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STRUCTURAL ADJUSTMENT, GROWTH AND POVERTY IN MADAGASCAR: A CGE ANALYSIS

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FINAL REPORT

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1. INTRODUCTION

Stabilization and structural adjustment dominated economic policy in Madagascar during the decade of the eighties. IMF stand-by agreements starting in 1981 were followed by a succession of World Bank and bilateral structural adjustment and sectoral loans designed to restore macro-economic balances and liberalize markets. Early in the reform process, a contentious debate developed as to whether the policy changes were adversely affecting the poor (see UNICEF, 1984). Using available information on prices, household income and expenditure patterns, and published survey results (AIRD, 1984 and World Bank, 1989), Dorosh, Bernier and Sarris, (1990), provided evidence suggesting that the adverse effects of adjustment policies, per se, were more limited.

Previous work on structural adjustment has analyzed the impacts of adjustment policies in a partial equilibrium context, with little analysis of role of price changes on economic activity and household welfare. In this study, a computable general equilibrium (CGE) model of the Madagascar economy, based on a disaggregated social accounting matrix (SAM) for 1984, is used to analyze the impacts of policy and exogenous shocks on household incomes. The model simulations are designed to shed light on the effects of major elements of the policy reforms undertaken in the eighties, with an emphasis on the impacts on lower income households.

The effects of government policies on the poor are no less important in current debates over government policy options and development strategy. With

many of the planned reforms in place by 1989 and renewed vitality in the economy, concerns over the distribution of the benefits of growth, rather than of the costs of adjustment, have become a major issue. Although renewed growth in the Malagasy economy has been sidetracked in the last two years, in large measure because of the political upheaval, the form which future economic growth takes will have profound implications for poverty alleviation.

This paper presents simulation results of major policies adopted during the eighties in Madagascar, along with an analysis of several current policy options. The quantitative results of the model simulations illustrate the orders of magnitude of the effects on income distribution of the policies simulated. More important, however, is the analytical framework for understanding linkages in the economy that determine how the poor are affected by changes in economic policy and external conditions.

PLAN OF THE PAPER

Chapter 2 presents a brief overview of the economy of Madagascar and a summary of key economic policies in Madagascar in the eighties, drawing on a more detailed presentation in Dorosh, Bernier and Sarris (1990). The data base for the CGE model, the social accounting matrix (SAM), is presented in Chapter 3, along with a description of the model itself. In Chapter 4, the CGE model is used to simulate the effects of major elements of the investment boom, stabilization and structural adjustment policies of the late seventies and eighties. Chapter 5 contains an analysis of alternative growth strategies and current policy issues. Conclusions are found in the final chapter.

2. THE MALAGASY ECONOMY AND ECONOMIC POLICY IN THE EIGHTIES

This chapter outlines the major characteristics of Madagascar's economy and reviews the major changes in economic policy since the late seventies: investment boom, stabilization and structural adjustment. The discussion draws heavily from Dorosh, Bernier, and Sarris (1990) and Dorosh and Bernier (forthcoming).

THE MALAGASY ECONOMY

Madagascar is typical of many low income countries with large agricultural and service sectors and a small industrial sector. In 1989, agriculture accounted for 29 percent of GDP, industry only 13 percent, and services approximately 49 percent of GDP. Less than twenty percent of the population lives in urban areas.

Although some large farms managed by parastatals exist, the bulk of agricultural production is carried out by traditional small holders whose average farm size is only 1.15 hectares.[1] Madagascar's agriculture differs from that of most of sub-Saharan Africa because of the dominance of irrigated land, especially on the densely populated high plateau which ranges from the

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[1] Traditional farmers defined in the 1984 Agricultural Census as farmers owning ten or fewer hectares, hiring fewer than 5 full-time, paid workers, and not using any specialized modern equipment or machinery.

north to the south in the center of the island. Irrigated area, planted primarily with rice or cotton, accounts for 44 percent of traditional cultivated area nationwide (MPARA 1988a-d). Rice consumption, alone, represents 54 percent of total calorie consumption (FAO 1984).

The relative importance of agricultural exports (mainly coffee, cloves and vanilla) declined during the 1980s because of declines in world prices of coffee and cloves, yet agricultural exports still accounted for 51.5 percent of Madagascar's total exports in the 1987-89 period,[2] (down from a share of 65.7 percent in 1980) (World Bank 1986, 1991).

Production of the formal industrial sector is concentrated in import-substitution sectors such as food processing, textiles and beverages, and in nontraded sectors such as water and electricity. Imports of raw materials, energy, and capital goods, make up about 70 percent of the import bill (World Bank 1991). High transport and marketing costs contribute to the large size of the service sector; marketing alone accounted for 21 percent of value added in 1984.

Based on poverty lines for rural and urban households calculated using food requirements and typical expenditure patterns, approximately 37 percent of rural households, 26 percent of households in small urban areas, and 18 percent of households in the seven large urban areas can be classified as poor, (Dorosh, Bernier, and Sarris 1990). Nationally, 34 percent of all households are poor, 90 percent of which are in rural areas.

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[2] Including agro-industrial exports such as cloth, preserved meats and essences of cloves and ylang ylang, the share rises to 62 percent (IMF 1991).

ECONOMIC POLICIES IN THE EIGHTIES

At the start of the eighties, severe macroeconomic imbalances plagued the Malagasy economy. The "investment to the limit" development strategy of the late seventies had led to a huge surge of imports, unsustainable balance of payments deficits, large government budget deficits and accelerating growth in the money supply (Table 1). The current account deficit reached 16.9 percent of GDP in 1981, and inflation jumped from 9.1 percent per year in 1977 to 23.8 percent per year in 1981.

Between 1981 and 1984, macro-economic adjustment in Madagascar focused largely on stabilization efforts endorsed by the IMF. Aggregate demand was quickly reduced through cuts in public investment and other government expenditures. Initial efforts at liberalization of rice marketing were begun,including a large reduction in the subsidy on rice for consumers. These stabilization efforts proved successful in terms of their major goals: by 1984 inflation had dropped to 10.3 percent per year and the trade deficit was cut to only 5.0 percent of GDP. However, real GDP also fell sharply, by 5.4 percent between 1979-81 and 1982-84.

Structural adjustment reforms aimed at restoring growth enjoyed relatively little success until 1988, the year a major trade liberalization was completed. Thereafter, in 1989 and 1990, Madagascar enjoyed positive growth in per capita GDP for the first time since the unsustainable surge of the investment boom at the start of the decade (Table 2). A decline in world export prices together with domestic credit expansion contributed to balance of payments difficulties in 1991. More important, political protests led to a temporary closing of the major port, Toamasina, in mid-1991 and continued

Table 1 — Madagascar: Macroeconomic Summary, 1961-1980

	1961-72	1973-77	1978-80
Real GDP (billion 1984 FMG)	1,189.00	1,712.90	1,797.60
Real GDP per capita (billion 1984 FMG)	188.30	224.30	212.10
Average GDP growth rate (percent)	2.87	-0.01	2.70
Annual percentage change in GDP deflator			
Average	3.70	11.60	11.00
End of period	5.20	8.60	15.00
Trade deficit/GDP (percent)			
Average	5.80	-4.10	-13.00
End of period	3.30	-3.60	-16.40
Budget deficit/GDP (percent)[a]			
Average	0.80	-3.28	10.05
End of period	3.80	-6.28	14.51
Rice imports ('000 tons)			
Average	-11.00	86.00	161.00
End of period	13.00	95.00	176.00
Exchange rate (FMG/dollar)			
Average	252.00	233.00	217.00
End of period	253.00	226.00	211.00
Industrial value added (billion 1984 FMG)			
Average	211.00	252.70	267.60
End of period	237.00	262.40	265.50

Sources: Pryor (1988) for 1961-72; World Bank (1991) for 1973-80.

[a] Budget deficit on a commitment basis.

Note: Industrial value added 1961-72 in factor prices, all other years in market prices.

Table 2 — Madagascar: Macroeconomic Summary, 1981-1989

	1981-82	1983-87	1988-89
Real GDP (billion 1984 FMG)	1,667.00	1,719.00	1,880.00
Real GDP per capita (billion 1984 FMG)	183.60	170.30	164.60
Average GDP growth rate (percent)	-5.80	1.40	4.40
Annual percentage change in GDP deflator			
Average	27.60	16.10	16.30
End of period	28.60	22.80	10.20
Trade deficit/GDP (percent)			
Average	-10.40	-5.90	-5.90
End of period	-9.40	-4.60	-5.20
Budget deficit/GDP (percent)[a]			
Average	-9.60	-3.70	-5.60
End of period	-7.10	-3.30	-7.90
Rice imports ('000 tons)			
Average	272.00	130.00	101.00
End of period	351.00	94.00	112.00
Exchange rate (FMG/dollar)			
Average	311.00	683.00	1,505.00
End of period	350.00	1,069.00	1,465.00
Industrial value added (billion 1984 FMG)			
Average	204.00	203.00	241.00
End of period	197.00	22.00	250.00

Sources: World Bank (1991); IMF (1988, 1991).

[a] Budget deficit on a commitment basis.

political uncertainty has hindered government development efforts, discouraged private investment and stalled foreign aid inflows.

The major channels by which adjustment policies and external shocks affected the poor are relatively clear. Rice subsidies and large quantities of imports heavily favored urban consumers, especially in the capital city, Antananarivo, to the detriment of producers of rice. The investment boom of the late seventies and the early eighties was concentrated in large industrial projects, spurring economic activity and (especially urban) incomes. And despite changes in the real exchange rate brought about by nominal devaluations and fiscal discipline, real producer prices of export crops changed little during the decade, initially because of increases in the rate of taxation on exports and then later because of a decline in world prices that coincided with, but was independent of, a liberalization in export crop marketing. The magnitudes of the above effects and their interactions are not straightforward, however, and require a more formal analysis, which is the main purpose of this report.

3. MODEL DESCRIPTION

Computable General Equilibrium (CGE) models have been used in the analysis of economic policics since the early 1960's. The first CGE model by Johansen (1960) was based on the Norwegian economy. Since then, CGE models have been formulated for a number of developing countries, including South Korea (Adelman and Robinson, 1978), Brazil (Taylor et al., 1980), Cameroon (Benjamin and Devarajan, 1985) and Indonesia (Thorbecke et al., 1989).[3]

The CGE model for Madagascar is designed for analysis of income distribution consequences of structural adjustment and other government policies. A social accounting matrix (SAM) for Madagascar's economy in 1984 is the data base for the model (Dorosh et. al., 1991). Adapted from a static model for Cameroon (Condon, Dahl and Devarajan, 1987), the Madagascar model provides a further disaggregation of production activities, households and institutions. The model presented here also draws some of its features from Sarris (1990).

In this chapter, the main structure of the model is outlined only briefly.[4] Special features of the model central to the policy issues analyzed — equations to model rice subsidies and quantitative restrictions on imports — are described in greater detail.

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[3] Decaluwé and Martens (1988), present a survey of 73 applications of CGE models to developing countries.

[4] A full description of the static version of the Madagascar CGE model is found in Dorosh (1992).

THE SOCIAL ACCOUNTING MATRIX

The social accounting matrix that serves as the data base for the model contains 27 production activities producing 15 commodities (Table 3). Three separate technologies (activities) are specified for paddy (small farm irrigated, large farm irrigated and upland). For both export crops and industrial crops, two technologies (large and small farm) are given. Separate technologies, for formal and informal sector production, are modeled for all other products with the exception of mining and public administration (which are formal sector activities) and private services (which combines both formal and informal activities together). In general, each formal activity produces more than one commodity, informal activities produce only their own characteristic commodity.[5]

Nine factors of production are modeled: three types of labor (highly skilled, skilled and unskilled), two types of non-farm capital (formal and informal sector capital) and four types of farm capital and land (belonging to small farmers in the Plateau, East Coast and West and South zones, and farm capital and land owned by large farmers).

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[5] The SAM follows Madagascar national accounts' conventions. The formal sector figures are based on the accounts of enterprises which typically produce several commodities (i.e. a manufacturing firm may also construct its own buildings and provide transport services).

Table 3 – Subsectors in Madagascar SAM

	Gross Value Added	Sectoral Gross Value Added as a Percent of Total GVA
Primary sector	568,709	35.8
1 Paddy	119,036	7.5
1a Small farm irrigated	44,227	
1b Large farm irrigated	58,947	
1c Upland	15,682	
2 Other food crops	197,855	12.5
3 Export crops	37,573	2.4
3a Small farms	27,283	
3b Large farms	10,290	
4 Industrial crops	11,680	0.7
4a Small farms	8,030	
4b Large farms	3,650	
5 Livestock and forestry	202,565	12.8
5a Informal sector	189,548	
5b Formal sector	13,017	
6 Mining, energy and water	31,969	2.0
7 Rice milling	3,807	0.2
7a Informal sector	0	
7b Formal sector	3,807	
8 Other food processing	59,944	3.8
8a Informal sector	12,118	
8b Formal sector	47,826	
9 Textiles	24,545	1.5
9a Informal sector	4,391	
9b Formal sector	20,154	
10 Other industry	44,447	2.8
10a Informal sector	10,664	
10b Formal sector	33,783	
11 Construction	42,752	2.7
11a Informal sector	5,339	
11b Formal sector	37,413	
12 Transportation & communication	160,758	10.1
12a Informal sector	130,818	
12b Formal sector	29,940	
13 Commerce	331,933	20.9
13a Informal sector	219,161	
13b Formal sector	112,772	
14 Services, private	188,787	11.9
15 Public administration	130,301	8.2
Total	1,587,954	100.0

Source: Dorosh, et. al. (1991) from the Tableau Entrées-Sorties, Madagascar National Accounts for 1984.

INSTITUTIONS IN THE SAM

The model specifies eleven institutions: eight households, formal enterprises, government and the Rest of World (Table 4).[6] The three urban household groups are classified according to the skill-level of the head of household (which corresponds with income levels, as well). Rural small farmers are disaggregated by agro-ecological zone: Plateau (where irrigated rice is the major crop), East Coast (a region with export crops), and West and South (the rest of the country, where livestock are a dominant source of rural income). Large farmers from throughout the country and rural non-farm households with a skilled head of household are classified as rural high income households.

Unlike in the published SAM (Dorosh et. al., 1991), in the SAM used in the model simulations all transfers between institutions (including households) have been netted out, so that both expenditures of institutions paying transfers and incomes of institutions receiving transfers are reduced.

CGE MODEL SPECIFICATION[7]

Value added generated by production activity j is specified as a constant elasticity of substitution (CES) production function with one fixed factor

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[6] The published Madagascar SAM (Dorosh et. al., 1991) has 13 institutions. In addition to the 11 institutions listed above, private non-profit institutions (included with high income urban households in the model) and financial enterprises (included with formal sector enterprises in the model) have separate accounts in the full SAM.

[7] Dervis, de Melo, and Robinson (1982) presents the theoretical foundation underlying the core model.

Table 4 — Institutional Classifications in the Madagascar SAM

Households	Classification
Urban	
25	Urban 1 - highly skilled
26	Urban 2 - skilled
27	Urban 3 - unskilled
Rural	
28	Small farmers - plateau
29	Small farmers - east coast
30	Small farmers - south
31	Rural rich
32	Rural nonagricultural
33	Private, nonprofit institutions
34	Formal sector enterprises
35	Financial institutions
36	Public administration

Source: Dorosh et al. (1991).

(aggregate capital, Kj, which includes land) and variable labor (Lkj, where k is the skill level of labor: highly skilled, skilled or unskilled). Quantities of intermediate inputs are modeled as fixed shares of the quantity of output produced. Each activity produces commodities i in fixed proportions. In cases where commodity i is produced by more than one activity, the price of commodity i is assumed to be the same regardless of its activity of origin.

Internationally traded goods are treated as imperfect substitutes for goods domestically produced and consumed. A constant elasticity of substitution (CES) aggregation function defines the composite of imports and home goods. Similarly, a constant elasticity of transformation (CET) aggregation is used to define a composite production good of export goods and goods produced for domestic consumption. Madagascar is assumed to be a price taker for imports, but world demand for Madagascar's exports is modeled as less than perfectly elastic.

Labor supply of each skill type is a log-linear function of its real wage. Factor payments are allocated to institutions (households and formal enterprises) according to the ownership of factors by each institution. Total income of household *h* has three basic components: wages, returns to capital and land, and transfers received from both the domestic institutions and the Rest of World. Formal enterprises receive income from returns to formal sector capital and transfers, only.

Government revenues are equal to import tariffs, export duties,[8] other indirect taxes, direct taxes on households and transfers from other institutions, (including income taxes on formal sector enterprises). Government current expenditure in real terms is exogenous with expenditure demand by commodity modeled as a fixed share of total real government current expenditure. Real government investment demand is specified apart from private investment demand and is exogenous.

The level of total private investment is determined by the total pool of savings (including government and foreign savings) available after government investment is financed. This specification reflects the situation in Madagascar during most of the eighties, when the commercial banks were controlled by the state and allocation of credit for investment was determined largely through rationing. The value of investment by sector of destination j is assumed to be a fixed share of total fixed investment and the composition of capital by activity is likewise fixed.

Quantitative Restrictions on Imports and Rice Subsidies

Quantitative restrictions on the imports of manufactured goods and rice are modeled by fixing imports of these commodities exogenously at the quota levels. Implicit tariffs are not explicitly modeled as in, e.g., Michel and Noel (1984). Instead, the constant elasticity of substitution function used to aggregate imports and domestically produced manufactured goods is calibrated using an estimate of the implicit tariff for 1984 (100 percent for

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8 Export duties include the revenues of the export stabilization fund (Fonds National Unique de Peréquation, FNUP).

manufactured goods, 47 percent for rice), instead of the actual tariff rate. In the simulations with the quotas on manufactured goods and rice, the equations which determine the level of imports of these commodities (the cost-minimization equation between imports and domestically produced goods) are dropped. Under the trade liberalization simulations in Chapter 4, the cost-minimization equation for imports of manufactured goods is again added to the model making imports endogenous.

Madagascar's rice policies in the eighties involved a combination of quantitative restrictions on imports of rice, subsidized sales of imports, and official producer and consumer prices. In the model simulations for this report, this complex array of government interventions is not explicitly modeled because changing the import quota on rice captures the main effects of the policies -- higher rice imports, lower consumer and producer prices, increased consumption and production.[9] Moreover, after 1983, implicit government subsidies and taxes on rice imports and domestic procurement were small (Dorosh, Bernier and Sarris, 1990).

Model Closure

Apart from quantitative restrictions on imports of rice and manufactured goods in some model runs, prices adjust to equate supply and demand. Labor markets also clear through adjustment in real wages, though the substantial underemployment in the Malagasy economy in the 1980s is reflected in high elasticities of supply of labor. Savings determines private investment given

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[9] An alternative methodology for modeling rice subsidies is found in Dorosh (1992).

fixed values of real government investment and government expenditure. The nominal exchange rate *(ER)* and foreign savings *(FSAV)* are also fixed exogenously, leaving changes in the aggregate price index (PINDEX) to bring about movements in the real exchange rate *(ER/PINDEX)* and equilibrium in the Rest of World accounts.

Alternative closures are possible as well. For example, both private and public investment can be exogenously fixed, and the level of foreign savings can be made endogenous. This closure allows estimation of the effects of policies on the trade balance, given a fixed level of investment. All of the model simulations in Chapters 4 and 5 use the fixed foreign savings closure, however.

The Dynamic Model

In the dynamic simulations, capital stock is updated each year according to the previous period's net investment by sector. The base level labor supply is also increased exogenously by a constant population growth rate. In the base runs used as a standard for comparison for the policy analysis, real government investment, real government recurrent expenditures and the level of foreign savings are all held constant in per capita terms. Details of the equations of the dynamic model are found in Appendix 1.

Table 5 shows the results of a three year simulation of the Malagasy economy from 1985 to 1987, the period just before the trade liberalization of 1988. Levels of government spending and foreign capital inflows are set to correspond to the historical changes in these variables. World prices of

Table 5 — Comparison of Simulated and Actual Growth Rates

	1984-87 Simulation	1984-87 Actual	1984-87 Average Difference[a]
GDP	5.6	4.4	0.4
Consumption	3.1	1.4	0.7
Total Investment	-27.1	24.4	-13.3
Private	-50.4	50.9	-27.9
Public	15.4	15.4	0.0
Government Consumption	9.1	9.1	0.0
Exports (Million US$)	-2.6	-0.4	-0.6
Imports (Million US$)	-3.4	-1.5	-0.9
Foreign Savings (Million US$)	-7.6	-6.6	0.0
Agriculture	3.3	7.0	-1.2
Industry	8.6	10.1	-0.5
Services	4.1	1.4	1.0

Source: Model runs and unpublished National Accounts data.

[a] Average difference of annual growth rates, simulation less actual.

Note: Simulated growth rates by sector represent gross production, whereas actual growth rates are based on sectoral value-added.

imports and exports are not adjusted, however, but are left at their 1984 levels.

The model simulates overall growth in real GDP, consumption, exports and imports quite well. Total simulated GDP growth is 5.6 percent between 1984 and 1987, compared with the historical growth of 4.4 percent. Simulated annual growth rates in agriculture are 1.2 percent lower than the historical data while simulated growth in services is overstated by an average of 1.0 percent per year. Total growth in industry is modeled to within 0.5 percent per year on average.

The evolution of investment over time is not well replicated, however. The simulated levels of investment for 1985 are higher, and those for 1986 and 1987 are considerably lower, than the historical figures for these years. In the model, the level of savings determines investment while other factors such as political stability, expectations of future earnings, access to foreign exchange and security of investment capital that are crucial to investment decisions are omitted. Changes in these and other factors as part of structural adjustment in Madagascar in the mid-eighties account for the increase in savings and investment in the historical series.

Although historical levels of investment in the mid-eighties are not replicated for some of the reasons outlined above, it is arguable that marginal investment behavior in the post-adjustment period may be determined to a greater extent by the availability of investible funds (total savings).

Further work on the determinants of investment in Madagascar is clearly a high priority for economic policy as well as CGE analysis. One simple modeling alternative to the savings-driven investment closure used in these

simulations would be to make private investment exogenous and allow either marginal savings rates of enterprises (and/or households) to change. Another option with the existing model would be to fix private investment and allow foreign savings to be endogenously determined.

The simple determination of investment in the model should be kept in mind in interpreting the simulation results in the subsequent chapters. Questions of whether savings determines investment on the margin do not affect the main thrust of the simulations of the investment boom and increased foreign savings in Chapter 4, however. In this case, the increase in investment was made possible by the increase in aggregate savings resulting from the foreign capital inflow, consistent with the model equations.

4. HISTORICAL SIMULATIONS

This chapter presents the results of a number of model simulations of terms of trade shocks and changes in government policy in Madagascar in the 1980s. The first set of simulations are designed to shed light on the effects of the major stabilization policies adopted in the early eighties: large reductions in foreign borrowing, rice imports, and investment. The second set of model runs illustrate the effects of the trade liberalization in 1988 and the adverse movements in the terms of trade in the late eighties.

In all the simulations, real government investment and expenditures are exogenous. The base run of the dynamic model fixes foreign savings, real government current expenditures and real government investment at their 1984 per capita values in each of the six years of the simulation. Quotas on imports of rice and manufactured goods are also kept constant on a per capita basis. In the dynamic policy simulations, the changes in exogenous variables modeled are maintained in real per capita terms over six years, except in simulation 1. The model results presented in the following tables compare the outcomes of simulated policies with the base solution of the model.

INVESTMENT BOOM AND STABILIZATION: SIMULATION 1

In the late seventies and continuing in the early eighties, the "investir à outrance" development strategy translated into a large increase in foreign

borrowing and imports of capital goods. A balance of payments crisis ensued as interest and principal on the foreign debts came due before the new investments generated sufficient additional foreign exchange. Madagascar rapidly cut imports, by tightening import quotas (rather than by a real devaluation or by increasing tariffs).

Simulation 1 illustrates the effects of an investment boom like that of the late seventies by specifying gross capital inflows of 25 million dollars (1984) in the first and second years of the simulation, and a gross capital inflow of 15 million dollars (1984) in year 3 of the simulation (Table 6). Principal and interest (at 5 percent per year) repayments begin in year 2 and increase steadily until the full debt is repaid in year 6. In this simulation, the quota on manufactured goods imports is adjusted each year by an amount equal to 50 percent of the value of the net capital inflow.

In an economy with no quantitative restrictions on trade, a large increase in foreign capital inflows normally leads to a large appreciation of the real exchange rate (a decrease in the price of traded goods relative to non-traded goods). This occurs as increased spending drives up prices of non-traded goods while prices of traded goods, determined by world prices and the nominal exchange rate, remain fixed.

For the Malagasy economy in the late seventies and early 1980s, however, import quotas for most goods were binding. A higher level of capital inflows, enables an increase in the import quota, and much of the increase in demand is channeled into imports instead of non-traded goods. With less change in demand, the rise in the price of non-traded goods is small and the real exchange rate appreciation is limited.

Table 6 - Foreign Capital Inflows for Simulation of Investment Boom and Stabilization

Simulation Year	Gross Capital Inflow	Interest	Principal Repayment	Net Flow	Debt
1	25.0	0.0	0.0	25.0	25.0
2	25.0	1.3	5.0	18.8	46.3
3	15.0	2.3	10.0	2.7	53.6
4	0.0	2.7	15.0	-17.7	41.2
5	0.0	2.1	20.0	-22.1	23.3
6	0.0	1.2	24.5	-25.7	0.0

Source: Model simulations.

In simulation 1, the increase in the size of the quota on imports of manufactured goods helps to limit the appreciation of the real exchange rate resulting from the increased capital inflow. As a result, the real exchange rate appreciates by only 3.7 in the first year (Table 7). Real GDP per capita increases by 0.77 percent in year 1 as the additional foreign savings increases the pool of funds available for investment.

In general, the increase in foreign savings has the expected effects on traded and non-traded sectors: services sector output rises by 0.91 percent, spurred by increased demand for construction services. Industrial output, an imperfect substitute for imports, grows by 0.88 percent. Agriculture (a mix of traded rice and export crops with non-traded crops and livestock) increases by only 0.28 percent.

The incomes of Urban I (high income) households increase the most in year 1 (3.02 percent), as the spending boom in the construction sector drives up the real wages of highly skilled labor by 1.2 percent and returns to capital rise. All households see an increase in real incomes in year 1, however. Among rural households, small farmers on the east coast, dependent on revenues from export crops, enjoy the smallest gain in real incomes (0.62 percent) as the appreciation of the real exchange rate reduces the domestic price of export crops.

As the direction of new net capital inflows reverses after year 3, the economy contracts and real incomes decline. By year 6 of the simulation, real GDP is down by 0.74 percent vis à vis year 6 of the base run, investment has fallen by 10.1 percent. Relative to year 1 of the investment boom, investment in year 6 is lower by 4.4 percent. The real exchange rate depreciates by 3.6

Table 7 – Stabilization and Increased Rice Imports: Simulation Results

	Simulation 1 Increased Foreign Savings			Simulation 2 Increased Rice Imports	
	Year 1	Year 3	Year 5	Year 1	Year 5
Real GDP (market prices)	0.77	0.29	-0.74	0.48	0.86
Private Consumption	1.12	0.31	-0.93	0.92	1.24
Total Real Investment	9.22	1.61	-10.07	9.00	10.70
Private Investment	14.28	2.50	-15.66	13.94	16.65
Government Investment	0.00	0.00	0.00	0.00	0.00
Government Consumption	0.00	0.00	0.00	0.00	0.00
Real Government Revenue	-0.37	0.26	0.65	1.54	1.67
CPI	3.84	0.32	-3.48	2.19	2.34
GDP Deflator	3.95	0.37	-3.51	2.81	3.02
Real Exchange Rate	-3.70	-0.31	3.60	-2.14	-2.29
Exports	-1.57	-0.02	1.54	-1.33	-1.16
Imports	4.13	0.54	-3.66	5.00	5.23
Foreign Savings	35.11	3.59	-31.44	39.36	39.36
Sectoral Production					
Agriculture	0.28	0.10	-0 25	-1.30	-1.45
Industry	0.88	0.41	-1.25	0.46	0.95
Formal	0.95	0.95	-0.43	1.71	3.76
Informal	0.82	-0.13	-2.08	-0.79	-1.85
Services	0.91	0.51	-0.56	0.50	1.40
Formal	1.75	0.49	-1.84	0.48	0.88
Informal	0.08	0.53	0.73	0.52	1.92
Public Administration	0.01	0.00	-0.01	0.03	0.03
Total	0.65	0.60	0.03	0.11	1.31
Household Incomes					
Urban 1 (High Income)	3.02	0.90	-2.34	3.11	4.20
Urban 2 (Middle Income)	1.10	0.47	-0.95	2.40	2.92
Urban 3 (Low Income)	0.88	0.25	-0.78	1.97	1.81
Small farm Plateau	0.77	0.24	-0.59	0.34	0.38
Small farm East	0.62	0.24	-0.60	0.22	0.51
Small farm West/South	0.69	0.20	-0.51	-0.06	0.03
Large Farm Rural High Income	1.09	0.19	-0.92	0.46	0.48
Non-farm Rural Low Income	0.87	0.17	-0.57	2.39	1.78
Total	1.22	0.34	-1.00	1.04	1.34

Source: Model simulations.

percent relative to the base run (year 6), helping to limit the reduction in agricultural output to -0.25 percent but worsening incentives for industry and services which fall by 0.43 and 0.56 percent, respectively.

All household incomes (per capita) decline continuously from after year 1 of the simulation. Only for high-income urban households is their income in year 6 of the simulation higher than in year 1 of the base SAM, and even for these households their year 6 income is 2.34 percent lower than in year 6 of the base run. The present value of the per capita income streams in simulation 1 is about 0.1 percent higher than in the base run for most income groups, (and 0.6 percent higher for urban high income households), however.

This simulation of reduced foreign capital inflows and reduced investment expenditures suggest that the biggest beneficiaries of the investment boom in the late seventies were the urban high income households, whose skilled labor was used by the construction and manufacturing industry to produce investment goods. Lower income households (especially rural households) benefitted little from the investment boom as the benefits of the increase in aggregate demand on employment were countered by negative effects of the real exchange rate depreciation.

The simulation results also suggest that since urban households were the major beneficiaries of the investment boom, these same households would be the major losers from the stabilization policies that cut back foreign capital inflows and government investment. It is important to keep in mind, however, that the investment boom itself was unsustainable. The large increase in foreign capital inflow in the form of loans could not continue indefinitely; some stabilization effort was inevitable.

Finally, although the calculations of the present value of the income streams under investment booms followed by stabilization are higher than in the base run, this measure may not be the most important consideration for people's perception of welfare. From a political economy standpoint, if expectations of higher incomes are raised during the investment boom period, the subsequent decline may lead to more dissatisfaction with government policies than the base scenario where a long term trend is maintained.

INCREASED RICE IMPORTS: SIMULATION 2

Not all of the increase in foreign savings in the late seventies was spent on imported capital goods. Rice imports also increased substantially in this period: imports in 1980 were nearly double those in 1984. Simulation 2 models an increase in rice imports together with a matching increase in foreign savings. Domestic paddy production falls by 6.3 (6.6) percent in year 1 (year 5). Real incomes rise for most groups, though, due to the positive effects of the increase in foreign savings on aggregate demand, and especially the construction sector. A decline in the cost of labor as the price of wage goods falls helps boost both the value of industrial production and the value of production in the services sector by 0.5 percent in year 1.

Not surprisingly, the biggest beneficiaries of the large increase in rice imports in the late seventies, are household groups that do not produce rice. Urban households and the non-farm rural poor enjoy the largest increase in real incomes (since the decline in rice prices reduces the cost of their consumption basket. Given that the rice imports in this simulation are funded through additional foreign borrowing, the net effect of the rice import policy

on rural groups was small, with the effects of greater aggregate demand balanced by the adverse effects of lower rice prices for producers.

While increasing imports of rice does increase real incomes, this policy leads to lower overall growth. Comparing year 1 of simulations 1 and 2, using foreign capital inflows to finance rice imports instead of manufactured goods and other diverse imports results in lower overall investment and real GDP growth,[10] but significantly higher real incomes for the urban middle and lower income groups and the rural non-farm poor. These results derive in large measure from the larger production disincentives arising from imports of a highly tradeable commodity (rice) compared with imports of goods which are less perfect substitutes for domestic production (imported manufactured goods).

For this simulation, sensitivity analysis was conducted using lower paddy supply elasticities and a higher degree of substitutability of imported and domestic rice. With this change in parameters, the increase in supply of imports does not reduce the average price of rice as much as in the simulation above. With little change in the average price of rice, total consumption of rice rises less (0.4 percent in year 1 compared with 1.8 percent in year 1 of simulation 2 above) and the decline in paddy supply is also somewhat smaller (-4.1 percent versus -6.3 percent), (Appendix Table A.4). Since rice prices fall less, wage labor costs also decline less. Industrial production rises by only 0.3 percent in year 1 (compared with 0.5 percent in Table 7); services production actually falls slightly. The result is a decline in real GDP in

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[10] Growth rates are higher under the investment boom in year 1 of simulation 1 even though the foreign savings inflow modeled is 3.0 percent less than in simulation 2.

year 1 (compared with the 0.5 percent gain in Table 7). The effects of higher rice imports on household incomes are similar in the two simulations, with the increase in household incomes somewhat lower and an actual decline in small farmer incomes in the simulation using the modified parameters.

TRADE LIBERALIZATION: SIMULATIONS 3 AND 4

A key part of Madagascar's economic reforms, trade liberalization, did not take place until 1988, six years after stabilization efforts were begun in earnest in 1982. Up until that time, import licenses and import quotas were used to control the outflow of foreign exchange. In simulation 3, the quota on manufactured imports is removed and the import tariff is kept at its 1984 value of 19.3 percent (Table 8). The nominal exchange rate is also devalued by 30 percent.

With the quota (and implicit import tariff) removed, demand for manufactured imports rises by 8.6 percent in year 1 and domestic production of manufactured goods falls by 12.8 percent. The drop in industrial output reduces urban incomes and domestic prices fall, especially prices of non-traded goods. Thus the real exchange rate depreciates by 5.44 percent in year 1, (5.99 percent relative to the base run in year 6), spurring production of traded goods. Both exports and imports rise in dollar terms increasing revenues from import tariffs and export taxes. Government revenues rise by 3.2 percent in real terms providing additional funds for investment which increases by 6.2 percent in year 1. Although real GDP falls by 0.37 percent in year 1, investment is 6 - 9 percent higher in each year, capital stock

Table 8 — Liberalization: Simulation Results

	Simulation 3 Liberalization		Simulation 4 Liberalization Decreased Foreign Savings	
	Year 1	Year 6	Year 1	Year 6
Real GDP (market prices)	-0.37	0.13	-0.62	-0.50
Private Consumption	-0.18	0.22	-0.79	-0.71
Total Real Investment	6.22	8.72	1.27	1.93
Private Investment	9.61	13.53	1.96	3.00
Government Investment	0.00	0.00	0.00	0.00
Government Consumption	0.00	0.00	0.00	0.00
Real Government Revenue	3.15	4.15	3.75	4.11
CPI	23.29	22.66	19.92	19.93
GDP Deflator	23.79	23.36	20.09	20.32
Real Exchange Rate	5.44	5.99	8.41	8.40
Exports	2.72	3.40	3.91	4.18
Imports	2.30	2.86	0.20	0.37
Foreign Savings	0.00	0.00	-20.00	-20.00
Sectoral Production				
Agriculture	0.23	0.49	0.11	0.17
Industry	-0.97	-0.55	-1.61	-1.80
Formal	-1.63	-0.01	-2.43	-1.83
Informal	-0.30	-1.09	-0.79	-1.77
Services	-0.32	1.16	-0.19	0.15
Formal	-0.57	1.03	-0.27	-0.51
Informal	-0.07	1.29	-0.12	0.81
Public Administration	-0.01	0.00	-0.02	-0.02
Total	-0.39	0.98	-0.59	0.14
Household Incomes				
Urban 1 (High Income)	-1.25	-0.03	-3.06	-2.59
Urban 2 (Middle Income)	-1.60	-1.04	-2.40	-2.25
Urban 3 (Low Income)	-0.26	0.09	-0.77	-0.66
Small farm Plateau	0.20	0.53	-0.19	-0.10
Small farm East	0.78	1.27	0.58	0.69
Small farm West/South	0.23	0.51	-0.10	-0.02
Large Farm Rural High Income	-0.11	0.05	-0.69	-0.65
Non-farm Rural Low Income	-0.07	0.04	-0.54	-0.49
Total	-0.24	0.19	-0.91	-0.81

Source: Model simulations.

grows faster than in the base run and real GDP in year 6 is 0.13 percent higher than in the corresponding year of the base run.

Rural per capita incomes rise slightly for small farmers in all regions of the country, with export crop producers on the East Coast enjoying the largest increase (1.27 percent in year 6) (Table 10). By year 6, all households have higher incomes than in the base run except for urban high and middle income households whose incomes are most affected by the decline in the manufacturing sector.

Historically, the trade liberalization in 1987 and 1988 was accompanied by a reduced trade deficit. In simulation 4, foreign savings are reduced by 20 percent. In this scenario, the depreciation of the real exchange rate in year 1 increases to 8.4 percent. Smaller capital inflows reduce the funds available for investment compared with simulation 3, but because of the increase in government tax revenues, investment still increases slightly (1.27 percent). Without a significant boost in earnings from the construction sector, urban incomes decline more steeply than in simulation 3. (Per capita incomes of urban high income households fall by 2.59 percent in year 6 compared with the 0.03 percent drop in year 6 in simulation 4.) Again small farmers do best in this scenario; export crop producers who benefit from the real exchange rate depreciation enjoy an increase of 0.69 percent in their incomes (year 6) while other small farmers experience declines in per capita incomes of less than 0.1 percent.

These simulations of trade liberalization (with and without reduced foreign capital inflows), a cornerstone of the structural adjustment measures undertaken in Madagascar, show that these policies tended to benefit rural

households, especially those producing export crops. Government revenues increase in these simulations, so that with government recurrent expenditures held in check, the trade liberalization increases total savings and investment in the economy. The size of the decline in foreign capital inflows is a major determinant of total investment and the extent of the real exchange rate depreciation.

5. ALTERNATIVE DEVELOPMENT STRATEGIES

In this chapter, a number of alternative development options involving investment, trade and aid strategies are analyzed using the Madagascar CGE model. Current policy issues such as exchange rate devaluation and rice import tariffs are also simulated. The discussion focuses on the channels by which economic policies and external shocks affect the level and distribution of income in Madagascar.

The base run of the model used in this chapter creates a social accounting matrix that represents the Malagasy economy in 1989 by using updated values for exogenous variables such as world export and import prices, government spending and foreign capital inflows. Details of the new base run are given in Appendix 2.

EFFECTS OF FOREIGN AID INFLOWS

Much of the foreign aid inflows to developing countries in Africa in the eighties (including Madagascar) took the form of general balance of payments support. An alternative form of aid flows, tied to projects or specific commodity purchases, predominated in the seventies. The effects of the aid flows on the level and distribution of income can be separated into two effects: the macro-economic effects of an increase in foreign exchange

availability and the sectoral and micro-economic effects of the investments financed with the aid flows.

Simulation 5 shows the effects of an increase in foreign aid inflows (foreign savings) of 8.84 million (1989) dollars, approximately equal to 10 percent of the Madagascar's 1989 trade deficit. Government current and capital expenditures are held constant in real terms. The increased foreign aid inflows are assumed to be re-lent by the government to private enterprises who then invest according to the historical pattern of investment.

In this simulation, as in the simulation of the investment boom (simulation 1 of chapter 4), the foreign aid inflows affect levels and distribution of incomes through three major channels. First, foreign aid flows add to the total pool of savings in the economy and enable increased investment. Private investment rises by 3.6 (4.4) percent in real terms in year 1 (year 5) and total real investment (both public and private) rises by 2.0 percent (2.5 percent in year 5, Table 9). Historically, investment funds have been heavily concentrated in urban areas (apart from certain large irrigation projects) both in terms of destination of investment and in terms of composition of investment goods (largely urban construction services and to a lesser extent domestic industrial goods).[11] The output of the construction sector rises by 2.05 percent in year 5. Urban higher-income households tend to benefit most from this spending as demand for scarce skilled labor in construction tends to push up real wages; returns to capital in construction also increase.

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[11] Purchases of imported intermediate and capital goods also make up a large part of investment spending.

Table 9 — Simulation Results of a 10 Percent Increase in Foreign Savings

	Simulation 5 Increased Foreign Savings	
	Year 1	Year 6
Real GDP (market prices)	0.26	0.39
Private Consumption	0.40	0.51
Total Real Investment	2.00	2.49
Private Investment	3.57	4.40
Government Investment	0.00	0.00
Government Consumption	0.00	0.00
Real Government Revenue	1.42	4.08
CPI	1.37	1.23
GDP Deflator	1.53	1.38
Real Exchange Rate	-1.35	-1.21
Exports	-0.75	-0.60
Imports	1.27	1.40
Foreign Savings	10.00	10.00
Sectoral Production		
Agriculture	-0.02	0.02
Industry	0.26	0.75
Formal	0.39	0.70
Informal	0.12	-0.11
Services	0.17	0.23
Formal	0.42	-1.14
Informal	0.07	0.79
Public Administration	0.01	0.01
Total	0.13	0.35
Household Incomes		
Urban 1 (High Income)	1.43	1.65
Urban 2 (Middle Income)	0.51	0.65
Urban 3 (Low Income)	0.37	0.42
Small farm Plateau	0.21	0.29
Small farm East	0.17	0.29
Small farm West/South	0.16	0.22
Large Farm Rural High Income	0.38	0.41
Non-farm Rural Low Income	0.42	0.40
Total	0.46	0.57

Source: Model simulations.

A second major determinant of the income distribution implications of foreign aid inflows is the extent of the appreciation of the real exchange rate (a decrease in the relative price of tradeables to non-tradeables).[12] As aid inflows are spent in the country (either directly or through the contre-valeur funds) prices of domestic goods, particularly non-traded goods, tend to rise. Prices of traded goods, which are tied to world prices, rise less, thus bringing about reductions in the domestic prices of traded goods in real terms. In Madagascar, as in most developing countries, the agricultural sector is the largest sector producing traded goods (e.g. rice, export crops and cotton) and thus agricultural production and agricultural real incomes tend to decline with an appreciation of the real exchange rate. In year 1 of simulation 5, the real exchange rate appreciates by 1.35 percent, real agricultural output declines by 0.75 percent while output of formal sector private services increases by 0.4 percent. Small farmers on the east coast, who derive a large share of their income from export crop revenues, enjoy only a small increase in real incomes (0.17 percent compared with the average of 0.46 percent).

Finally, the third major macro-economic channel determining incomes and production is the effect of the increased aggregate demand (resulting from the initial increase in investment spending and the subsequent multiplier effects). Given the high level of underemployment of unskilled labor in the economy, supply of many goods, especially non-traded goods and services, are

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[12] This appreciation, and the negative effects on tradeable goods production due to the change in producer incentives, is often referred to as the Dutch disease, named after the decline in the industrial sector of the Netherlands following an increase in natural gas export revenues in the seventies.

relatively elastic in supply. Thus an increased demand for these goods will elicit an increase in supply with a relatively small increase in price. It is this Keynesian effect of increased aggregate demand on output that enables real GDP to increase by 0.26 percent in simulation 1, before any positive effects of an increase in capital stock are realized.

Given the above three effects, urban households, especially those with skilled labor and capital revenues, benefit the most. The richest household group, Urban I, (defined as households headed by a highly skilled worker), gains the most (1.65 percent in year 5); poor rural farm households benefit least, gaining only 0.23 to 0.29 percent in year 5 relative to the base run.

FERTILIZER IMPORTS

Changing the type of investments financed with the foreign aid can make a difference in these results, of course. Instead of urban investments, rural investments or intermediate goods can be financed. In simulations 6 and 7, the effects of an increase in fertilizer use by small farmers on irrigated paddy are modeled (Table 10). In simulation 6, increased fertilizer use is modeled with no change in foreign aid flows. In simulation 7, fertilizer imports are financed with foreign aid equal in value to the foreign capital inflow of simulation 5. Any additional expenditures required for extension efforts are not modeled.

Technical coefficients derived from Ministry of Agriculture crop budgets are used to calculate the marginal returns to fertilizer (4.11 kgs of paddy

Table 10 — Simulation Results of Increased Fertilizer Imports

	Simulation 6 Fertilizer Imports		Simulation 7 Fertilizer Imports with Capital Inflow	
	Year 1	Year 5	Year 1	Year 5
Real GDP (market prices)	0.27	0.27	0.52	0.65
Private Consumption	0.24	0.22	0.65	0.73
Total Real Investment	0.78	0.99	2.72	3.42
Private Investment	1.40	1.75	4.87	6.04
Government Investment	0.00	0.00	0.00	0.00
Government Consumption	0.00	0.00	0.00	0.00
Real Government Revenue	0.72	3.29	2.15	4.80
CPI	-0.58	-0.66	0.80	0.57
GDP Deflator	-0.52	-0.60	1.03	0.80
Real Exchange Rate	0.58	0.67	-0.79	-0.57
Exports	0.30	0.44	-0.45	-0.17
Imports	0.25	0.36	1.51	1.75
Foreign Savings	0.00	0.00	10.00	10.00
Sectoral Production				
Agriculture	0.39	0.34	0.37	0.35
Industry	0.70	0.95	0.95	1.47
Formal	0.53	0.55	0.91	1.32
Informal	0.88	0.57	1.00	0.74
Services	0.17	0.06	0.34	0.41
Formal	0.13	-1.66	0.55	-0.99
Informal	0.19	0.79	0.25	1.00
Public Administration	0.01	0.01	0.01	0.01
Total	0.36	0.42	0.49	0.71
Household Incomes				
Urban 1 (High Income)	0.63	0.66	2.08	2.33
Urban 2 (Middle Income)	0.66	0.57	1.17	1.21
Urban 3 (Low Income)	0.67	0.48	1.04	0.90
Small farm Plateau	0.24	0.16	0.46	0.45
Small farm East	0.11	0.12	0.29	0.41
Small farm West/South	0.10	0.06	0.27	0.29
Large Farm Rural High Income	-0.02	-0.03	0.36	0.39
Non-farm Rural Low Income	0.73	0.52	1.15	0.93
Total	0.25	0.22	0.72	0.79

Source: Model simulations.

per kilogram of fertilizer, mainly NPK).[13] Foreign aid inflows of 8.84 million (1989) dollars could finance imports of about 32,700 tons of fertilizer, enough to produce an extra 107,300 tons of paddy (net of losses). This represents an increase in small farmer irrigated production of 15.8 percent over the 1989 base run levels and a total increase in paddy production of 5.6 percent.[14]

In simulation 6 (increased fertilizer use with no change in foreign aid flows), production of irrigated paddy by small farmers increases by 12.2 percent. Production by large farmers falls, however, because of lower paddy prices.[15] Overall domestic production of paddy thus increases by only 1.3 percent; rice imports fall by 5.1 percent and rice consumption increases by 0.4 percent.

Real GDP (in market prices) increases by 0.27 percent in year 1, about the same increase as in simulation 5.[16] By year 5, real GDP is higher in simulation 1 since the foreign capital inflows allow more investment. Increased productivity in paddy production lowers rice prices, leading to lower nominal wages and prices of non-traded goods. Thus, the real exchange rate depreciates (the ratio of the price of traded to non-traded goods rises).

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[13] Assumptions on the marginal productivity of fertilizer are derived from AIRD (1991).

[14] The calculation assumes an average import price of 434.1 FMG/kg (271 dollars per ton) CIF.

[15] The simulation exaggerates somewhat the decline in large farmer production and the increase in small farmer production. The real price of value added falls by 9.0 percent for large farmer paddy production and their production falls by 5.5 percent, implying a price elasticity of supply of 0.6.

[16] Much of the gain in real GDP at market prices in simulation 5 is due to a gain in indirect tax (import tariff) revenues.

Increased demand for fertilizer imports and increased incomes raise import demand, more than offsetting the decrease in rice imports.

Households who have large net consumption of rice, the urban households and the rural non-farm poor, gain most in this scenario. The direct effect of a decline in rice prices lowers consumption costs more for the poor, for whom rice accounts for a greater share of total consumption, than for the rich. Thus, the percentage gain in real incomes for the urban poor is equal to that of the urban rich, even though the rich gain most from the effects of increased investment.

Key assumptions in the above policy analysis are the degree to which domestic rice is substitutable for imported rice and the supply elasticity of paddy. Using the higher elasticity of substitution of domestic and imported rice and the greater implicit elasticity of supply of paddy as in the sensitivity analysis for simulation 2, small farmer paddy production increases by 14.4 percent, total paddy production increases by 0.7 percent and rice imports fall by 16.0 percent. The increase in real GDP is slightly higher by year 5 with the new parameters, (0.37 percent versus 0.27 percent), (Appendix Table A.5). Small farmers' incomes rise more as well (0.25 to 0.43 percent compared with 0.06 to 0.16 percent) due to the greater increase in their paddy production with the modified parameters.

In simulation 7 with the same foreign aid inflow as in simulation 5, real GDP rises by 0.52 percent in year 1, compared with an increase of only 0.26 percent in simulation 5. Small farmer paddy production increases by 11.9 percent and total paddy production is 1.1 percent higher. The fertilizer imports lead to additional government savings as well, due to the counterpart

(contre-valeur) funds generated by government sales of the fertilizer in the domestic market. In addition, the pool of savings increases because of higher incomes. Thus, investment increases by 2.7 percent, compared with 2.0 percent in simulation 5. As the counterpart funds received by the government for sales of rice are partially spent in the domestic economy, the real exchange rate appreciates by 0.8 percent.

Urban households gain most from this scenario since they derive most of the benefits from increased investment spending. All households gain, however, with the effects of increased aggregate demand outweighing negative effects of real exchange rate appreciation and lower paddy production for large farmers. Sensitivity analysis with the same modified parameters as in the sensitivity analysis for simulation 5 again shows larger gains in real incomes for small farmers with the alternate parameters (Appendix Table A.5).

IMPORT TARIFFS ON RICE

The imposition of a thirty percent tariff on rice imports is modeled in simulation 8 (Table 11). Paddy production in year 5 increases by 5.2 percent and rice consumption declines by only 0.9 percent. Putting on a tariff reduces total imports by 1.7 percent in year 5 (rice imports fall by 28.7 percent)[17] and raises domestic prices and thus leads to an appreciation of the real exchange rate of 3.5 percent. Real GDP falls slightly in year 1 of the simulation, but the tariff revenues fund an increase of 1.25 percent in

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[17] Note here that the base for the calculation of percentage change in rice imports is much smaller than the base for consumption or production.

Table 11 — Simulation Results of a Tariff on Rice Imports

	Simulation 8 30 Percent Tariff on Rice Imports	
	Year 1	Year 5
Real GDP (market prices)	-0.06	0.08
Private Consumption	-0.20	-0.05
Total Real Investment	1.25	1.36
Private Investment	2.23	2.41
Government Investment	0.00	0.00
Government Consumption	0.00	0.00
Real Government Revenue	4.97	7.09
CPI	4.28	3.64
GDP Deflator	4.32	3.69
Real Exchange Rate	-4.10	-3.51
Exports	-2.33	-2.14
Imports	-1.89	-1.73
Foreign Savings	0.00	0.00
Sectoral Production		
Agriculture	0.69	0.95
Industry	0.71	1.21
Formal	0.30	0.50
Informal	1.15	1.23
Services	-0.37	-0.27
Formal	-0.35	-1.81
Informal	-0.39	0.38
Public Administration	0.00	0.00
Total	0.24	0.51
Household Incomes		
Urban 1 (High Income)	1.12	1.17
Urban 2 (Middle Income)	-0.90	-0.51
Urban 3 (Low Income)	-1.59	-1.08
Small farm Plateau	-0.36	-0.13
Small farm East	-0.51	-0.32
Small farm West/South	-0.12	0.05
Large Farm Rural High Income	-0.01	0.06
Non-farm Rural Low Income	-1.31	-0.87
Total	-0.15	0.03

Source: Model simulations.

total investment so that real GDP is 0.08 percent higher than the base run in year 5.

The real exchange rate appreciation discourages non-rice agricultural production, lowering incomes especially for the export crop producers on the East Coast. Real incomes of urban and non-farm rural poor households also fall due to the direct effects of higher rice prices on the cost of their consumption baskets.

Using the alternate set of rice parameters (Appendix Table A.5), the import tariff results in a larger reduction in rice imports (-67.6 percent versus -26.6 percent). The tariff thus results in only a small gain in government import, tariff revenues, and total savings and total investment increase less than in Table 11. With a larger elasticity of substitution between domestic and imported rice, and a larger supply elasticity, the increase in tariff also leads to higher real incomes for farmers.

Alternative Growth Strategies

Simulations 9 through 12 show the effects of alternative growth strategies (Table 2). In simulations 9 and 10, the effects of a 10 percent increase in the world price of export crops, with and without an increase in the rate of taxation on export crops, are modeled. (One means of achieving a higher average export price for export crops is an investment in marketing and quality control.) Simulation 11 shows the effects of an increase in mining export revenues (modeled as an increase in the world price of mining exports).

In simulation 12, a 20 percent increase in the capital stock of the formal textile sector is modeled.[18]

With an increase in world prices of export crops (simulation 9), export crop producers naturally enjoy an increase in real incomes (1.63 percent in year 5). Export crop production is relatively price-inelastic, so production increases by only 3.7 percent in real terms and the dollar value of total exports increases by 4.6 percent (Table 12). All household groups in the economy benefit from the favorable change in the international terms of trade, however, as the additional incomes are spent in the domestic economy. Surprisingly, urban households enjoy the biggest gain in revenues (Urban I households' incomes rise by 3.4 percent in year 5). Increased government export tax revenues lead to a greater pool of savings and more investment (again concentrated in the urban sector). While small farmers on the East Coast benefit from the higher export crop prices, the appreciation in the real exchange rate caused by the export price boom dampens the rise in farm incomes in general.

Raising the tax on export crops to capture more of the revenue from higher world prices, (simulation 10), results in lower real household incomes. Total export earnings in year 5 rise by only 2.0 percent in this scenario compared with 4.6 percent in simulation 9. However, the imposition of the tax results in a large increase in savings and investment. This occurs through two channels. First, additional export tax revenues add to government and

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[18] No attempt is made here to model the investment required to increase the capital stock by 20 percent. The effects of this type of investment spending are approximately those of simulation 5. Simulation 12 shows only the effects of the increase in the capital stock itself.

Table 12 — Simulation Results of Higher World Export Prices

	Simulation 9 Higher World Price of Export Crops		Simulation 10 Higher World Price of Export Crops with Increase in Export Tax	
	Year 1	Year 5	Year 1	Year 5
Real GDP (market prices)	1.30	1.52	0.59	0.81
Private Consumption	1.35	1.55	0.31	0.46
Total Real Investment	2.08	2.72	3.96	4.94
Private Investment	3.72	4.80	7.08	8.73
Government Investment	0.00	0.00	0.00	0.00
Government Consumption	0.00	0.00	0.00	0.00
Real Government Revenue	6.35	9.59	6.60	9.18
CPI	4.30	4.56	1.23	0.72
GDP Deflator	4.59	4.82	1.73	1.20
Real Exchange Rate	-4.12	-4.36	-1.21	-0.72
Exports	4.11	4.58	1.81	1.98
Imports	3.34	3.72	1.47	1.61
Foreign Savings	0.00	0.00	0.00	0.00
Sectoral Production				
Agriculture	0.29	0.36	-0.26	-0.22
Industry	0.38	0.89	0.46	1.21
Formal	0.56	0.92	0.70	1.40
Informal	0.18	-0.08	0.21	0.04
Services	0.75	0.82	0.03	0.26
Formal	1.62	0.05	0.19	-1.11
Informal	0.37	1.10	-0.04	0.83
Public Administration	0.02	0.02	0.01	0.01
Total	0.47	0.72	0.07	0.43
Household Incomes				
Urban 1 (High Income)	3.00	3.43	2.14	2.48
Urban 2 (Middle Income)	1.65	1.87	0.40	0.64
Urban 3 (Low Income)	1.67	1.77	0.01	0.07
Small farm Plateau	0.93	1.04	0.02	0.15
Small farm East	1.48	1.63	-0.40	-0.18
Small farm West/South	0.73	0.83	-0.01	0.10
Large Farm Rural High Income	1.37	1.49	0.22	0.24
Non-farm Rural Low Income	1.50	1.51	0.25	0.20
Total	1.53	1.72	0.37	0.53

Source: Model simulations.

total savings (government expenditures are held fixed in real terms) and thus total investment expenditures. Second, as investment expenditures are made in urban areas, incomes of urban households rise. Since urban households (particularly urban I households) have a higher marginal propensity to save than do rural households, the transfer of income from rural farmers to the urban rich through the export tax - increased urban investment mechanism results in greater household savings. In spite of additional indirect (export) tax revenues, GDP rises by 0.82 percent compared with 1.52 percent in simulation 9 because of lower value added in agriculture and services.

Additional revenues from mining exports (simulation 11, Table 13) have similar effects on the economy and income distribution as do increases in foreign savings (simulation 5). The major difference is that more of the income gains are concentrated in the urban rich (Urban I) households, since they reap the benefits of higher dividends earned in the mining sector when exports increase. If taxes on the mining sector exports are increased so that the government captures the windfall revenues, the effects will be essentially identical to that of an increase in foreign aid grants of the same amount.

Increasing the capital stock of the formal textile sector by 20 percent (simulation 12) raises real GDP by 0.55 percent in year 1. Textile production rises by 7.0 percent and textile exports increase by 13.2 percent. Production of industrial crops (including cotton) increases by 2.9 percent.

Initially, rural incomes rise by 0.70 to 0.84 percent, while urban incomes increase by only 0.26 to 0.49 percent. These progressive income distribution results occur because of increased demand for medium-skilled and unskilled labor in the textile and industrial crops sectors and only a small

Table 13 — Simulation Results of Increased Energy Prices and Investment in Textiles

	Simulation 11 Increased World Price of Energy Products		Simulation 12 Investment in Textiles (20%)	
	Year 1	Year 5	Year 1	Year 5
Real GDP (market prices)	0.47	0.48	0.55	0.44
Private Consumption	0.56	0.58	0.63	0.50
Total Real Investment	0.08	0.01	0.30	0.28
Private Investment	0.13	0.01	0.54	0.50
Government Investment	0.00	0.00	0.00	0.00
Government Consumption	0.00	0.00	0.00	0.00
Real Government Revenue	1.60	1.82	0.62	3.10
CPI	1.77	1.91	0.21	0.19
GDP Deflator	1.85	1.98	0.27	0.22
Real Exchange Rate	-1.74	-1.87	-0.21	-0.19
Exports	1.99	2.10	0.97	0.80
Imports	1.62	1.70	0.79	0.65
Foreign Savings	0.00	0.00	0.00	0.00
Sectoral Production				
Agriculture	-0.05	-0.10	0.20	0.16
Industry	0.50	0.81	0.85	0.97
Formal	0.94	0.93	1.63	1.23
Informal	0.04	-0.26	0.02	-0.30
Services	0.26	0.13	0.39	0.18
Formal	0.47	-1.33	0.81	-1.19
Informal	0.16	0.74	0.21	0.75
Public Administration	0.01	0.01	0.00	0.00
Total	0.22	0.30	0.44	0.43
Household Incomes				
Urban 1 (High Income)	2.39	2.36	0.26	0.28
Urban 2 (Middle Income)	1.11	1.14	0.44	0.36
Urban 3 (Low Income)	0.48	0.45	0.49	0.37
Small farm Plateau	0.18	0.15	0.76	0.55
Small farm East	0.08	0.06	0.71	0.54
Small farm West/South	0.12	0.10	0.70	0.52
Large Farm Rural High Income	0.44	0.45	0.84	0.64
Non-farm Rural Low Income	0.45	0.42	0.77	0.56
Total	0.66	0.68	0.66	0.51

Source: Model simulations.

appreciation of the real exchange rate (0.2 percent). As increased incomes add to the pool of savings, investment and the capital stock increase so that benefits for urban households grow relative to those of rural households.

OTHER CURRENT POLICY ISSUES

In simulation 13, government recurrent expenditures are raised by 10 percent in nominal terms with no accompanying tax increases or foreign aid inflows (Table 14). Increased government expenditures reduces government savings and total savings in the economy. As a result, total investment falls by 6.9 percent (year 1). Urban households with skilled labor (Urban I and II) who enjoy higher government salaries benefit most in year 1. The additional spending, concentrated on government salaries and subsequently on other domestic goods, leads to a rice in domestic prices, i.e. an appreciation of the real exchange rate, which hurts the agricultural sector and rural incomes. By year 5 real GDP is 0.26 percent lower and average real incomes are 0.34 percent below base run levels. Only for Urban II households does the increase in government salaries outweigh the effects of lower overall economic activity due to a smaller capital stock. For Urban I households, lower revenues from capital lead to a decline in real incomes of 0.87 percent.

A nominal exchange rate devaluation of 10 percent accompanied by a freeze on additional government expenditures in nominal terms is modeled in simulation 14. This simulation is approximately equivalent to a reduction in real government expenditures of 10 percent with no change in the exchange rate. Prices in the model rise by nearly 10 percent and the major real effect is a shift from public recurrent and capital expenditures into savings and

Table 14 — Simulation Results of Increased Government Expenditures and Exchange Rate Devaluation

	Simulation 13 Increased Current Government Expenditures (10%)		Simulation 14 Devaluation (10%) No Change in Nominal Government Expenditures	
	Year 1	Year 5	Year 1	Year 5
Real GDP (market prices)	0.31	-0.26	-0.57	-0.05
Private Consumption	0.15	-0.31	-0.09	0.31
Total Real Investment	-6.91	-6.78	5.64	9.07
Private Investment	-12.35	-11.98	20.40	25.44
Government Investment	0.00	0.00	-13.09	-12.30
Government Consumption	8.30	6.20	-7.76	-5.92
Real Government Revenue	-0.92	1.38	10.99	13.93
CPI	0.45	0.75	9.57	8.23
GDP Deflator	0.03	0.38	10.37	9.13
Real Exchange Rate	-0.45	-0.74	0.39	1.63
Exports	-0.43	-1.02	0.34	1.23
Imports	-0.35	-0.82	0.32	1.00
Foreign Savings	0.00	0.00	0.00	0.00
Sectoral Production				
Agriculture	-0.08	-0.27	0.07	0.17
Industry	-0.97	-1.40	0.77	2.39
Formal	-1.56	-2.55	1.27	3.38
Informal	-0.36	-0.76	0.24	0.12
Services	0.04	-0.78	-0.02	0.44
Formal	-0.35	-3.06	0.36	0.05
Informal	0.21	0.23	-0.19	0.52
Public Administration	7.96	5.94	-7.44	-8.55
Total	0.30	-0.29	-0.31	0.30
Household Incomes				
Urban 1 (High Income)	0.38	-0.87	-0.12	1.20
Urban 2 (Middle Income)	2.12	1.00	-1.94	-1.63
Urban 3 (Low Income)	0.07	-0.29	-0.07	-0.05
Small farm Plateau	-0.23	-0.54	0.21	0.71
Small farm East	-0.36	-0.73	0.31	0.93
Small farm West/South	-0.20	-0.48	0.19	0.65
Large Farm Rural High Income	0.09	-0.15	-0.04	-0.02
Non-farm Rural Low Income	-0.10	-0.26	0.15	-0.05
Total	0.20	-0.30	-0.14	0.29

Source: Model simulations.

private investment, with a 5.6 percent increase in total investment in year 1. The initial effect of the real devaluation is a drop in real GDP of 0.57 percent, but by year 5, real GDP is only 0.05 percent lower than the base run because of the positive effects of higher capital stocks in the devaluation scenario.

Real incomes of small farmers rise in year 1 due to a depreciation in the real exchange rate of 1.63 percent. Urban skilled households suffer a decline in real incomes due to lower government salaries. By year 5 of the simulation, though, Urban I household incomes are 1.20 percent higher than in the base run due mainly to higher earnings from capital.

6. CONCLUSIONS

Madagascar's investment boom, external shocks, and stabilization and structural adjustment policies led to massive gyrations in macro-economic aggregates in the late seventies and throughout the eighties. In this report, the effects of changes in macro-economic and sectoral policies on household incomes are analyzed using a CGE model. The purpose of the model simulations is not to produce exact measures of the effects of policies. Parameter values in the model are known only approximately and the model results should be regarded accordingly. More important than the exact numbers, however, is an understanding of the channels by which policies and external shocks affect household incomes and a measure of the rough orders of magnitude of these effects.

The simulation results point to three key mechanisms in the determination of the impact of macro-economic policies on household incomes: the real exchange rate, the level of investment and aggregate demand effects. Real exchange rate changes, whether caused by changes in trade policy, foreign capital inflows or other factors, to a large extent determine production and consumption incentives in the economy. Policies leading to depreciations of the real exchange rate tend to benefit the agricultural sector and small farmers, who constitute the bulk of the poor in Madagascar. Increased government savings and total investment, on the other hand, tend to benefit higher income, urban households who gain most from gains in the industrial and

construction sectors. These latter effects result from an urban bias in the destination of investment as well as in the composition of investment goods, , factors held fixed in the model simulations. Investment concentrated more heavily in rural activities, using more unskilled labor and local materials, is likely to have a more positive effect on alleviating poverty. Finally, given the assumption of relatively elastic supplies of non-traded goods in the Malagasy economy due to considerable underemployment of unskilled labor, there are positive multiplier effects resulting from an increase in aggregate demand, from whatever the source.

In most of the simulations, urban high income households, not the poor, are more affected by policy changes and external shocks than are other household groups. Urban high income households, because they own significant amounts of two of the most scarce resources in the Malagasy economy, capital and skilled labor, see major changes in their incomes from policy-induced changes in the formal sector and the levels of investment. That these households were among the biggest beneficiaries of the investment boom and the biggest losers from the contraction in the economy in the stabilization period suggests one major reason why adjustment policies were initially so strongly resisted in Madagascar, as in other countries of sub-Saharan Africa.

Sectoral and household level interventions can of course offset the negative effects of macro-economic and other policies on income distribution. But interventions such as food subsidies and income transfers can be expensive and difficult to target and administer. Although tax policies can be used to adjust relative prices of key goods in favor of the poor, targeting and enforcement can be problematic.

The urban bias in development policy effects is not unchangeable, however. Investment can be more concentrated in rural areas where the bulk of the poor live and in labor-intensive urban activities. More unskilled-labor intensive means of capital construction can be used to increase demand for labor supplied by poor households. An appropriate blend of fiscal, monetary and exchange rate policies can prevent real exchange rate appreciations that hurt the rural poor.

On the level of a single project, the linkages described in this report may be negligible. Of far more importance is assuring that the micro-economic and financial aspects of the project are sound. Yet the overall framework of a development strategy concerned with poverty alleviation should not ignore the macro-economic and economy-wide linkages modeled above. The investment boom of the late seventies did not greatly benefit the poor and rice policies, while benefitting the urban poor, increased the poverty of the rural population who constitute the bulk of Madagascar's poor.

More work must be done in order to better understand the dynamic implications of development policy alternatives, especially in considering the interactions of rural savings and investment, infrastructure, and environmental issues relating to land degradation. As more data from household surveys are gathered, the quality of the social accounting matrix (SAM) underlying the model can be improved, enhancing the reliability of the simulation results and the depth of understanding of key components of Madagascar's economy. Hopefully, poverty issues can be incorporated into policy analysis at an early stage so that future development policies can result in a more equitable distribution of the benefits of economic growth.

APPENDIX 1

MODIFICATIONS TO THE SOCIAL ACCOUNTING MATRIX AND CGE MODEL

Dorosh et al. (1991) presents a social accounting matrix which forms the data base for the CGE model. Several minor revisions have been made to the published SAM for use in the model. First, total savings of the rural rich households are set equal to zero, (the published SAM shows negative savings for these households). Savings of the rural poor in the revised SAM are calculated as a residual. The other modifications to the SAM involve transfers between institutions. Transfers are netted out[19] and dividends of formal enterprises now accrue solely to Urban I households (instead of to the rural rich as well), thus lowering incomes of rural rich households.

As mentioned above in Chapter 3, the computer code for implicit transfers for rice outlined in Dorosh (1992) is not used. Instead rice imports are modeled in the same way as imports of manufactured goods. The base data entered into the model code, however, represent a SAM with explicit flows shown for the value of the implicit tariff on rice. In this base data, the benefits of the quota are assumed to accrue only to urban households. Given the small size of the implicit subsidy after 1984, it is not modeled in the base solution. Rather, rice imports are valued at the border price plus

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[19] Transfer income is subtracted from the receiving household's income (lowering the household's savings) and thus also subtracted from the source household's expenditures (increasing the source household's savings).

normal marketing margins. Because of this change, the model does not solve exactly to the base data SAM for 1984.

The treatment of rice milling by the household has also been changed. This sector produces no value added in the national accounts, but is necessary in the model because paddy and rice are treated as distinct products. In the earlier version of the model, the quantity of rice milled by the household was held fixed. The revised version of the model holds the share of paddy milled on the farm fixed by adding an equation, ACTIVRZA, for the output of RIZER-A (informal sector rice milling):

XPTACT("RIZER-A") = XPTACTO("RIZER-A")/XPTACTO("RIZER-B")*XPTACT("RIZER-B"),

where XPTACTO("RIZER-A") and XPTACTO("RIZER-B") are the base 1984 SAM levels of informal and formal rice milling, respectively.

EQUATIONS OF THE DYNAMIC MODEL

In a multi-period ("dynamic") simulation, the model is solved for each year of the simulation sequentially, using the values for the previous year's solution to update capital stocks. There is no forward-looking behavior or expectations modeled and in this, sense, the model is not truly dynamic.

Base labor supplies are updated using an exogenous growth rate, equal to the overall population growth rate (2.8 percent) for each of the three types of labor (highly skilled, skilled and unskilled). Actual labor supply in each year of the simulation is still endogenously determined as a function of the base labor supply and the real wage.

$LSO_{LC,t} = LSO_{LC,t} * (1 + LSGR_{LC,t})$,

where $LSGR_{LC,t}$ is the exogenous growth rate of labor supply of type LC.

Capital stocks in each sector are updated using an exogenous rate of depreciation (DEPRiact), gross private investment (DKiact) and gross government investment by sector (GDKiact):

$$K_{iact,t+1} = K_{iact,t} * (1-DEPR_{iact}) + DK_{iact} + GDK_{iact}.$$

Gross government investment by sector is determined as a constant share of total real government investment.

$$GDK_{iact} = GKIO_{iact} * GOVIVT.$$

In the base run, exogenous macro- variables (real government recurrent expenditures (GDTOT), real government investment (GOVIVT) and foreign savings (FSAV) are kept constant in per capita terms. In the historical simulations modeling import quotas on rice and manufactured goods, the import quota is likewise increased by the population growth rate each year to maintain the quota at constant per capita levels.

A simplified version of the GAMS code for the dynamic section of the model follows. Note that all the statements from the line beginning LOOP(TP to the end parentheses following the line "END OF DO LOOP" are all part of the loop which is repeated for each simulation year.

```
 **DYNAMIC MODEL CODE ** ** ** ** ** ** **

SET   TP      TIME PERIODS   /T0, T1, T2, T3, T4, T5, T6 /
      T(TP)   SIMULATIONS      ;

T(TP) = NO;
T("T0") = YES;

*UPDATE DATA**

TABLE LSGR(LC,TP)    GROWTH RATES OF LABOR SUPPLY
              T1     T2     T3     T4     T5
QELEV        2.8    2.8    2.8    2.8    2.8
QMOYEN       2.8    2.8    2.8    2.8    2.8
QBAS         2.8    2.8    2.8    2.8    2.8
 ;

 LSGR(LC,TP) = 2.8 ;


TABLE MACGR(*,TP)    GROWTH RATES FOR MACRO VARIABLES
              T1     T2     T3     T4     T5
GDTOT        2.8    2.8    2.8    2.8    2.8
GOVIVT       2.8    2.8    2.8    2.8    2.8
FSAV         2.8    2.8    2.8    2.8    2.8
 ;

POPHH(H) = 100 ;
POPHHO(H) = 100 ;
POPHHTP(H,"T0") = 100 ;

*BOUCLAGE POUR LES SIMULATIONS DES POLITIQUES.

*FSAV.FX = FSAV.L * 1.1 ;

* DO LOOP BEGINS HERE.  MODEL IS NOT SOLVED FOR T0.
LOOP (TP $(ORD(TP) GE 2 AND ORD(TP) LE 7),

  OPTIONS ITERLIM=2000,LIMROW=0,LIMCOL=0 ;
  OPTIONS SOLPRINT = OFF ;

 SOLVE MAGCGE MAXIMIZING OMEGA USING NLP;

* STORE SOLUTIONS FOR EACH YEAR HERE
```

```
  PCPIHH(H) = SUM(I,PHHWT(I,H)*PC.L(I)*(1-TCX(I,H)) ) * 100 ;
  PCPIHHB100(H) = PCPIHH(H)/PCPIHH0(H) * 100 ;
  PCPI = PINDEX.L * 100 ;
  PCPIB100 = PCPI/PCPI0 * 100 ;
  XDGR(I,"PROD") =100*(XPT.L(I)/XPT0(I) - 1)$XPT0(I) ;
  IMGR(IM,"IMPORTS") =100*(M.L(IM)/M0B(IM) - 1);
  EXGR(IT,"EXPORTS") = 100*(E.L(IT)/E0B(IT) - 1);
  CDGR(I,"CONS") = 100*(CD.L(I)/CD0(I) - 1)$CD0(I) ;
  PWEGR(IT,"PWE") = 100*(PWE.L(IT)/PWE0B(IT) - 1);
  REALWAGR(LC, "REALWAGE") = 100*((WA.L(LC)/PCPI)/(WA0B(LC)/PCPI0)-1) ;
  LSTP0(LC,TP) = LS0(LC) ;
  LSTP(LC,TP) = LS.L(LC) ;
  LABSUPCH(LC) =  (LS.L(LC)/LS0(LC) - 1) * 100;
  LSOCH(LC) = (LS0(LC)/LSTP0(LC,"T0") -1) * 100;
  POPHHTP(H,TP) = POPHH(H) ;
* LANDTP(IACT,TP) = KTYPE("LAND",IACT) ;
  GDPAGGTP("CONS","LEVEL",TP) = CDTOT ;
  GDPAGGTP("CONS","ABS-CHANGE",TP) = CDTOT-CDTOT0 ;
  GDPAGGTP("CONS","PCT-CHANGE",TP) = (CDTOT/CDTOT0 - 1)*100 ;
  GDPAGGTP("GOVC","LEVEL",TP) = GDTOT.L ;
  GDPAGGTP("GOVC","ABS-CHANGE",TP) = GDTOT.L-GDTOT0 ;
  GDPAGGTP("GOVC","PCT-CHANGE",TP) = (GDTOT.L/GDTOT0 -1)*100 ;
  GDPAGGTP("GOVIVT","LEVEL",TP) = GOVIVT.L ;
  GDPAGGTP("GOVIVT", "ABS-CHANGE",TP) = GOVIVT.L-GOVIVT0 ;
  GDPAGGTP("GOVIVT", "PCT-CHANGE",TP) = (GOVIVT.L/GOVIVT0 -1)*100 ;
  GDPAGGTP("PRIVIVT", "LEVEL",TP) = DKTOT.L ;
  GDPAGGTP("PRIVIVT", "ABS-CHANGE",TP) = DKTOT.L-DKTOT0 ;
  GDPAGGTP("PRIVIVT", "PCT-CHANGE",TP) = (DKTOT.L/DKTOT0 - 1)*100 ;
  GDPAGGTP("VSTOCK", "LEVEL",TP) = SUM(I,DST.L(I)) ;
  GDPAGGTP("VSTOCK", "ABS-CHANGE",TP) =
      GDPAGGTP("VSTOCK","LEVEL",TP)-SUM(I,DST0(I)) ;
  GDPAGGTP("EXPORTS", "LEVEL",TP) = EXPORTOT*ER.L ;
  GDPAGGTP("EXPORTS", "ABS-CHANGE",TP) = EXPORTOT*ER.L - EXPORTOT0*ER0 ;
  GDPAGGTP("EXPORTS", "PCT-CHANGE",TP) =(EXPORTOT*ER.L/(EXPORTOT0*ER0) -1)*100;
  GDPAGGTP("IMPORTS", "LEVEL",TP) = IMPORTOT*ER.L ;
  GDPAGGTP("IMPORTS", "ABS-CHANGE",TP) = IMPORTOT*ER.L - IMPORTOT0*ER0 ;
  GDPAGGTP("IMPORTS", "PCT-CHANGE",TP) =(IMPORTOT*ER.L/(IMPORTOT0*ER0) -1)*100;
  GDPAGGTP("TOTAL", "LEVEL",TP) = CDTOT + GDTOT.L + GOVIVT.L + DKTOT.L +
     EXPORTOT*ER.L - IMPORTOT*ER.L + SUM(I,DST.L(I)) ;
  GDPAGGTP("TOTAL", "ABS-CHANGE",TP) = GDPAGGTP("TOTAL","LEVEL",TP) - YGDP0 ;
  GDPAGGTP("TOTAL", "PCT-CHANGE",TP) = (GDPAGGTP("TOTAL","LEVEL",TP)
      /YGDP0 - 1)*100 ;
  GDPAGGTP("GOVREV", "LEVEL",TP) = GR.L/PGDP * 100 ;
  GDPAGGTP("GOVREV", "ABS-CHANGE",TP) = (GR.L/PGDP  - GR0/PGDP0) * 100 ;
  GDPAGGTP("GOVREV", "PCT-CHANGE",TP) = ( ((GR.L/PGDP) / (GR0/PGDP0) )
      - 1) * 100 ;
  ERDEF    = 100*(ER.L/PGDP);

  DISPLAY  XDGR, IMGR, EXGR, CDGR, YGR, GDPGR, PCGR, PVAGR, PWEGR  ;
* UPDATE VARIABLES HERE
```

```
LHH(LC,H) = LHHO(LC,H) * (1 + SUM(T,LSGR(LC,TP))/100 ) ;
LSTEST(LC) = LSO(LC)*(1 + SUM(T,LSGR(LC,TP))/100 )  ;
DISPLAY LHHO, SHRLCHH ;
LSO(LC) = SUM(H,LHH(LC,H)) ;
SHRLCHH(LC,H) = LHH(LC,H)/LSO(LC) ;
POPHH(H) = POPHH(H) * (1 + SUM(T,LSGR("QBAS",TP))/100 )  ;
DISPLAY LHH, LSO, SHRLCHH, LSTEST, LSGR, POPHH ;
* NOTE THAT T IS A SUBSET OF TP. ONLY T=TP IS USED.

KO(IACT) = K.L(IACT) ;
GDK(IACT) = GKIO(IACT)*GOVIVT.L ;
K.FX(IACT)=K.L(IACT)*(1-DEPR(IACT))+DK.L(IACT)+GDK(IACT) ;
TOTKAP(TP+1) = SUM(IACT,K.L(IACT)) ;
TOTKAPCH = (TOTKAP(TP+1)/TOTKAP(TP) - 1)*100 ;
DISPLAY TOTKAP, TOTKAPCH ;
GDTOT.FX = GDTOT.L * (1 + SUM(T,MACGR("GDTOT",TP))/100 ) ;
GOVIVT.FX = GOVIVT.L * (1 + SUM(T,MACGR("GOVIVT",TP))/100 ) ;
FSAV.FX = FSAV.L * (1 + SUM(T,MACGR("FSAV",TP))/100 ) ;
M.FX("RIZ-P") = M.L("RIZ-P") * (1 + SUM(T,LSGR("QBAS",TP))/100 )  ;

M.FX("MANF-P") = M.L("MANF-P") * (1 + SUM(T,LSGR("QBAS",TP))/100 )  ;

 DISPLAY GDTOT.L, GDTOTO, GOVIVT.L, GOVIVTO, FSAV.L, FSAVO ;
 XPTATP(IACT,TP) = 100 * (XPTACT.L(IACT)/POPHHTP("URB1",TP))
                              / (XPTACTO(IACT)/POPHHTP("URB1","TO")) ;
 RWAGETP(LC,TP) = 100 * (WA.L(LC)/PCPI)  /(WAOB(LC)/PCPIO)  ;
 PGDPTP(TP) = PGDP ;
 PCPITP(TP) = PCPI ;
 DISCRATE(TP) = DISCRATE(TP-1)*(1 + DRATE) ;
 ) ;

*END OF DO LOOP

DISPLAY GDPAGGTP, XPTATP, RWAGETP, PGDPTP, PCPITP, POPHHTP ;
```

APPENDIX 2

BASE RUNS USING THE 1984 AND 1989 SAMS

The simulation results presented in Chapters 4 and 5 compare policy simulations with a "base run" which models a continuation of the policies and external conditions (world prices) from the base year (1984 for the historical simulations in Chapter 4 and 1989 for the current policy simulations in Chapter 5). In the base runs, population grows at a constant exogenous rate, capital stock is determined by the previous period's capital stock and investment and current depreciation, and the macro-economic variables determining closure (foreign savings and government recurrent and capital expenditures) are held constant in per capita terms.

Appendix Table A.1 shows the change in major variables in the base run using the 1984 SAM. The growth rate in real GDP is 11.0 percent, slightly lower than the 14.8 percent increase in population during the five year period. The simulation suggests that if the level of investment and foreign capital flows of 1984 had been maintained, real output of the Malagasy economy would have fallen in per capita terms due to a net depreciation of the capital stock. Recall that in the simulation of the actual policies of 1985 - 1987, the simulated growth in real GDP is 5.6 percent, slightly higher than the 4.4 percent growth actually recorded over the three years (Table 5), but less than the population growth of 8.6 percent over the same period. Agricultural

Appendix Table A.1 — Growth Rates of Main Aggregates and Incomes, 1984-89

	1984	Growth 1984-89
Real GDP (market prices)	1,765.9	11.0
Private Consumption	1,482.6	10.6
Total Real Investment	122.4	13.9
Private Investment	79.0	13.4
Government Investment	43.4	14.8
Government Consumption	173.3	14.8
Real Government Revenue		
CPI	100.0	1.1
GDP Deflator	100.0	0.8
Real Exchange Rate	100.0	-0.8
Exports	386.7	12.9
Imports	457.9	13.2
Foreign Savings	71.2	14.8
Sectoral Production		
Agriculture	719.3	8.3
Industry	747.2	12.5
Formal	383.0	20.2
Informal	364.2	4.3
Services	995.8	15.0
Formal	389.3	19.8
Informal	606.6	11.9
Public Administration	203.8	14.8
Total	2,666.2	12.5
Household Incomes		
Urban 1 (High Income)	100.0	18.6
Urban 2 (Middle Income)	100.0	12.8
Urban 3 (Low Income)	100.0	10.1
Small farm Plateau	100.0	7.3
Small farm East	100.0	10.6
Small farm West/South	100.0	6.3
Large Farm Rural High Income	100.0	8.8
Non-farm Rural Low Income	100.0	8.0
Total	100.0	10.5

Source: Model simulations.

output increases by only 8.3 percent in the 1984-89 base run, as no technical change or area expansion is modeled and most investment goes toward industry and services. Real household incomes exceed the population growth rate only for the urban rich households, with the largest declines in per capita incomes suffered by small farmers on the Plateau and the West and South region.

Creating the base run for the current policy simulations first required a SAM for 1989, which was created by running the model with the levels of per capita government spending and foreign savings, as well as world prices of major commodities, set to their 1989 values (BDE unpublished data). Tariff and export tax rates are also set to their average values (Appendix Table A.2). Neither labor supply nor capital is updated to 1989 levels, but this makes no difference to the percentage changes calculated in this report.[20] As shown in Appendix Table A.3, the 1989 simulated GDP is slightly higher (4.2 percent) than the actual GDP. The major difference between the simulated and actual levels for 1989 is the level of government investment caused by differences in definition of investment.[21]

The base run beginning with 1989 is similar to that beginning in 1984. Real GDP grows by only 9.5 percent over the five year period, as the levels of foreign capital inflows and real investment are somewhat higher in per capita

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[20] An alternative method of constructing a 1989 base SAM would have been to run a dynamic simulation from 1984 to 1989 which would trace the path of the economy over time. Sensitivity analysis of the policy simulations run in Chapter 5 showed that the choice of base year (in this case 1984 and 1989) made little difference to the policy results reported as percentage changes vis à vis the base run.

[21] It should be noted that the difference in the level of foreign savings arises because the change in foreign savings calculated for the base run was measured in absolute terms (million 1984 dollars) rather than as a percentage.

Appendix Table A.2 — Closure for Generation of 1989 SAM

```
*** BOUCLAGE POUR LA NOUVELLE SIMULATION DE BASE ***
PARAMETER POPGR ;
POPGR = 1.14806 ;
PWM.FX("AUTC-P") = PWMO("AUTC-P")* 1.64;
PWM.FX("ELEV-P") = PWMO("ELEV-P")* 1.0 ;
PWM.FX("ENER-P") = PWMO("ENER-P")* 0.6 ;
PWM.FX("RIZ-P") = PWMO("RIZ-P")* 1.04 ;
PWM.FX("ALIM-P") = PWMO("ALIM-P")* 0.66;
PWM.FX("TEXT-P") = PWMO("TEXT-P")* 0.75;
PWM.FX("MANF-P") = PWMO("MANF-P")* 0.96 ;
PWEO("AUTC-P") = PWEO("AUTC-P")* 1.0 ;
PWEO("CEXP-P") = PWEO("CEXP-P")* 0.6 ;
PWEO("ELEV-P") = PWEO("ELEV-P")* 0.996 ;
PWEO("ENER-P") = PWEO("ENER-P")* 1.0 ;
PWEO("ALIM-P") = PWEO("ALIM-P")* 1.0 ;
PWEO("TEXT-P") = PWEO("TEXT-P")* 1.12 ;
PWEO("MANF-P") = PWEO("MANF-P")* 1.0 ;
PWE.L(IT) = PWEO(IT) ;
TM.FX("AUTC-P")=0.136 ; TM.FX("ELEV-P")=0.098 ; TM.FX("ENER-P")=0.106 ;
TM.FX("RIZ-P")=0.000 ;  TM.FX("ALIM-P")=0.255 ; TM.FX("TEXT-P")=0.400 ;
TM.FX("MANF-P")=0.334 ;
TE("CEXP-P")=0.72 ;
GDTOT.FX = 184.2 / POPGR ;
GOVIVT.FX = 73.5 / POPGR ;
FSAV.FX = (136.7/1.6034) / POPGR ;
TCX(I,H) = 0 ;
```

Appendix Table A.3 — Growth in Major Aggregates, 1989-94

	1989 Level Actual	1989 Level Simulation	Growth 1989-94
Real GDP (market prices)	1,903.6	1,982.6	9.5
Private Consumption	1,468.8	1,647.8	9.1
Total Real Investment	255.0	166.8	13.5
Private Investment	70.5	93.3	14.9
Government Investment	184.5	73.5	14.8
Government Consumption	184.2	184.2	14.8
Real Government Revenue		204.8	9.7
CPI	n.a.	n.a.	2.4
GDP Deflator	n.a.	n.a.	2.6
Real Exchange Rate	n.a.	n.a.	-2.3
Exports	421.0	370.0	10.7
Imports	428.8	455.2	10.9
Foreign Savings	7.8	85.3	11.7
Sectoral Production			
Agriculture	610.9	807.2	7.5
Industry	216.8	829.9	11.2
Formal	...	425.5	18.0
Informal	...	404.4	4.1
Services	743.7	1,159.6	13.6
Formal	...	351.3	18.1
Informal	...	808.3	11.7
Public Administration	110.6	217.1	11.7
Total	1,682.0	3,013.8	11.2
Household Incomes			
Urban 1 (High Income)		203.5	16.6
Urban 2 (Middle Income)		150.2	11.3
Urban 3 (Low Income)		30.1	9.5
Small farm Plateau		193.0	6.2
Small farm East		203.5	9.0
Small farm West/South		157.4	5.4
Large Farm Rural High Income		472.7	7.8
Non-farm Rural Low Income		45.4	7.1
Total		1,455.8	9.1

Source: Directorate Generale de la Banque des Données de l'Etat (computer files) and model simulations.

terms than in the base 1984-1989 simulation. Again, the agriculture sector lags behind the other sectors in terms of output growth for the same reasons as in the 1984-89 base simulation. Patterns of household income growth are likewise similar to those in the 1984-89 base simulation.

Appendix Table A.4 — Increased Rice Imports with Larger Substitution Elasticities

	Increased Rice Imports	
	Year 1	Year 5
Real GDP (market prices)	-0.15	0.26
Private Consumption	0.29	0.65
Total Real Investment	7.49	9.32
Private Investment	11.58	14.51
Government Investment	0.00	0.00
Government Consumption	0.00	0.00
Real Government Revenue	-0.73	0.06
CPI	3.22	3.09
GDP Deflator	3.78	3.62
Real Exchange Rate	-3.11	-2.99
Exports	-1.69	-1.50
Imports	4.69	4.95
Foreign Savings	39.36	39.36
Sectoral Production		
Agriculture	-1.08	-1.06
Industry	0.31	0.85
Formal	1.23	3.15
Informal	-0.61	-1.45
Services	-0.04	0.89
Formal	-0.21	0.23
Informal	0.13	1.55
Public Administration	0.01	0.02
Total	-0.09	1.15
Household Incomes		
Urban 1 (High Income)	2.42	3.45
Urban 2 (Middle Income)	1.10	1.82
Urban 3 (Low Income)	0.28	0.52
Small farm Plateau	-0.30	-0.11
Small farm East	-0.45	-0.10
Small farm West/South	-0.39	-0.22
Large Farm Rural High Income	0.01	0.09
Non-farm Rural Low Income	0.46	0.40
Total	0.36	0.74

Source: Model simulations.

Appendix Table A.5 – Rice Policy Simulations with Larger Substitution Elasticities

	Fertilizer Imports		Fertilizer Imports with Capital Inflow		Increased Tariff on Rice Imports	
	Revised Parameters					
	Year 1	Year 5	Year 1	Year 5	Year 1	Year 5
Real GDP (market prices)	0.30	0.37	0.51	0.72	0.08	0.03
Private Consumption	0.26	0.30	0.62	0.77	0.14	0.07
Total Real Investment	1.05	1.40	2.96	3.86	-0.35	-0.39
Private Investment	1.91	2.54	5.45	7.01	-0.64	-0.72
Government Investment	0.00	0.00	0.00	0.00	0.00	0.00
Government Consumption	0.00	0.00	0.00	0.00	0.00	0.00
Real Government Revenue	0.65	2.46	2.05	3.94	1.12	2.46
CPI	-0.93	-1.05	0.51	0.24	1.94	1.37
GDP Deflator	-0.87	-0.98	0.71	0.44	1.84	1.31
Real Exchange Rate	0.94	1.06	-0.51	-0.24	-1.90	-1.35
Exports	0.55	0.78	-0.34	0.02	-1.18	-0.96
Imports	0.44	0.62	1.70	2.01	-0.95	-0.77
Foreign Savings	0.00	0.00	10.00	10.00	0.00	0.00
Sectoral Production						
Agriculture	0.32	0.33	0.31	0.36	0.41	0.34
Industry	0.63	0.50	0.88	0.99	0.34	-0.01
Formal	0.54	0.66	0.89	1.41	0.09	-0.08
Informal	0.73	0.44	0.87	0.64	0.59	0.19
Services	0.14	0.63	0.34	1.04	0.05	0.39
Formal	0.07	-1.52	0.44	-0.90	0.18	-1.64
Informal	0.21	0.92	0.25	1.11	-0.09	0.56
Public Administration	0.01	0.01	0.01	0.02	0.00	0.00
Total	0.33	0.46	0.45	0.74	0.20	0.20
Household Incomes						
Urban 1 (High Income)	0.69	0.82	1.97	2.34	0.37	0.18
Urban 2 (Middle Income)	0.75	0.79	1.18	1.39	-0.02	-0.06
Urban 3 (Low Income)	0.75	0.72	1.03	1.08	-0.17	-0.12
Small farm Plateau	0.46	0.43	0.64	0.70	0.08	0.07
Small farm East	0.21	0.28	0.35	0.56	0.01	-0.01
Small farm West/South	0.27	0.25	0.41	0.47	0.13	0.10
Large Farm Rural High Income	-0.12	-0.11	0.21	0.26	0.22	0.14
Non-farm Rural Low Income	0.78	0.70	1.10	1.03	-0.15	-0.11
Total	0.29	0.33	0.70	0.85	0.14	0.08

Source: Model simulations.

REFERENCES

Adelman, Irma and Robinson, Sherman. 1978. *Income Distribution Policy in Developing Countries: A Case Study of Korea*. Stanford, CA: Stanford University Press.

Associates for International Resources and Development. 1984. *Etude du Sector Rizicole*. Somerville, MA: AIRD.

_____. 1991. "Madagascar Irrigated Sub-Sector Review: An Economic and Financial Analysis." Somerville, MA. Draft.

Benjamin, Nancy and Shantayanan Devarajan. 1985. *Oil Revenues and Economic Policy in Cameroon: Results from a Computable General Equilibrium Model*. World Bank Staff Working Paper No. 745. Washington, D.C.: The World Bank.

Condon, Timothy, Henrik Dahl and Shantayanan Devarajan. 1987. *Implementing a Computable General Equilibrium Model*. Report No. 290. Washington, D.C.: Research Department, World Bank.

Decaluwé, Bernard and André Martens. 1988. "CGE Modeling and Developing Economies: A Concise Empirical Survey of 73 Applications to 26 Countries." *Journal of Policy Modeling*. 10(4).

Dervis, Kemal, Jaime de Melo and Sherman Robinson. 1982. *General Equilibrium Models for Development Policy*. Washington, D.C.: The World Bank.

Dorosh, Paul. 1992. *A Computable General Equilibrium Model for Madagascar: Equations and Parameters*. Washington, D.C.: Cornell Food and Nutrition Policy Program.

Dorosh, Paul and René Bernier. Forthcoming. "Staggered Reforms and Limited Success: Structural Adjustment in Madagascar in the Eighties." In *Economic Crisis and Reform in Africa*, David E. Sahn (ed.). Ithaca: Cornell University Press.

Dorosh, Paul, René Bernier, Armand Roger Randrianarivony and Christian Rasolomanana. 1991. *A Social Accounting Matrix for Madagascar: Methodology and Results*. Working Paper 6. Ithaca, N.Y.: Cornell Food and Nutrition Policy Program.

Dorosh, Paul A., René E. Bernier and Alexander H. Sarris, 1990. *Macroeconomic Adjustment and the Poor: The Case of Madagascar.* CFNPP Monograph 9. Ithaca: Cornell Food and Nutrition Policy Program.

Food and Agriculture Organization. 1984. *Food Balance Sheets.* Rome: FAO.

Henderson, James M. and Richard E. Quandt. 1980. *Microeconomic Theory, A Mathematical Approach.* Third Edition. New York: McGraw-Hill.

International Monetary Fund. 1991. *Madagascar -- Statistical Appendix.* Unpublished.

_____. 1988. *Madagascar -- Statistical Annex.* Unpublished.

Johansen, L. 1960. *A Multi-sectoral Study of Economic Growth.* Amsterdam: North-Holland.

Michel, Gilles and Michel Noel. 1984. *Short-term Responses to Trade and Incentive Policies in the Ivory Coast: Comparative Static Simulations in a Computable General Equilibrium Model.* World Bank Staff Working Paper No. 647. Washington, D.C.: The World Bank.

Ministère de la Production Agricole et de la Reforme Agraire. 1988a. *Généralités et Méthodologie, Campagne Agricole 1984/85.* Projet Recensement National de l'Agriculture et Système Permanent des Statistiques Agricoles, Tome I. Antananarivo: MPARA.

_____. 1988b. *Charactéristiques Générales du Milieu Rural, Campagne Agricole 1984/85.* Projet Recensement National de l'Agriculture et Système Permanent des Statistiques Agricoles, Tome II. Antananarivo: MPARA.

_____. 1988c. *Main d'Oeuvre des Exploitations Agricoles, Campagne Agricole 1984/85.* Projet Recensement National de l'Agriculture et Système Permanent des Statistiques Agricoles, Tome III. Antananarivo: MPARA.

_____. 1988d. *Cultures et Superficies des Exploitations Agricoles, Campagne Agricole 1984/85.* Projet Recensement National de l'Agriculture et Système Permanent des Statistiques Agricoles, Tome IV. Antananarivo: MPARA.

Pryor, Frederic L. 1988. *Income Distribution and Economic Development in Madagascar: Some Historical Statistics.* World Bank Discussion Paper Number 37. Washington, D.C.: World Bank.

Robinson, Sherman. 1989. "Multisectoral Models" in *Handbook of Development Economics.* Vol. 2. Hollis Chenery and T.N. Srinivasan, Eds. Amsterdam: North-Holland.

Sarris, Alexander H. 1990. *A Micro-Macro Framework for the Analysis of the Impact of Structural Adjustment on the Poor in Sub-Saharan Africa.* Monograph 5. Ithaca, N.Y.: Cornell Food and Nutrition Policy Program.

Taylor, Lance, Edmar Bacha, Eliana Cardoso and Frank Lysy. 1980. *Models of Growth and Distribution for Brazil.* London: Oxford University Press.

Thorbecke, Erik et. al. 1989. *Adjustment, Growth and Income Distribution in Indonesia. Draft.*

UNICEF. 1984. *Analysis of the Situation of Children in Madagascar.* Antananarivo: UNICEF.

Varian, Hal R. 1978. *Microeconomic Analysis.* New York: WW Norton and Co.

World Bank, 1991. *Madagascar: Beyond Stabilization to Sustainable Growth.* Washington, D.C.: World Bank.

_____. 1989. *Poverty Alleviation in Madagascar: Country Assessment and Policy Issues.* Washington, D.C.: World Bank.

_____. 1986. *The Democratic Republic of Madagascar: Country Economic Memorandum.* Report No. 5996-MAG. Washington, D.C.: World Bank.