GROWTH LINKAGES IN MADAGASCAR: IMPLICATIONS FOR SECTORAL INVESTMENT PRIORITIES

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ABBREVIATIONS

CGE	Computable General Equilibrium
FMG	Franc Malagasy
ICOR	Incremental Capital-output Ratios
SAM	Social Accounting Matrix
SIO	Semi-input-output

1. INTRODUCTION

In the late 1970's, Madagascar launched an ambitious investment program, as part of its investir à outrance[1] development strategy to spur economic growth. For a few short years during the investment boom, the economy surged forward, fueled by massive capital inflows, much of these short-term commercial bank loans at market interest rates. When scheduled payments of interest and principal on the loans coincided with a decline in terms of trade in the early 1980's, however, a balance of payments crisis ensued. As part of the stabilization and structural adjustment efforts supported by the IMF and The World Bank, the investment program was scaled back, government spending was slashed and government controls on markets were gradually reduced.

Although the role of the public sector has diminished in Madagascar, government investment, as embodied in the public investment program, remains an important part of the country's development efforts. With investment resources limited, strategic allocation of national investment is a crucial element of the transition from structural adjustment to long-run economic growth. The *investir à outrance* development push placed a major emphasis on industry, to the relative neglect of agriculture. What investments in agriculture that were made during the 1970s and 1980s focused largely on large-scale irrigated rice perimeters, such as Lac Alaotra, as well as in increased production of export crops, particularly coffee. Overall, the results of most of these investments have been disappointing. After a decade of stabilization and structural adjustment, as the country hopes of achieving sustained economic growth, it is important that the earlier mistakes are not repeated, but that scarce resources are used efficiently and equitably.

In setting priorities, the micro-economic profitability of the investment, i.e. the costs and benefits directly resulting from the investment project, plays a major role. But initial project selection is also guided by overall development strategy, incorporating a blend of objectives including economic growth, income distribution and regional or spatial criteria. Here, linkages between the project outcome at a micro-economic level and its impact on the rest of the economy also become important (Bell, Hazell and Slade, 1982). A thorough understanding of the tradeoffs involved in alternative growth paths, including potential multiplier effects and impacts on income distribution, provides a fundamentally important input into public decision making.

This chapter examines the implication of alternative growth strategies on the level and distribution of income in Madagascar. We focus on growth linkages emanating from the three key sectors of the Malagasy economy most commonly

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[1] Investment to the limit.

advanced as objects of public attention - paddy (the major food crop), coffee (the major export crop) and the formal manufacturing sector.

After a brief discussion of the roles of agriculture and industry in the Malagasy economy, we present a semi-input-output (SIO) model for projecting the income and employment consequences of these three alternative growth strategies. The model uses a Social Accounting Matrix (SAM) as a framework for tracing the interrelationships among productive sectors, households and other institutions in the economy. The results focus on the tradeoffs between investments in rice, export crops and manufacturing. Summing up, the final section offers policy conclusions.

2. AGRICULTURE AND INDUSTRY IN THE MALAGASY ECONOMY

The choices between investment in agriculture versus industry - and, within agriculture, between foodcrops and export crops - are especially important given the large size of the agricultural sector and the limited resources available in Madagascar. Agriculture provides the primary source of income for three-quarters of Madagascar's population and is second only to services in generating value added (Table 1). The formal industrial sector, dominated by food processing and textiles, remains small, accounting for only 8.6 percent of GDP and 3 percent of employment.

By value, farm output is concentrated in rice (paddy), export crops (coffee, vanilla and cloves), root crops and livestock. Paddy, the major staple, is grown throughout Madagascar, mostly by small farmers on irrigated land. In the central highlands (Hauts-Plateaux), paddy cultivation forms the base of the rural economy. Coffee, vanilla and cloves are grown on the east and north coasts.

Apart from the short-lived investment boom, Madagascar's economy stagnated from the early 1970s to the late 1980s.[2] Nationalization of industries and increasing government intervention in markets resulted in a disappointing 0.06 per cent average annual decline in real GDP from 1973 to 1977, (Table 2). The *investir à outrance* strategy in the late 1970s was designed to take advantage of high world coffee prices and readily available credit on world markets to jump-start the economy with massive investments in industry and infrastructure. Investment as a share of GDP rose to 13.5 percent in the 1978-80 period, up from an average of 11.4 percent of GDP from 1973 to 1977. During these boom years, industrial output grew by an average of 4.76 percent per year, though the growth rate of agriculture was only 1.03 percent per year.

Unfortunately, declining world coffee prices, increased debt servicing obligations and tighter world credit markets in the early 1980s brought about a balance of payments crisis before many of the investment projects were completed. With foreign exchange shortages limiting imports of intermediate and capital goods, value added in industry fell by an average of 13.17 percent per year in 1981 and 1982, to a level 9.1 percent below the average output of 1973-77. The industrial sector recovered somewhat thereafter, as price controls were gradually eliminated and official lending helped ease foreign exchange constraints from 1983 to 1987. Industrial growth was a mere 0.67 percent per year from 1988 to

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[2] Further details on the Malagasy economy and economic policies are found in Dorosh, Bernier and Sarris (1990), Dorosh (1994) and in chapter x of this book, "Macroeconomic Adjustment and Poor in Madagascar: a CGE Analysis".

Table 1 – Madagascar: Listing of SAM Accounts

SAM Row Accounts	1984 Gross Output (mn FMG)	Percentage of Value Added
Activities		
1. Paddy, irrigated low-input	59,973	2.4
2. Paddy, irrigated high-input	87,315	2.7
3. Paddy, rainfed	20,918	1.1
4. Coffee, low-input	21,534	1.3
5. Coffee, high-input	7,201	0.4
6. Vanilla and cloves	14,569	0.9
7. Nontraditional export crops	-	-
8. Industrial crops (cotton, groundnuts, sugarcane)	14,176	0.5
9. Other agriculture (livestock, tubers, perishables)	487,485	26.1
10. Mining, energy, and water	85,298	2.0
11. Rice milling	169,988	0.2
12. Formal manufacturing	84,885	2.3
13. Informal industries	403,829	6.8
14. Private services (commerce, construction, services)	1,001,088	45.0
15. Public services	203,799	8.2
Commodities		
16. Paddy		
17. Coffee		
18. Vanilla and cloves		
19. Nontraditional export crops		
20. Industrial crops		
21. Other agriculture (livestock, tubers, perishables)		
22. Mining, energy and water		
23. Rice		
24. Formal manufacturing		
25. Informal industries		
26. Private services (commerce, construction, services)		
27. Public services		
Households		
28. Large urban areas		
29. Secondary urban centers		
30. Large farms		
31. Small farms		
32. Rural nonfarm poor		
33. Rural nonfarm rich		
34. Institutions (corporations, financial, nonprofits		
35. Government		
36. Rest of world		
37. Capital		

Table 2 – Madagascar: Sectoral Growth and Investment, 1973-1990.

	1973-1977	1978-1980	1981-1982	1983-1987	1988-1990
Real GDP (Billion 1987 FMG)					
Agricultural	760.8	740.7	756.7	824.7	922.1
Industry	347.5	380.8	316.0	299.6	335.5
Services	1224.5	1311.9	1273.9	1200.8	1307.3
Real GDP	2332.9	2433.4	2346.6	2325.1	2564.9
Real GDP per capita (Thousand 1987 FMG)	306.5	286.7	262.6	232.6	226.7
Real GDP Growth Rates (percent)					
Agriculture	0.86	1.03	0.67	2.51	3.16
Industry	-0.31	4.76	-13.17	4.99	0.67
Real GDP	-0.06	2.49	-3.59	1.38	3.37
Real GDP per capita	-2.57	-0.27	-6.13	-1.50	0.16
Investment per capita (Thousand 1987 FMG)	35.2	39.0	31.9	23.4	37.0
Investment/GDP (Percent)	11.4	13.5	12.0	10.1	16.3
Rice Production (thousand metric tons)	1931.2	2025.3	2030.3	2192.6	2329.0
Per capita Rice Production[1] (kgs)	168.8	159.1	151.4	146.2	137.2

Sources: World Bank (1993), Bernier and Dorosh (1993).

[1]Rice equivalent equal to 0.67 kilograms of milled rice per kilogram of paddy.

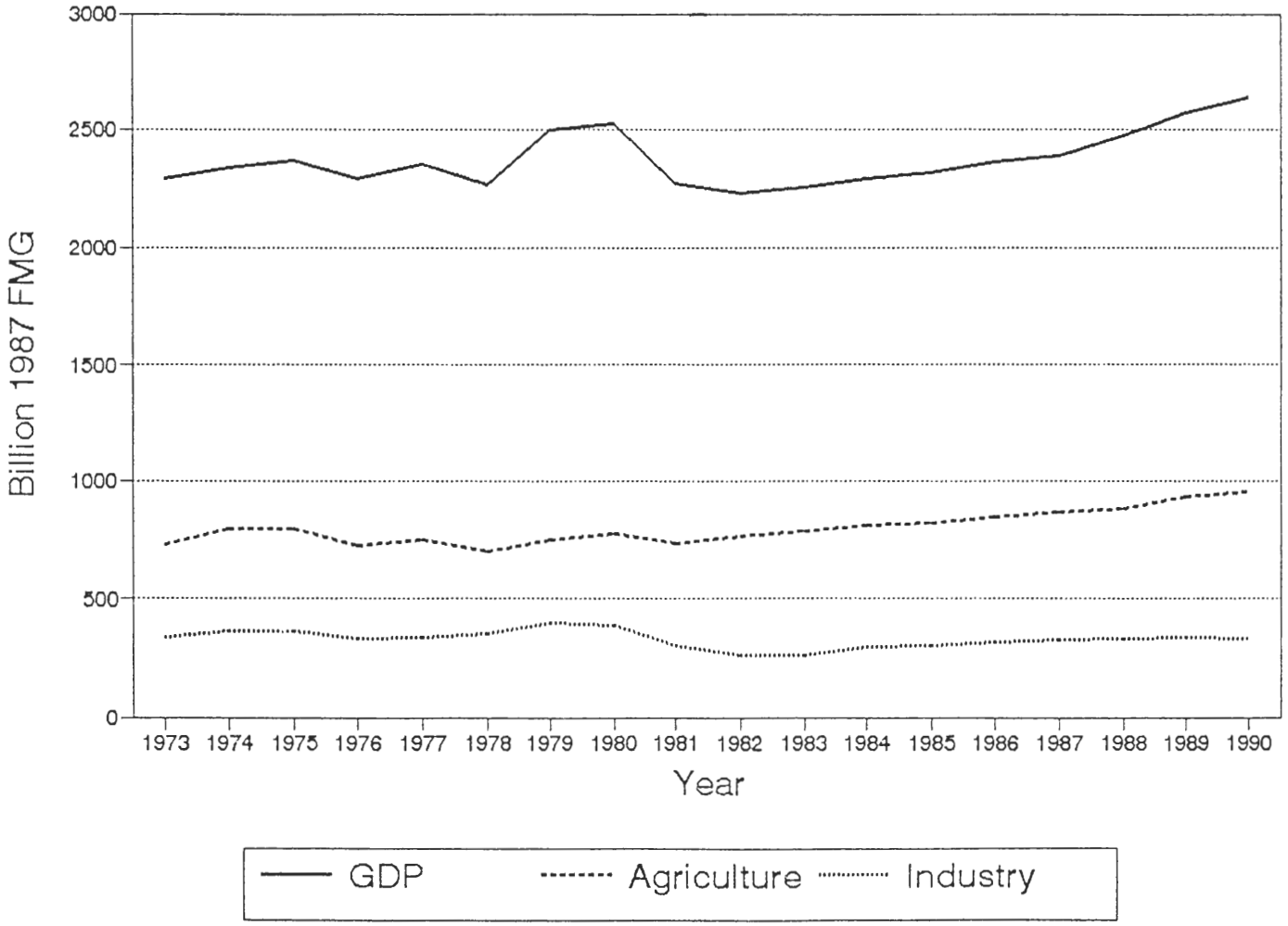
1990, however, despite an overall gain in real GDP averaging 3.16 percent per year in this period.

In contrast to industry the agriculture sector fared better under structural adjustment (Figure 1). Since liberalization of agricultural markets, beginning in 1983, value added in agricultural increased by an average of 2.51 percent per year from 1982 to 1987 and 3.16 percent per year from 1987 to 1990. However, rice output per capita, declined by 20.6 percent between 1975 and 1988, before increasing slightly in 1989 and 1990, and rice imports averaged 8.2 percent of total rice availability over the second half of the eighties (Bernier and Dorosh, 1993). Production of traditional export crops also declined in value after the late seventies.

Political turmoil in the early 1990s reversed the growth in GDP following the major trade liberalization of 1987 and 1988. Several key reforms undertaken under structural adjustment were reversed and more stringent government controls were reimposed on foreign exchange and trade. Whether economic growth is restored will depend in part on the policies of the new Malagasy government with regard to the extent of liberalization of key markets and other policies affecting economic incentives and private investment. A key aspect of the government's own investment strategy, having major implications for both growth and equity, will be the sectoral allocation of public investment.

Discouraged by the disappointing record of past investments in large-scale irrigated rice perimeters and in manufactured goods, many now argue that a heavier emphasis on export crops will yield the greatest prospects for long-run growth. A thorough understanding of the tradeoffs involved in alternative growth paths, including potential multiplier effects and impacts on income distribution, provides a fundamentally important input in public decision making.

Figure 1
Madagascar: Sectoral Growth



3. MODELING LINKAGES IN THE MALAGASY ECONOMY

OVERVIEW OF THE MODEL

Investment, like new technology, directly increases output in the target sector. In the process, this increased output stimulates demand for production inputs and for consumer goods required by the households earning income in the new production units. Because of these twin sources of demand, increased output generates not only direct income growth within a sector but also indirect increases in demand for other goods and services in the economy. Where excess capacity exists, the increased demand translates into higher output and consequently higher incomes. Thus the total income gain generated by growth in a given sector includes the direct sectoral income plus the indirect earnings generated in other sectors.

The measurement of these indirect effects requires a model that relates sectoral output, household income, consumer demand, and inter-industry input linkages. Since supply responsiveness across sectors determines how effectively growing demand will translate into increased domestic output and income, any model must make clear assumptions about supply elasticities in all sectors of the economy.

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

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

Presuming supply to be perfectly elastic in all sectors, total output and incomes become determined by the level of exogenous demand (E) and the matrix of multipliers $(I-M)^{-1}$, where M offers shorthand notation for the parameters $(A+\beta)$.

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

Because they assume perfectly elastic supply in all sectors, input-output models over-estimate output responses following from any intervention. Yet in reality, in most developing countries some sectors face supply constraints. This is especially true for agriculture, where land, labor, rainfall and technology frequently limit output. Industrial output is also often constrained by lack of capital. By ignoring supply constraints altogether, input-output models

typically exaggerate the size of the inter-sectoral linkages. In the case of crop-based agriculture, input-output models overstate growth multipliers by a factor of two to ten (Haggblade, Hammer and Hazell, 1991).

A more realistic approach, and the one adopted here, is to use a semi-input-output (SIO) model. While retaining many of the basic assumptions of the IO approach, the SIO model differs in that it introduces supply rigidities in some sectors. The following two equations, contrasted with (1) and (2) above, capture the SIO model's essential distinction. By classifying all economic sectors as either supply-constrained (Z_1) or perfectly elastic in supply (Z_2), the SIO model permits output responses only in some sectors (Z_2). In supply-constrained sectors (Z_1), increases in domestic demand merely reduce net exports (E_1), which then become endogenous to the system.[3]

$$\begin{aligned} Z_1 &= A_1 Z + \beta_1 V_1 Z + E_1 \\ Z_2 &= A_2 Z + \beta_2 V_2 Z + E_2 \end{aligned} \tag{3}$$

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

The model used here is built around a condensed SAM that includes 12 commodity accounts, 15 activities, 6 household groups, 1 other nongovernment institution, the government, the rest of the world and 1 capital account (Table 1).[4]

The semi-input-output (SIO) model is described graphically in Figure 2. For simplicity of exposition, it collapses the 12 SAM commodity accounts still further, into the following three categories: (Z_1) paddy; (Z_2) other supply-constrained commodities: tradables such as coffee, industrial crops, minerals, and formal manufacturing; and (Z_3) commodities highly elastic in supply: nontradables such as services, informal industries, perishable agriculture, plus the tradables, vanilla and cloves.

Following along in Figure 2, consider the consequences of public or private investments in paddy production. Regardless of the technology chosen, be it rehabilitation of small irrigated perimeters or investment in large-scale irrigated rice schemes, the immediate impact of this investment is to increase

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[3] A formal exposition of the SIO model is found in Appendix 2 of Dorosh, Haggblade et. al, (1991).

[4] The SAM used in this study is a condensed version of the SAM described in Dorosh et. al. (1991). Details of the modifications for the purpose of the modeling here are found in Dorosh, Haggblade et. al., (1991).

Figure 2 — Graphic Representation of Multiplier Effects

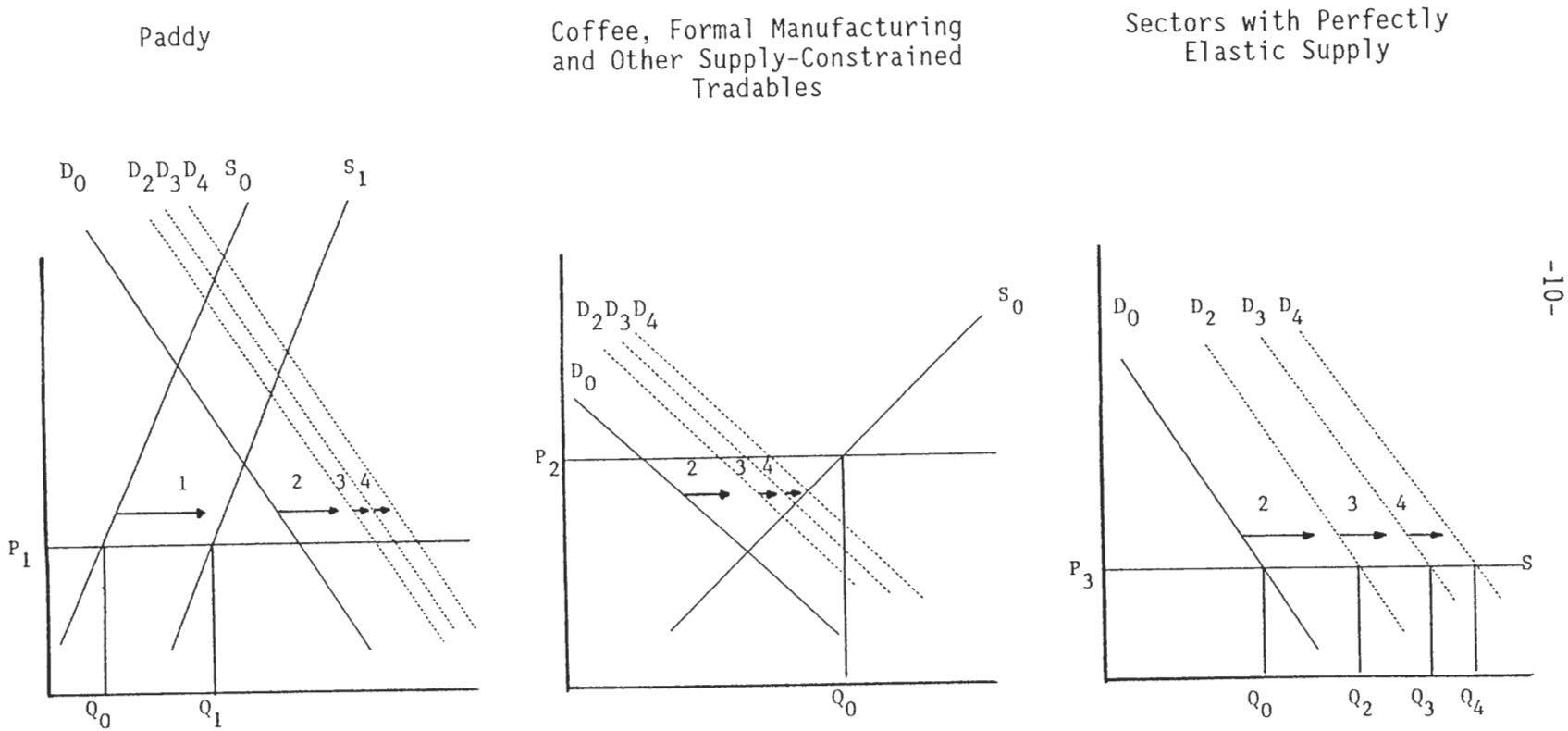

Figure 2 (continued)

Paddy	**Coffee**	**Non-traded**
(Inelastic supply, imported good)	(Inelastic supply, exported good)	(Perfectly elastic supply)
Round 1		
Invest in paddy - increase in supply - increase in farmer income		
Round 2		
Increased demand (final and intermediate goods); supply fixed at Q_1 - exports decrease - domestic output and income unchanged	Increased demand (final and intermediate goods); supply fixed at Q_0 - exports decrease - domestic output and income unchanged	Increased demand (final and intermediate goods) - increased output - increased income
Rounds 3 and 4		
Increased demand (final and intermediate goods); supply fixed at Q_1 - exports decrease - domestic output and income unchanged	Increased demand (final and intermediate goods); supply fixed at Q_0 - exports decrease - domestic output and income unchanged	Increased demand (final and intermediate goods) - increased output - increased income

paddy supply. In Round 1, this directly raises farm income by 0.49 FMG for every one FMG of increased paddy supply. This direct injection triggers a series of responses that increase income even more.

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

The increased production of commodities with elastic supply (Z3) once again raises demand for production inputs and consumer goods. In Round 3, this increases demand in all three sectors. As before, production of paddy and other supply-constrained commodities does not increase. Instead, net exports decrease still more. For this reason, as Equation (4) indicates, exports in these supply-constrained sectors become endogenous to the model. Yet once again, output and incomes rise in the activities with highly elastic supply. This induces further rounds of successively dampening demand increases.

In total, the indirect effects of the irrigation investment, from Rounds 2 on, stimulate another 1.31 FMG in national income. Thus the total increase resulting from paddy investments equals 0.49 + 1.31 = 1.80.

Investments in coffee production or formal manufacturing will generate the same sequence of events. They differ only in that the shock, the initial supply increase, will occur in sector Z2. Since coffee and formal manufacturing generate different input demands than paddy and a different distribution of income, the second round demand shifts will differ from the paddy results in both composition and magnitude. Ultimately, the total income gain will also be different.

UNDERLYING PREMISES

The semi-input-output (SIO) model falls into the general family of linear, fixed-price models. For the SIO model to generate sensible predictions, each of these characteristics must offer reasonable approximations of reality.

Linearity

As with many kinds of economic models, the SIO requires that all relationships be expressed as linear functions. For intermediate inputs, this standard assumption suggests that increases in output require additional inputs in fixed proportions. For household consumption, it requires that consumption expenditures rise in tandem with income. Although marginal expenditures or input

demands may differ from the average, the increments must be expressed as linear functions of output and income.

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

Fixed Prices

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

For tradable goods, most analysts agree that the fixed-price assumption is appropriate in small countries. World markets will determine their price level. Madagascar, a small country, takes world prices as given in all markets except vanilla and cloves where they account for over half of world trade. We will return to the price fixity of vanilla and cloves in a moment.

For nontraded goods, such as services, informal manufactured goods and many perishable agricultural commodities, fixed prices depend on firms' ability to increase output at constant cost. Formally, this requires a perfectly elastic output supply. Because of the considerable unemployment and excess capacity present in Madagascar, especially in the 1984 base year for which the SAM was constructed, the constant cost assumption appears to be a reasonable approximation of reality.

Vanilla and cloves, too, even though they are tradable commodities, are highly elastic in supply. Essentially wild gathered crops requiring primarily harvesting labor, their output can be increased at constant cost so long as wage rates do not rise. Given current underemployment, it appears that vanilla and cloves supply can be considered highly elastic, at least in the short run.

At some point, as expansion and liberalization proceed, supply constraints may develop in some of Madagascar's nontradable sectors. When this day arrives, the SIO model will overstate income multipliers emanating from sectoral growth. Consequently, some sort of adjustment will be required to capture the income-dampening effects of the inflation that will follow. Recent experiments suggest that in the face of upward-sloping nontradable supply, SIO models overstate true income multipliers by 10 to 25% (Haggblade, Hammer and Hazell, 1991). So the simplest accommodation would involve rule-of-thumb discounting based these results. A much more complicated alternative is to use a computable general equilibrium model.[5]

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[5] See Dorosh (1994) for a description of a CGE model for Madagascar.

4. MODEL SIMULATIONS

The following results explore the three most commonly considered alternative investment strategies for Madagascar: foodcrops (rice), export crops (coffee) and manufacturing. In agriculture, we model what observers consider the most likely sources of agricultural growth, those focused on improved small farmer technology. High-input technology, and in the case of rice, rehabilitation of small-scale irrigation perimeters rather than large-scale perimeters or rainfed cultivation, seem the most viable avenues for future investment. For manufacturing, we focus on the formal sector[6] where, after decades of neglect, supply-side investment seriously constrains growth.

The model simulation assumes that consumers spend additional income the same way they have in the past, that is, that average budget shares equal marginals, and that savings is not translated into investment expenditure in the short run. Thus investment is taken as exogenous.

IMPACT ON GROWTH

Income

Under these assumptions, a 1 FMG increase in agricultural output will generate roughly 2 FMG in national income, 1.802 FMG for paddy and 1.974 FMG for coffee (Table 3). In contrast, manufactured goods produce only half as much income, 0.963 FMG for every 1 FMG in increased output. This difference arises primarily because of smaller value added generated by the direct increase in manufacturing output. Material inputs used in formal manufacturing account for 70% percent of the value of production. Consequently, value added per unit of output stands at only 30%. Yet in the agricultural sectors, the value added in total output is much higher, 49% in paddy and 63% for coffee. If direct increase in paddy production generates only 0.49 FMG in income per unit of output, where does the remaining 1.310 FMG (1.802 - 0.492) come from? It comes from the second and third round linkages, the input demand and consumption growth emanating from

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[6]Small-scale and informal manufacturing is not appropriate for comparison in these simulations because it is not constrained by investment capital. Because capital requirements are so very small in informal and small-scale manufacturing activities, most observers consider them to be constrained by discriminatory policies, working capital, or by demand, but not by investment capital (Kilby, Liedholm and Meyer, 1984; Haggblade, Liedholm and Mead, 1986; Liedholm and Mead, 1987; Page and Steel, 1984). While public intervention in support of these small enterprises is appropriate, that intervention will primarily involve removal of discriminatory policies, provision of infrastructure, including a well-functioning credit system, and fostering a pattern of general economic growth that generates buoyant demand to which these small enterprises can respond.

Table 3 – Madagascar: Multiplier Decomposition Under Improved Small Farmer Technology

	Effect of a 1 FMG Increase		
	Paddy Output	Coffee Output	Formal Manufacturing Output
Change in National Income			
initial direct increase	0.492	0.632	0.303
multiplier effects	1.310	1.343	0.660
total income increase	1.802	1.974	0.963
Investment Multiplier, High Returns Scenario			
investment required	0.387	0.641	1.000
national income generated per unit of investment	4.651	3.079	0.964
Investment Multiplier, Low Returns Scenario			
investment required	0.644	1.282	3.000
national income generated per unit of investment	2.797	1.540	0.321

Source: Model simulations.

Note: High-input paddy and coffee production, average budget shares.

the injection of agricultural growth. Clearly the linkages are important. They account for over two-thirds of total income created, in all three sectors (Table 3).

All three sectors generate large linkages. But in agricultural they are larger, primarily because of larger initial income (value added) and consequently larger second round of consumer spending on local goods and services.

Investment requirements

Ultimately, the efficiency of alternative investment strategies depends on how much investment is required to initiate output growth in the first place. Once output grows by 1 FMG, the income consequences are broadly similar in the two agricultural sectors, though only half as large in manufacturing.

But the investment necessary to increase output of paddy, coffee and formal sector manufactured goods by 1 FMG differ substantially from one another. Given that investment data in all sectors suffer from considerable uncertainty, Table 3 offers both optimistic and pessimistic projections for each of the three sectors under review. For paddy and coffee, the analysis presents two investment scenarios, based on traditional cost-benefit analysis (see Appendix Table 1 for details of the calculations). The paddy scenarios show the costs and benefits for rehabilitation of small irrigated perimeters in the high plateaus using traditional and input-intensive technologies (AIRD, 1991). These yield pessimistic and optimistic projections, respectively. The coffee scenarios are based on FAO (1989) under high and low world coffee price assumptions. For the formal manufacturing sector, it is clear that some industries, such as textiles and food processing require lower fixed investments than others, such as chemicals, metal products and pharmaceuticals. Synthesizing from a variety of sources, Table 3 contrasts two alternative incremental capital-output ratios (ICORs) for manufacturing, 1 for the low-investment industries and 3 for the more capital-intensive (World Bank, 1978; Liedholm and Mead, 1987; World Bank, 1991).

Although these investment costs vary considerably across locations (rural versus urban) and over time (short-run investments in paddy versus longer-run investments in coffee and manufacturing), it appears that under best- and worst-case settings for each investment opportunity, policy makers can increase paddy output at significantly lower investment cost than for coffee or manufactured goods. Investment requirements for producing one unit of paddy range from 0.4 - 0.6. This compares with 0.6 - 1.3 in coffee and 1.0 to 3.0 in manufacturing. Under the most optimistic scenario for each activity, paddy requires investments 30% to 60% lower than coffee and manufacturing.

Income/investment multipliers

Given low investment costs and high income per unit of output, paddy generates the largest income multipliers of the three. In the worst-case setting, assuming high-input technology but low marginal increase in output, 1 FMG invested in paddy rehabilitation will generate 2.8 FMG in national income (GDP). The same 1 FMG invested in coffee, under current low world prices, would

only yield 1.5 FMG in national income, while the gain from a similar investment in manufactured goods is still smaller, only 0.3 FMG in value added.

Even with more optimistic assumptions on efficiency of investment in manufacturing, the pessimistic, low-yield scenario for paddy still results in a much larger gain in GDP, 2.8 FMG from paddy versus 0.964 FMG for manufacturing (Table 3). Similarly, returns to investment in paddy under the low yield scenario are larger than returns to investment in coffee under the high world coffee price scenario. Thus, on efficiency grounds it appears that investments in agriculture - especially paddy - yield much higher returns than investments in manufacturing.[7]

EMPLOYMENT AND INCOME DISTRIBUTION

Investment in agriculture also generates more employment, particularly for unskilled labor, than does investment in manufacturing (Table 4). For each 1 million FMG increase in output of paddy and coffee, employment increases by 2.9 and 2.6 jobs, respectively. The same 1 million FMG increase in manufacturing output increases employment by only 1.1 jobs. Moreover, more than 90 percent of the employment generated with increased paddy and coffee output is for unskilled labor, compared with 82 percent for an increase in manufacturing investment.

Because the greater employment generated by paddy and coffee is concentrated among unskilled workers, these investments result in a more equitable distribution of income as well (Table 5). The rural poor, who constitute 88 percent of Madagascar's poor (Dorosh, Bernier and Sarris, 1990), enjoy a much larger gain in incomes when agricultural output is increased. With increased paddy output, the rural poor earn 54 percent of all income created, while they receive only 34 percent from coffee and 25 percent from manufactured goods.

Surprisingly, the change in urban household income is approximately the same for all three sectors, 0.20 to 0.30 FMG per unit of output increased. How is it possible that agriculture-led growth generates at least as much urban income as that focused on urban manufacturing? The answer lies in spatial linkages.

SPATIAL LINKAGES

Not surprisingly, rural incomes rise most with increases in paddy and coffee, the two agricultural outputs (Table 6). In absolute terms, rural incomes rise by 1.38 FMG for each 1 FMG increase in output of paddy, nearly three times

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[7] These scenarios differ slightly from those in Dorosh and Haggblade (1993). For rice, the pessimistic scenario now models a high input technology but with only a small marginal increase in output of only 1.5 Mt/ha. For coffee, only the value of incremental coffee output is used in the multiplier calculations here.

Table 4 – Madagascar: Employment Consequences of Alternative Growth Strategies

	Effect of a 1 million FMG Increase		
	Paddy Output	Coffee Output	Formal Manufacturing Output
Employment Generated (thousands of jobs)			
skilled jobs	0.024	0.046	0.036
semi-skilled jobs	0.148	0.202	0.170
unskilled jobs	2.757	2.392	0.941
total jobs	2.929	2.640	1.147
Emloyment Generated (percent)			
skilled jobs	0.8	1.7	3.1
semi-skilled jobs	5.1	7.7	14.8
unskilled jobs	94.1	90.6	82.0
total jobs	100.0	100.0	100.0

Source: Model simulations.

Note: High-input paddy and coffee production, average budget shares.

Table 5 – Income Distribution Consequences of Alternative Growth Strategies

	Result of a 1 FMG Increase in Output of each of the following		
	Paddy Supply	**Coffee Supply**	**Formal Manufacturing Supply**
Income Distribution (FMG)			
Government Income	0.067	0.436	0.175
Institutions	0.142	0.164	0.116
Households			
urban	0.213	0.323	0.219
rural rich	0.408	0.389	0.214
rural poor	0.972	0.663	0.238
Total Income	1.802	1.975	0.962
Income Distribution (Percent)			
Government Income	3.7	22.1	18.2
Institutions	7.9	8.3	12.1
Households			
urban	11.8	16.4	22.8
rural rich	22.6	19.7	22.2
rural poor	53.9	33.6	24.7
Total Income	100.00	100.00	100.00

Source: Model simulations.

Note: High-input paddy and coffee production, average budget shares.

Table 6 – Spatial Implications of Alternative Growth Strategies

	Result of a 1 FMG Increase in Output of each of the following		
	Paddy	**Coffee**	**Formal Manufacturing**
Total Income (by location)			
Large Urban Centers			
households	0.177	0.272	0.185
institutions	0.142	0.164	0.116
government	0.067	0.436	0.175
total	0.386	0.872	0.476
Secondary Cities Households	0.036	0.051	0.034
Rural Areas Households	1.380	1.052	0.452
Total Income	1.802	1.975	0.962
Percentage Share of Total Income			
Large Urban Centers			
households	9.8	13.8	19.2
institutions	7.9	8.3	12.1
government	3.7	22.1	18.2
total	21.4	44.2	49.5
Secondary Cities Households	2.0	2.6	3.5
Rural Areas Households	76.6	53.3	47.0
Total Income	100.00	100.00	100.00

Source: Model simulations.

Note: High-input paddy and coffee production, average budget shares.

as much as that resulting from increased manufacturing output. Three-quarters of the gain in incomes generated from increased paddy output accrue to rural households. For both coffee and manufactured goods, the income share earned by rural households is about 50 percent.

The large urban centers attract 20 to 50 percent of all income gains under each of the three growth scenarios. Although the percentages vary, absolute income increments are roughly comparable for paddy and manufacturing. For coffee, however, urban income generation is roughly double that of the other two sectors. The large urban linkages for coffee arise mainly because 45% of crop value accrues to the government and traders as commodity taxes and commercial margins.

Secondary cities, so important in many decentralized schemes of development, appear unaffected by any of these strategies. Yet a growing contingent of geographers, regional planners, anthropologists and public finance economists have become increasingly concerned about the importance of these small towns in fostering an equitable and decentralized pattern of economic growth (Bendavid-Val, 1989; Karaska and Blesky, 1987; Rondinelli, 1983; Evans, 1989).

Decomposing the total income gain reveals that direct income accrues, as expected, primarily in rural areas for paddy and in urban areas for manufacturing (Table 7). Coffee, however, generates large direct income in urban areas, primarily through heavy taxation of this export crop.

Yet indirect linkages run strongly in both directions (Table 8). Agricultural growth generates urban income through increases in demand for private services and informal manufactures. Conversely, manufacturing generates rural income through increases in demand for nontradable agricultural products such as milk, meat and vegetables. The share of indirect income accruing to rural households is roughly the same for all three types of investment, 42 to 50 percent.

In fact, in absolute magnitude, indirect linkages from agriculture to large cities are double those from manufacturing (Table 8). This result arises because of the high use of imported inputs in formal manufacturing as well as the higher import content of urban consumption.

Table 7 – Direct Impact on Spatial Distribution of Income

	Result of a 1 FMG Increase in Output of each of the following		
	Paddy	**Coffee**	**Formal Manufacturing**
Initial Direct Income (by location)			
Large Urban Centers			
households	0.000	0.000	0.074
institutions	0.006	0.041	0.055
government	0.000	0.376	0.145
total	0.006	0.417	0.274
Secondary Cities Households	0.000	0.000	0.013
Rural Areas Households	0.485	0.215	0.016
Total Direct Income	0.491	0.632	0.303
Percentage Share of Direct Income Increment			
Large Urban Centers			
households	0.0	0.0	24.4
institutions	1.2	6.5	18.2
government	0.0	59.5	47.9
total	1.2	66.0	90.4
Secondary Cities Households	0.0	0.0	4.3
Rural Areas Households	98.8	34.0	5.3
Total Direct Income	100.0	100.0	100.0

Source: Model simulations.

Note: High-input paddy and coffee production, average budget shares.

Table 8 – Indirect Impact on Spatial Distribution of Income

	Result of a 1 FMG Increase in Output of each of the following		
	Paddy	**Coffee**	**Formal Manufacturing**
Indirect Income Multipliers (by location)			
Large Urban Centers			
households	0.177	0.272	0.111
institutions	0.136	0.123	0.061
government	0.067	0.060	0.030
total	0.380	0.455	0.202
Secondary Cities Households	0.036	0.051	0.021
Rural Areas Households	0.895	0.837	0.436
Total Indirect Income	1.311	1.343	0.659
Percentage Share of Total Income			
Large Urban Centers			
households	13.5	20.3	16.8
institutions	10.4	9.2	9.3
government	5.1	4.5	4.6
total	29.0	33.9	30.7
Secondary Cities Households	2.7	3.8	3.2
Rural Areas Households	68.3	62.3	66.2
Total Indirect Income	100.0	100.0	100.0

Source: Model simulations.

Note: High-input paddy and coffee production, average budget shares.

5. CONCLUSIONS

SECTORAL PRIORITIES

Structural adjustment in Madagascar succeeded in generating only a few short years of per capita economic growth after 1988 before political turmoil and a subsequent reversal of liberalization measures led to economic declines again in the early nineties. Restoring and sustaining this growth will require both market reforms, sound government policies and appropriate public sector investments as part of a coherent overall development strategy.

The simulation results presented in this chapter strongly suggest that an agriculturally based investment strategy - particularly one focused on rehabilitation of small irrigated paddy perimeters - will generate the most rapid income growth, the most jobs, the most equitable income distribution, and rapid urban economic growth. Even under the most optimistic assumptions about manufacturing and the most pessimistic returns in agriculture, paddy investments outperform those in manufacturing by a factor of three. And over half of the agricultural income accrues to the rural poor, compared to only 25% for manufacturing. On both equity and efficiency grounds, investments in paddy emerge as the priority option.

As an additional bonus, the urban spinoffs projected from agricultural growth appear surprisingly strong. Both paddy and coffee generate substantial income and employment in large urban centers.

Yet, like manufacturing, they make little impact on secondary urban centers. This is surprising, and disappointing, given the considerable emerging interest in decentralized urbanization. In a modeling exercise such as this, parameters built on present locational patterns may not faithfully forecast the future growth of small towns. Given the large volume of evidence from elsewhere on the importance of rural towns, it would be premature to discount the rural town linkages based on this one empirical exercise (Anderson and Leiserson, 1980; Haggblade, Hazell and Brown, 1989; Bendavid-Val, 1989; Karaska and Belsky, 1987; Evans, 1989). Clearly, more field work is warranted. Perhaps, too, the secondary cities of Madagascar have simply not benefitted from the basic infrastructural investments that elsewhere facilitate agricultural processing and marketing linkages to develop there.

SUSTAINING THE GROWTH LINKAGES

Growth linkages across urban-rural boundaries have been shown to be significant for both urban and rural investments. Nearly one quarter of the income generated from increased paddy production accrues to urban households and institutions (including the government). Similarly, rural households earn almost one half the total income generated from investments in formal sector manufacturing. Government policies can help assure that these growth linkages achieve their full potential.

First, attention to rural infrastructure - roads, electricity, water, and communications - is especially important since it will both affect the ability of nonfarm sectors to respond to the increased demand of farm households and facilitate the response of farm sectors to increased demand of non-farm households. To ensure that spinoffs achieve their full potential will require ongoing decisions about the siting, construction, maintenance and finance of rural infrastructure. In all these phases, local decision making and the ability to mobilize local resources will be key. This makes local governments important actors in agriculture-led growth strategies. To play their role effectively, the local authorities must enjoy the necessary political and financial authority as well as the management skills necessary to mobilize local resources and coordinate decision making.

Second, direct intervention on behalf of nonfarm and secondary farm activities can effectively accelerate their growth. To enjoy the full benefit of the agriculturally induced demand stimulus, evidence suggests that supporting supply-side interventions can be cost-effective (Haggblade, Hazell and Brown 1989). While working capital credit programs have proven most popular, policy reform and technical assistance can also be viable if judiciously targeted.

The experience of the late 1970s with the failed investment push in Madagascar illustrates the importance of project design, funding and policy environment for sustainable growth. In addition to these factors, maximizing the efficiency of scarce government resources for public investment will requires an appropriate sectoral focus as part of the overall development strategy. The growth linkage analysis here provides evidence that an agriculturally focused growth strategy, with collateral incentives and support for rural infrastructure and nonfarm enterprises will likely yield the most rapid and equitable pattern of growth for Madagascar.

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Appendix Table 1 – Madagascar: Returns to Investment in Agriculture

Paddy: Rehabilitation of Small Irrigated Perimeters	**Pessimistic (Traditional Technology)**	**Optimistic (High-Input Technology)**
Investment cost (FMG/ha)	241,564	242,133
Marginal Increase in Output (MT/ha)	1.5	2.5
Investment Cost per MT Increase in Production (FMG/MT)	161,043	96,853
Price of Paddy (FMG/MT)	250,000	250,000
Value of Output per FMG Invested (FMG)	1.552	2.581
Incremental Capital Output Ratio	0.644	0.387

Robusta Coffee Project: Mixed Replanting and Pruning, High-Input Technology	**Pessimistic (Low World Price)**	**Optimistic (High World Price)**
Investment Cost (mn FMG)	4,896	4,896
Additional Output of Coffee (mn FMG)	3,820	7,639
FMG Value of Coffee Output per FMG Invested	0.780	1.560
Incremental Capital Output Ratio	1.282	0.641

Note: Benefits and costs for the Coffee project are amortized annual values calculated at a discount rate of 10 percent.

Source: AIRD (1991), FAO (1989) and authors' calculations.