTING CHILD
NUTRITION SURVEYS IN DEVELOPING COUNTRIES
ISBN 1-56401-121-6 | Victoria J. Quinn |
| # | 22 | AGRICULTURAL GROWTH LINKAGES IN MADAGASCAR
ISBN 1-56401-122-4 | Paul Dorosh et al. |
| # | 23 | NUTRITIONAL STATUS OF RWANDAN HOUSEHOLDS:
SURVEY EVIDENCE ON THE ROLE OF HOUSEHOLD
CONSUMPTION BEHAVIOR
ISBN 1-56401-123-2 | Randall D. Schnepf |

- # 24 TESTING THE LINK BETWEEN DEVALUATION AND INFLATION: TIME-SERIES EVIDENCE FROM GHANA
ISBN 1-56401-124-0 Stephen D. Younger
- # 25 THE POLITICAL ECONOMY OF ECONOMIC DECLINE AND REFORM IN AFRICA: THE ROLE OF THE STATE, MARKETS, AND CIVIL INSTITUTIONS
ISBN 1-56401-125-9 David E. Sahn & Alexander Sarris
- # 26 INCOMES AND FOOD SECURITY IN GHANA
ISBN 1-56401-126-7 Harold Alderman
- # 27 FOOD AND NUTRITIONAL ADEQUACY IN GHANA
ISBN 1-56401-127-5 Harold Alderman & Paul Higgins
- # 28 FOOD SECURITY AND GRAIN TRADE IN GHANA
ISBN 1-56401-128-3 Harold Alderman
- # 29 THE ADVERSE NUTRITION EFFECTS OF TAXING EXPORT CROPS ON NUTRITION
ISBN 1-56401-129-1 David E. Sahn, Yves Van Frausum, & Gerald Shively
- # 30 PARTICIPATION RATES, EFFICIENCY, AND CHARACTERISTICS OF WORKERS
ISBN 1-56401-130-5 R. S. Canagarajah
- # 31 AGRICULTURAL INPUT POLICIES UNDER STRUCTURAL ADJUSTMENT: THEIR DISTRIBUTIONAL IMPLICATIONS
ISBN 1-56401-131-3 Charles D. Jebuni & Wayo Seini
- # 32 TOLERATING THE PRIVATE SECTOR: GRAIN TRADE IN TANZANIA AFTER ADJUSTMENT
ISBN 1-56401-132-1 H.K.R. Amani, Rogier van den Brink, & W.E. Maro
- # 33 HOUSEHOLD WELFARE DURING CRISIS AND ADJUSTMENT IN GHANA
ISBN 1-56401-133-X Alexander H. Sarris
- # 34 CONSTRAINTS ON RICE PRODUCTION IN MADAGASCAR: THE FARMER'S PERSPECTIVE
ISBN 1-56401-134-8 René Bernier & Paul Dorosh
- # 35 CONSEQUENCES OF PERMANENT LAY-OFF FROM THE CIVIL SERVICE: RESULTS FROM A SURVEY OF RETRENCHED WORKERS IN GHANA
ISBN 1-56401-135-6 Harold Alderman, R.S. Canagarajah & Stephen D. Younger
- # 36 SHORT-TERM CONSUMPTION BEHAVIOR, SEASONALITY, AND LABOR MARKET UNCERTAINTY
ISBN 1-56401-136-4 R.S. Canagarajah & S.E. Pudney

- # 37 LABOR AND WOMEN'S NUTRITION: A STUDY OF ENERGY EXPENDITURE, FERTILITY, AND NUTRITIONAL STATUS IN GHANA
ISBN 1-56401-137-2 Paul A. Higgins & Harold Alderman
- # 38 EXCHANGE RATE MANAGEMENT IN GHANA
ISBN 1-56401-138-0 Stephen D. Younger
- # 39 A GENERAL EQUILIBRIUM ANALYSIS OF THE EFFECT OF MACROECONOMIC ADJUSTMENT ON POVERTY IN AFRICA
ISBN 1-56401-139-9 Paul A. Dorosh & David E. Sahn
- # 40 EXTERNAL SHOCKS, POLICY REFORM AND INCOME DISTRIBUTION IN NIGER
ISBN 1-56401-140-2 Paul A. Dorosh & B. Essama Nssah
- # 41 INCOME DISTRIBUTION AND ADJUSTMENT IN AN AGRICULTURAL ECONOMY: A GENERAL EQUILIBRIUM ANALYSIS OF CAMEROON
ISBN 1-56401-141-0 Nancy Benjamin
- # 42 IS THERE LIFE AFTER PUBLIC SERVICE: THE FATE OF RETRENCHED WORKERS IN CONAKRY GUINEA
ISBN 1-56401-142-9 Bradford Mills & David E. Sahn
- # 43 LABOR FORCE PARTICIPATION, SECTORAL CHOICE, AND EARNINGS IN CONAKRY GUINEA
ISBN 1-56401-143-7
(forthcoming) Peter Glick & David E. Sahn
- # 44 SMALL SCALE URBAN ENTERPRISES IN TANZANIA: RESULTS FROM A 1991 SURVEY
ISBN 1-56401-144-5 Mboya S.D. Bagachwa, Alexander H. Sarris & Platon Tinios
- # 45 EVIDENCE FROM AFRICA ON THE INTRASECTORAL ALLOCATION OF SOCIAL SECTOR EXPENDITURES
ISBN 1-56401-145-3 David E. Sahn & René Bernier
- # 46 A GENERAL EQUILIBRIUM ANALYSIS OF ADJUSTMENT AND THE POOR IN GAMBIA
ISBN 1-56401-146-1 Paul A. Dorosh & Mattias K. Lundberg
- # 47 POVERTY AND FOOD CONSUMPTION IN URBAN ZAIRE
ISBN 1-56401-147-X Hamid Tabatabai

- # 48 ESTIMATING TAX INCIDENCE IN GHANA:
AN EXERCISE USING HOUSEHOLD DATA
ISBN 1-56401-148-8 Stephen D. Younger
- # 49 AGRICULTURAL POLICY AND TECHNOLOGY
OPTIONS IN MALAWI: MODELING SMALLHOLDER
RESPONSES AND OUTCOMES
ISBN 1-56401-149-6 Kenneth Simler
- # 50 FOOD AID AND POVERTY ALLEVIATION IN
MOZAMBIQUE: THE POTENTIAL FOR SELF-
TARGETING WITH YELLOW MAIZE
ISBN 1-56401-150-X Paul A. Dorosh, Carlo
del Ninno & David E.
Sahn
- # 51 THE IMPACT OF GENDER DISCRIMINATION ON THE
JOB SEARCH STRATEGIES OF REDEPLOYED PUBLIC
SECTOR WORKERS
ISBN 1-56401-151-8 Bradford Mills
- # 52 PUBLIC FINANCE AND PUBLIC EMPLOYMENT: AN
ANALYSIS OF PUBLIC SECTOR RETRENCHMENT
PROGRAMS IN GUINEA AND GHANA
ISBN 1-56401-152-6 Bradford Mills,
David E. Sahn, E.E.
Walden & Stephen D.
Younger
- # 53 THE EMERGENCE OF PARALLEL MARKETS
IN A TRANSITION ECONOMY: THE CASE
OF MOZAMBIQUE
ISBN 1-56401-153-4 David E. Sahn &
Jaikishan Desai
- # 54 THE EFFECT OF FOOD SUBSIDIES ON
LABOR SUPPLY IN SRI LANKA
ISBN 1-56401-154-2 David E. Sahn &
Harold Alderman
- # 55 MACROECONOMIC POLICIES AND POVERTY
ALLEVIATION IN ZAIRE: A SAM APPROACH
ISBN 1-56401-155-0 Solomane Koné &
Erik Thorbecke
- # 56 LIVING STANDARDS AND THE DETERMINANTS
OF POVERTY AND INCOME DISTRIBUTION IN
MAPUTO, MOZAMBIQUE
ISBN 1-56401-156-9 Carlo del Ninno &
David E. Sahn
- # 57 TERMS OF TRADE AND THE REAL EXCHANGE
RATE IN THE CFA ZONE: THE CASE OF NIGER
ISBN 1-56401-157-7 Paul A. Dorosh,
B. Essama Nssah &
Ousmane Samba Mamadou
- # 58 THE STRUCTURE OF HOUSEHOLDS IN TANZANIA
IN 1991: RESULTS FROM A NATIONAL
HOUSEHOLD SURVEY
ISBN 1-56401-158-5 Platon Tinios, Alexander
H. Sarris, H.K.R. Amani,
W.E. Maro & S.
Zografakis

- # 59 STRUCTURAL CHANGES IN TANZANIAN
POVERTY OVER THE LAST 15 YEARS
ISBN 1-56401-159-3 Alexander H. Sarris &
Platon Tinios
- # 60 GROWTH LINKAGES IN MADAGASCAR
IMPLICATIONS FOR SECTORAL
INVESTMENT PRIORITIES
ISBN 1-56401-160-7 Paul A. Dorosh &
Steven Haggblade
- # 61 MACROECONOMIC ADJUSTMENT AND THE
POOR IN MADAGASCAR: A CGE ANALYSIS
ISBN 1-56401-161-5 Paul A. Dorosh
- # 62 A SOCIAL ACCOUNTING MATRIX FOR TANZANIA
ISBN 1-56401-162-3 Alexander H. Sarris
- # 63 AGRICULTURAL AND FOOD POLICY ISSUES
IN MOZAMBIQUE: A MULTI-MARKET ANALYSIS
ISBN 1-56401-163-1 Paul A. Dorosh &
René Bernier
- # 64 A COMPARISON OF GHANAIAN CIVIL
SERVANTS' EARNINGS BEFORE AND AFTER
RETRENCHMENT
ISBN 1-56401-164-X Harold Alderman,
Sudarshan Canagarajah &
Stephen D. Younger
- # 65 THE EFFECTS OF TRADE AND EXCHANGE
POLICIES IN FOOD MARKETS, HOUSEHOLD
FOOD CONSUMPTION AND URBAN POVERTY IN
GUINEA MARITIME: A MULTI-MARKET ANALYSIS
ISBN 1-56401-165-8 Jehan Arulpragasam
- # 66 WELFARE AND POVERTY IN CONAKRY:
ASSESSMENT AND DETERMINANTS
ISBN 1-56401-166-6 Carlo del Ninno
- # 67 STRUCTURAL ADJUSTMENT AND INCOME
DISTRIBUTION IN CAMEROON
ISBN 1-56401-167-4 Shankar Subramanian
- # 68 MACROECONOMIC POLICY AND HOUSEHOLD
INCOMES: A DYNAMIC GENERAL EQUILIBRIUM
ANALYSIS FOR TANZANIA
ISBN 1-56401-168-2 Alexander H. Sarris
- # 69 THE MICROENTERPRISE SECTOR IN
TANZANIA: EVOLUTION AND SIGNIFICANCE
ISBN 1-56401-169-0 Mboya S.D. Bagachwa

70 HEALTH AND EARNINGS IN A HETEROGENOUS URBAN LABOR MARKET: EVIDENCE FROM GUINEA 1-56401-170-4 Peter Glick & David E. Sahn

For information about ordering CFNPP working papers and other publications contact:

CFNPP Publications Department
3M28 Martha Van Rensselaer Hall
Cornell University
Ithaca, NY 14853
607-255-8093

51