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Changes in poverty in Madagascar: 1993-1999[1]

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I. Introduction: [*]

By all estimates, Madagascar is one of the poorest countries in the world today, with macroeconomic indicators suggesting that the nation has steadily grown poorer over the past 30 years. Average income per capita fell by approximately one third in real terms between 1960 and 1999. Unfortunately, inter-temporal comparisons of national poverty in Madagascar to date have been hindered by a shortage of relevant and comparable data. As such, our understanding of the characteristics of the poverty that persist in this Indian Ocean country, and in particular how they have evolved, has been limited. This study uses recently available household survey data (see Appendix 1) to further our understanding of the nature of poverty in this country in the 1990s. The timing of this effort is fitting in light of Madagascar's involvement in the Highly Indebted Poor Country (HIPC) debt-relief initiative, and the effort by the government to place poverty reduction on center stage with it's "Document de Strategie Pour la Reduction la Pauvreté".

The objective of this analysis is broad in scope. The underlying motivation is to determine where attention and resources can be targeted in future efforts to alleviate the existing high levels of poverty in Madagascar. To fashion a more informed response, several key questions are posed and addressed at the outset: "Have poverty rates increases or decreased since 1993?"; "How have rural areas fared relative to urban areas?"; and "Are the observed changes in poverty consistent with changes in other indicators of well-being such as national income, access to basic services, and nutritional outcomes?" Further, to benefit from past experiences, we examine the effects of Madagascar's recent fiscal and monetary reforms on standards of living, and importantly, ask who has benefited and who has been left behind by them. More directly addressing the underlying question, however, involves appraising the determinants of poverty. Towards this end, we examine who the poor are (i.e. where they live, their levels of education, their sectors of employment, their access to services and markets, etc), and how their characteristics affect the likelihood that they will be poor. We then take these findings a step further to ask how changes in household characteristics, and how changes in the relationships between these characteristics and levels of consumption, helped to shape the changes in poverty that we observed between 1993 and 1999. In this way, we hope to isolate groups that are inherently vulnerable to persistent poverty and some of the factors that make them so vulnerable.

In the remainder of this paper, we describe the setting with background information on the economy and economic policy in section II, and very briefly discuss the general methodology in section III. In section IV, we examine the patterns of change in poverty as measured using our preferred welfare indicator, per capita household consumption. Various decomposition methods are employed to gain more insight into distributional aspects of the observed changes in poverty. In section V, we briefly examine changes in inequality and explore the link between changes in inequality and

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poverty. In section VI, we analyze the patterns of change in non-monetary measures of welfare and examine how well they correlate with well-being as measured by our preferred household consumption aggregate. We note that the analysis up to this point is limited to two-way cross tabulations (i.e. comparisons of poverty statistics among mutually exclusive groups), and *ceteris* are not *paribus*. In this setting, we can at most infer associations between certain household characteristics and probabilities of being poor. Thus in section VII, we discuss results of multivariate econometric estimates of the determinants of household consumption and consequently of poverty. These models are in turn used in a simulation exercise in section VIII to decompose the observed changes in poverty into changes in household endowments (e.g. levels of education) and changes in returns to these endowments (e.g. effect of education). We conclude with some brief remarks highlighting the main results.

II. Background Information:

The long history of poor economic performance of this Indian Ocean country of some 14.6 million people (1999), is surprising given the natural and human resource base. Much of this reflects the impact of nationalist policies adopted during the 1970s and much of the 1980s that stressed self-sufficiency and extensive state intervention in the economy. It was during this period that Madagascar left the "zone franc" and maintained an overvalued exchange rate through trade controls and foreign borrowing, established price controls that favored public enterprises, financed government spending through money creation, and relied heavily on import and export tariffs to generate government revenues. From 1971 to 1987, real GDP per capital fell from FMG 254,000 to FMG 171,000 in 1984 prices.

By 1988, the country's leadership began reversing the unsustainable policies of the past decade and a half by focusing on price and trade liberalization and the restructuring of public enterprises. This effort was supported with structural adjustment assistance from the IMF and the World Bank. The establishment of export processing zones ("zones franche") and the devaluation of the exchange rate led to large increases in both foreign and domestic private investment and to a tripling of manufacturing exports between 1988 and 1991. Real GDP per capita also exhibited the first sustained increase since 1971, rising to FMG 174,000 by 1990.

The political liberalization that coincided with the process of economic liberalization manifested itself in a general strike, civil unrest and political instability that hindered the government and commercial activity between 1991 and 1993. The immediate impact was a 6.3 percent drop in the real GDP and an 8.9 percent fall in real GDP per capita in 1991. The longer term effect was the establishment of a new multi-party constitution and a new government by 1993. Hopes for recovery after the transition, unfortunately, were not met as the freshly installed populist government succumbed to political pressures to reduce taxes and to finance government expenditures through money creation following a sharp depreciation in the exchange rate in 1994-1995. The consequences of these policies were high levels of inflation (42 percent in

1994 and 45 percent in 1995), deteriorating performance in the health and education sectors, and further declines in real per capita GDP (to FMG 149,000 in 1995).

In consultation with the IMF and World Bank in 1996, the government of Madagascar rejuvenated the reform process spelling out its intent in the Document Cadre de Politique Economique (DCPE, 1996). The consequent changing of the name of this strategy to "Strategie Nationale de Lutte Contre la Pauvreté" underlined the government's stated fundamental concern with poverty reduction. Macroeconomic stability followed the tightening of monetary policy, the liberalization of the exchange rate, and improved revenue collection since 1996. Further efforts by the government to reform the banking, fishing and petroleum sectors, to attract tourism, to improve government administration, and to improve the business climate, also contributed to an improved economic environment in which growth of output surpassed the population growth rate for the first time since 1992. The one percent rise in real per capita GDP in 1997 was a welcome respite, as was the drop in the inflation rate to single digits (7.3 percent) for the first time in 18 years.

Finally, to provide the setting for the time period of this analysis, we present some basic macroeconomic indicators in Table 1. The high levels of inflation experienced during the post transition period are seen in the average annual inflation rates of 25 percent between 1993 and 1997. The average of 2 percent growth in GDP during this period was not enough to outpace population growth, consequently per capita GDP fell by almost 1 percent. During the post 1996 period, inflation was brought under control to an average of 8.5 percent per annum between 1997 and 1999, and average annual GDP growth of 4 percent outstripped the population growth rate as per capita GDP increased by 1.5 percent. The gains realized in the latter two year period, however, were not large enough to overcome the economic disruption experienced in the earlier four year period. As such, although real GDP grew by an average 2.7 percent per annum between 1993 and 1999, average annual growth of per capita GDP was marginally negative.

III. Methodology

As with any analysis of poverty, choices had to be made regarding (a) the welfare indicator, (b) the threshold between the poor and the non-poor, and (c) the measure of poverty. While we concentrate primarily on a money measure of welfare – household consumption per capita[5] – we also examine other indicators of well-being such as access to basic services, educational enrollments, and nutritional outcomes of children.[6] The differing designs among the three surveys further motivated our decision regarding the form of our money-metric of welfare as well as the choice of the poverty line. By placing an emphasis on comparability between our preferred household consumption aggregates

[5] A battery of tests were conducted to determine the sensitivity of the analysis to the normalization of household consumption aggregate. We found the welfare rankings that appear in the remainder of the analysis to be robust to the choice of the equivalence scale.

[6] Note that household consumption, access to electricity, water and housing, and enrollment rates can all be viewed as inputs or proxies for well-being, while the nutritional status of children is an outcome. In light of this, nutrition can serve as an important indicator of national welfare (see Sahn and Stifel, 2000). Due to data limitations, however, we treat the nutrition indicators in this analysis with extreme caution.

across the three years, we had to alter the make-up of the aggregates previously derived by researchers using the 1993 survey (World Bank, 1996; Dorosh et al 1998).[7] At the same time, we were satisfied with the poverty estimates found in previous studies. So to square these two objectives – to obtain consumption aggregates that are comparable over time and to leave the 1993 poverty rate unchanged – the poverty line is derived endogenously. In other words, the poverty line is determined to be the FMG amount that reproduces exactly the 1993 national poverty rate of 70.0 percent (World Bank, 1996). A lower poverty line is also defined to replicate the 59 percent of the population categorized as extremely poor. The poor are defined such that the value of their total consumption is insufficient to purchase both a reference 2,100 calorie daily food basket and minimum non-food needs. The extreme poor are those whose total consumption value is insufficient to purchase the minimum food basket alone (see World Bank 1996 for details). Because the extreme poor households also devote resources to non-food items such as clothing and shelter, it follows that they actually consume fewer than the 2,100 calories required per day.

With the welfare indicators and poverty lines in hand, we primarily employ the Foster-Greer-Thorbecke (1984) class of poverty indices to measure levels and changes in poverty (see Appendix 3 for a discussion of these indices). We also move beyond the use of poverty indices to analyze changes in poverty by employing standard tests of stochastic dominance (see Appendix 4). The benefit of using this latter method is that it permits us to test the sensitivity of our results to the choice of the poverty line and/or the measure.

IV. <u>Patterns of Change in Poverty</u>: *Who are the poor and how has their lot changed?*

In this section we describe the patterns of change in poverty observed at the national level, and at various levels of disaggregation. This discussion is meant to be purely descriptive, with discussions of causality left to section VII where we use multivariate econometric techniques to examine the determinants of consumption, and examine how changes in the determinants have affected changes in poverty.

Table 2 shows the estimated rates and depth of poverty for both the upper and lower poverty lines (see Appendix 3 for a discussion of the Foster, Greer and Thorbecke, 1984, poverty measures used in this paper). By construction, 70 percent of the population in 1993 was poor, and 59 percent was extremely poor. In other words, 84 percent of the poor lived in extreme poverty. The headcount ratio is estimated to have increased to 73.3 percent in 1997 and then to have declined to 71.3 in 1999. This pattern of change is consistent with macroeconomic data in which per capita GDP (1984 prices) was found to have fallen from 155,300 FMG in 1993 to 149,700 FMG in 1997, before rebounding to 154,100 FMG in 1999 (INSTAT, 2000)[8]. A similar pattern emerges

[7] Appendix 2 provides a detailed discussion of the methodology used to construct and deflate the household consumption aggregate to facilitate welfare comparisons over time.

[8] See Appendix Table 1 for more information on per capita consumption levels. See also Appendix Tables 2 and 3 for estimates of the absolute numbers and percentages of those poor.

among the extremely poor with the rate rising to 63.1 percent in 1997 and back down to 61.7 percent in 1999. While there was less poverty in 1999 than in 1997, some 86 percent of those in poverty in 1999 continued to live in extreme conditions.

Estimates of the depth of poverty – a measure that accounts for the size of the consumption shortfalls of the poor, and that is proportional to the cost of eliminating poverty through perfectly targeted transfers – also rise between 1993 and 1997 from 30.3 to 33.6, before falling to 32.8 in 1999 among the poor in general, and rise from 23.0 to 26.3 before falling to 25.8 among the extremely poor in particular. Figure 1, gives a sense of why this reduction in the depth of poverty between 1997 and 1999 is not as large that of the headcount. The plots of the poverty incidence curves (or the cumulative distributions of real per capita consumption) that appear in this figure are informative for poverty analysis because they readily illustrate the percentage of the population (vertical axis) whose value of consumption (horizontal axis) falls below any given level, and because they also show their consumption shortfalls, or poverty gaps (horizontal distance from the poverty line to the point on the curve). In line with the headcount ratios, we see from these curves that at both the upper and lower poverty lines, smaller percentages of the population were poor in 1999 than in 1997. But at levels of consumption between FMG 100,000 and 200,000, there is no real distinction between the distributions for these two years. Thus, while the lot of the very poorest and the least poor of the poor improved during this interval, the situation of most of those in extreme poverty remained unchanged. This explains why the depth of poverty improved only slightly during the period between 1997 and 1999. [For a discussion of statistical tests of the differences between these distributions and the poverty measures, see Appendix 4 "Stochastic Dominance Testing: Methods and Results"].

Urban-Rural Poverty

Changes in national levels of poverty invariably mask much of the variation found at more disaggregated levels, which is certainly the case for Madagascar over the course of this 7-year period. Table 2 shows that poverty in this country is first and foremost a rural phenomenon. Rural poverty was considerably higher than urban poverty throughout the 1990s. With the rural population making up more than 75 percent of the total Malagasy population, rural areas contributed to over 80 percent of national poverty in all three years, reaching as high as 90 percent of the depth of poverty in 1993. Further, rural poverty has steadily risen as a whole between 1993 and 1999. The distributions of rural per capita consumption in the bottom panel of Figure 2 show that for all possible poverty lines above FMG 80,000, the percent of those living in poverty in rural areas rose gradually, though much of the change between 1997 and 1999 is not statistically significant. Finally, although the increases of 2 percent in the headcount between 1993 and 1997, and 1 percent increase between 1997 and 1999, may appear slight, these are admittedly small increments to already high levels of poverty, and as such are not minor.

Urban poverty, on the other hand, moved in parallel with macroeconomic indicators. The estimated share of the population living in poverty rose a staggering 13 percentage points between 1993 and 1997 from 50.1 percent to 63.2 percent, before

dropping 11 percentage points to 52.1 percent in 1999 (see Table 2). This pattern and magnitude of change emerges regardless of the poverty measure or poverty line employed. For instance, the upper panel of Figure 2 shows that for any possible positioning of the poverty line, there was approximately 10 percentage points more overall urban poverty in 1997 than in 1999.

At first glance, it appears that the urban areas between 1993 and 1997 were reservoirs for an increasingly poor population. Indeed the decomposition of the changes in poverty during this period illustrated in the top panel of Table 3, show that the increase in urban poverty alone contributed to approximately 74 percent of the national rise in poverty (see Appendix 5 for a discussion of the decomposition methodology and interpretation). But these decompositions also illustrate that migration (intra-sectoral effect) between rural and urban areas served to mitigate the rise in national poverty. In other words, this evidence suggests that those who migrated from worsening situations in rural areas settled in less worse circumstances in urban areas, though their presence in these new communities drove up urban poverty.

Similarly, although the urban settings showed improvements during this period, rural-urban migration between 1997 and 1999 served to ameliorate the increase in rural poverty as individuals and households who left the increasingly poor rural areas found themselves in improved urban settings (see the bottom panel of Table 3).

Regional Poverty

Table 2 and Figure 3 illustrate how poverty at the provincial (*Faritany*) level evolved. Over the entire period from 1993 to 1999, there were clear demarcations between those provinces that experienced declines in poverty, and those that suffered rises. While Antananarivo, Taomasina and Toliara all experienced increases in poverty in some manner between 1993 and 1997, they also benefited enough from growth during this period so that most, if not all, of the losses had been overcome by the time of the 1999 survey. Fianarantsoa, Mahajanga and Antsiranana were not so fortunate.

Toliara in particular is the one region in the country where the overall situation in 1999 was unambiguously better than in 1993 (see Figure 3). As Figure 4 illustrates, these improvements moved Toliara from its rank as the poorest province in 1997 with a headcount ratio of 82 percent, past Antsiranana, Mahajanga and Fianarantsoa, to third with a headcount ratio of 72 percent.

Table 4 and Figures 5 and 6 show that for Toliara, both urban and rural areas saw increased levels of consumption between 1997 and 1999, though contrary to national trends the majority of the gains were found in the rural areas. In fact, because of significant rises in urban poverty in this region between 1993 and 1997 (headcount rising from 66.9 percent to 69.1, and the more distributionally sensitive poverty depth rising from 25.0 to 37.3), consumption growth between 1997 and 1999 was insufficient to return all of the levels of poverty to those of 1993 (see Figure 5). In rural Toliara, on the other hand, while no statistically significant changes in the distribution of consumption

occurred between 1993 and 1997, well distributed growth between 1997 and 1999 resulted in over 10 percentage-point declines in poverty incidence for any possible poverty line. While a combination of the discovery of sapphires in the province in early 1999, and the positive effects of the development projects (World Food Program, Secaline Project, etc.) likely contributed to the falling rates of poverty, it is difficult to attribute the entire fall in poverty to them.

The picture for Antananarivo, which includes the capital city as well as surrounding districts, and in which some 28 percent of the population lives, is mixed. While the share of the population living below both the upper and lower poverty lines steadily declined over the three survey years, the depth of poverty rose between 1993 and 1997, before falling again in 1999. The differing directions of change between the two types of poverty measures are illustrated in Figure 3 by the crossing of the distributions of per capita consumption for these two years. The higher points on the 1997 distribution for levels of consumption below FMG 125,000 shows that the poorer of the poor – those with larger consumption shortfalls – fared poorly during this period, while the plight of the less poor of the poor improved marginally. The almost one-for-one shift in the distribution between 1997 and 1999 means that the population as a whole was better off, though the poorest 40 percent of the population was no better off than in 1993. Although the rank of Antananarivo by headcount ratios improved from third to first (see Figure 4), the share of national poverty attributable to the province remained among the largest because of its large population share.

In rural Antananarivo, the real consumption levels of poorest 50 percent of the population exhibited no statistically significant changes throughout the period between 1993 and 1999. The richer half of the population did, however, experience gains, and as such the rate of poverty in rural Antananarivo dropped from a high of 76.2 percent in 1993, to 72.1 percent in 1997, to 69.3 percent in 1999. Again, despite having the lowest levels of poverty relative to rural areas in other regions, this region accounted for 23 percent of total rural poverty because of it's large population size.

Figure 5 illustrates that the situation in urban Antananarivo in 1993 and 1999 was unchanged following setbacks experienced between 1993 and 1997. The capital city itself was very responsive to macroeconomic shocks and benefited so much from the economic growth between 1997 and 1999, that the headcount ratio (depth) actually dropped from 36.8 percent (12.5) in 1993, to 27.7 percent (9.4) in 1999. This was not the case for other urban areas in the province, in which 1999 poverty rates were still higher than those of 1993.

Following increases in poverty between 1993 and 1997, Taomasina experienced declines in poverty similar to Antananarivo between 1997 and 1999, as the headcount dropped over 10 percent from 79.8 percent to 71.3 percent. Thus, in terms of headcount rankings (Figure 4), by 1999 Taomasina was ranked second least poor instead of second poorest as it was in 1993. Because of the initial setbacks between 1993 and 1997, however, the gains due to growth in the later years were not enough to raise the consumption levels of the poorest half of the regional population to those of 1993, as

illustrated in the crossing of the 1993 and 1999 distributions in Figure 3, and by the very slight rise in the depth of poverty at the lower poverty line from 25.4 to 25.6 in Table 2.

Although the paths were substantially different, the final changes between 1993 and 1999 for both urban and rural Taomasina were remarkably similar (see Figures 5 and 6), and consequently are mirrored in the overall provincial changes in consumption (see Figure 3). The differences emerge in the experiences in the years between 1993 and 1999. While the consumption levels of the poorest 60 percent of the rural population in Taomasina fell somewhat between 1993 and 1997, the entire urban population became substantially worse off in response to negative policy shocks. For instance, the urban poverty rate rose 37 percent from 55.8 percent to 76.3 percent, and the depth of poverty grew by 116 percent from 18.5 to 39.9. As such, the remarkable growth in urban consumption after 1997 served only to lower the urban headcount ratio to 52.6 percent, while the depth of poverty remained above its 1993 level at 21.1.

Levels of poverty in Fianarantsoa, Mahajanga and Antsiranana all rose unambiguously between 1993 and 1999, running counter to, and muting, the national dynamics. In Fianarantsoa, for example, small changes in the distributions of real consumption that left poverty rates statistically unchanged between 1993 and 1997,[9] were followed by poverty rates that soared from an already high level of 75 percent in 1997 to a staggering 81 percent in 1999. This phenomenon affected the population as a whole, as seen in the upward shift of the entire distribution of real per capita consumption between 1997 and 1999 in Figure 3. The result was that by 1999, Fianarantsoa had the highest rate and depth of poverty of any region by far (see Table 3), and although 19 percent of the national population resided there, it accounted for some 23 percent of the national depth of poverty.

What is more revealing is that the overall increase in poverty in Fianarantsoa between 1997 and 1999 occurred despite a first order increase in real consumption levels in urban areas in this province. For instance, while this region's poverty rate rose by 8 percent, the urban headcount ratio fell by 33 percent from 83 percent to 56 percent, and the poverty depth fell 40 percent from 42 percent to 25 percent. The improvements in urban conditions were in stark contrast to the rise in rural poverty in Fianarantsoa. The rural headcount ratio rose some 17 percent from 74 percent to a national high of 86 percent. Similarly, the depth of poverty in rural Fianarantsoa rose, but by 43 percent from 30 percent to 43 percent. These dramatic rural-driven rises in poverty will be the subject of further study in a forthcoming collaborative analysis between Cornell University and INSTAT.

The region with the most remarkable increase in poverty was Mahajanga, which suffered a rise in the headcount ratio from a national low of 53.2 percent in 1993, to the second highest level of 76.0 percent in 1999. Most of this 43 percent rise in the incidence of poverty took place between 1993 and 1997, though the depth of poverty rose a further

[9] It should be noted, however, that the dominance test results in Appendix 4 show that the 1997 distribution third order dominates the 1993 distribution, suggesting that for all poverty lines and for all FGT poverty measures with sensitivity parameters greater than one, poverty fell in 1997.

25 percent between 1997 and 1999, as illustrated in the higher points on the 1999 distribution of consumption relative to the 1997 distribution in Figure 3.

Aside from other urban centers in Antananarivo Province, urban areas in Mahajanga were the only ones in the country to be unambiguously worse off in 1999 than in 1993 (see Figure 5). And, unlike the other urban centers in Antananarivo where the headcount ratio rose by 10, the share of the urban population in Mahajanga living in poverty exploded by 75 percent from 37.3 in 1993 to 65.2 in 1999. So contrary to the experience of Fianarantsoa, and as we shall see for Antsiranana, the increase in rural poverty in Mahajanga was augmented – instead of muted – by increases in urban poverty, instead of muted. Whether this was a consequence of the outbreak of cholera in this province in early 1999 cannot be determined with the data at hand.

Antsiranana, which shares a border with Mahajanga, also suffered a large rise in its headcount ratio between 1993 and 1999, from a relatively low 60.2 percent to 72.6. Unlike in Mahajanga, the most substantial falls in consumption occurred between 1997 and 1999. The multiple crossings of the 1993 and 1997 distributions in Figure 3, are contrasted by the unambiguous upward shift of the 1999 distribution and its consequences for poverty. Further, unlike in Mahajanga, poverty in Antsiranana province as a whole rose despite the 37 percent decline in the headcount ratio, and the 45 percent decline in the depth of poverty in urban areas between 1993 and 1999.

The overall patterns of change in regional poverty and their contributions to changes in national poverty are illustrated in the decompositions that appear in Table 5. The lower two panels clearly show the gains experienced in reduced poverty in Antananarivo, Taomasina and Toliara between 1993 and 1999, as well as the losses for Fianarantsoa, Mahajanga and Antsiranana. For instance, in the absence of migration and rises in poverty elsewhere, national headcount ratio would have fallen by 4.3 percentage points (1.9 + 1.1 + 1.3) instead of rising 1.3 percentage points due to declines in poverty in Antananarivo, Mahajanga and Antsiranana. Conversely, the national poverty rate would have risen by a further 4.0 percentage points to 75.3 percent had the changes in poverty been isolated only to Fianarantsoa, Mahajanga and Antsiranana.

Table 6 highlights how the rural sectors in Fianarantsoa, Mahajanga and Antsiranana, as well as the urban sector in Mahajanga fared poorly between 1993 and 1999 contributing to an increase in the national headcount ratio of 5.7 percentage points, relative to the 1.3 percentage point increase observed. The lower panel of this table further illustrates how poverty (as measured by the incidence, depth and severity measures) fell simultaneously in both urban and rural areas in Antananarivo, Taomasina and Toliara provinces between 1997 and 1999, and increased simultaneously in urban and rural Antsiranana.

To sum up, while all urban areas were adversely affected by macroeconomic shocks between 1993 and 1997, all but urban Mahajanga responded positively to the improved macroeconomic environment in the post-1997 years with declines in poverty. Rural areas as a whole witnessed persistently rising rates of poverty, and were seemingly

unaffected by the fiscal and monetary policy changes introduced in 1996. Nonetheless, rural poverty in Antananarivo, Taomasina and Toliara provinces fell over the entire period.

Vulnerable Groups

Disaggregations of poverty estimates need not be limited to spatial dimensions. More importantly, alternative disaggregations can help us identify groups in society that may be more susceptible to persistent poverty. With this in mind we now proceed by examining changes in the poverty status of households by economic sector, and then by their characteristics. Finally, we explore the issue of remoteness and its correlation to poverty. We caution that this type of analysis does not permit us infer whether certain groups have inherent unobservable traits that lead to their persistent poverty, or whether other characteristics of the individual households in the groups explain their states of affairs. This is left to the econometric analyses in section VII.

a. Economic Sector

In Table 7 we illustrate the changes in poverty for households classified by mutually exclusive economic sector.[10] In most cases, the household's sector is determined by that of the household head. In instances when the head was not working, or there was missing information in the data, the sector of the spouse or the eldest child was recorded. Since our unit of analysis is the household (i.e. we start with a household level consumption aggregate) and because households pool their resources, classification schemes that do not place households in mutually exclusive groups do not lend themselves to accurate comparisons of poverty across the groups. Thus while many households admittedly have members economically active in multiple sectors, we adopt the categorizations in Table 7 as a convenience in which to classify them into mutually exclusive groups.

The most conspicuous and unsurprising feature that emerges from this table is that in addition to being a rural phenomenon, poverty in Madagascar is also an agricultural phenomenon. With headcount ratios above 75 percent throughout the 1993-1999 period, individuals in agricultural households which made up just over 70 percent of the total population in 1999 persistently accounted for more than 74 percent of national poverty. In urban areas, the percentage of the population belonging to agricultural households grew from 23 percent in 1997 to 27 percent in 1999. At the same time, the headcount ratio among these individuals dropped 6 percentage points from 70 percent to 64 percent. Nonetheless, this group continued to account for more than 32 percent of urban poverty, and in addition, the depth of poverty rose from 24 percent to 27 percent.

Rural agricultural household are those that fared the worst during this period, with the headcount ratio rising from 76.5 percent in 1993 to 78.6 percent in 1999, and the

[10] The sector classifications which are identical for the 1997 and 1999 EPM, differ with those of the 1993 EPM. The aggregations that are necessary for purposes of comparability leave the 15 categories that appear in Table 7.

depth of poverty rising from 34.5 percent to 37.4 percent. And with this group of households making up 83 percent of the rural population in 1999, it is not surprising that 85 percent of rural poverty could be attributed to them during this year.

Within the agricultural sector further disaggregation between small-scale farming households (0 to 1.5 hectares of land cultivated) on the one hand, and medium- and large-scale farming households on the other is informative (see Table 8).[11] Regardless of the area of residence, small-scale farming households are poorer and experienced increases in poverty to a greater degree than did their larger neighbors. For instance, the poverty rate among rural small-scale farmers rose from 79 percent in 1993 to 83 percent in 1999, accounting for some 61 percent of poverty in the agricultural sector despite accounting for only 55 percent of the population in this sector. At the same time the rate of poverty among medium- and large-scale farming households remained statistically unchanged at 72 percent. In urban areas, the headcount ratios in the small-scale and larger-scale farm sectors fell approximately six percentage points between 1993 and 1999, though there remained 40 percent more poverty among the small-scale farming households at 71 percent. We return to the relationship between access to land and poverty in more detail below when we examine land ownership.

The other households which contributed considerably to the national poverty were those in the manufacturing, trade and government services sectors. Because of their relatively large population shares, these households accounted for over 10 percent of the national headcount ratio in 1999, despite the relatively low incidence of around 54 percent poor in each sector. The manufacturing sector experienced a drop of 4 percentage points in the headcount ratio between 1993 and 1999, though the depth of poverty remained unchanged at 22.5. Although the levels of poverty in this sector were higher in rural areas than in urban areas, the percentage poor in manufacturing in rural areas fell between 1993 and 1999 (66.7 percent to 56.3 percent), while the percentage poor in urban areas rose from 46.1 percent to 53.0. Further, this group continued to account for 8.5 percent of urban poverty in 1999.

In the trading sector, the rise in the depth of poverty from 20.2 to 22.3 at the national level between 1993 and 1999, and the lack of change in the headcount ratio (54.5 percent), was mirrored in the urban sector. In rural areas, the 3 percentage point drop in the headcount ratio was not accompanied by a similar drop in the depth of poverty, suggesting that those trading households who remained in poverty were worse off in 1999 than in 1993. Nonetheless, compared to other rural sectors, poverty rates in the trading sector were low.

While still doing better than other groups in society, 73 percent more of the individuals in civil servants households (i.e. those in the government services sector) found themselves in poverty in 1999 than in 1993. The depth of poverty among individuals in this sector increased even more, by over 150 percent from 8.7 to 22.2. This is surprising in light the fact that data from the Minsterè des Finances et de l'Economie

[11] We note that this classification is based on a socio-economic group category filled in by the enumerator, not by a recording of land cultivated.

shows that real minimum public sector wages rose throughout this period (see Table 9). As the population share in this sector rose from 2.5 percent in 1993 to 5.3 percent in 1999, the rise in the poverty rates thus likely follow from new employees in this sector entering at the lowest wage levels which are not sufficiently high to lift their households out of poverty (despite the real rises). In rural areas, the poverty rate among individuals in civil servant households rose from 45.7 percent to 55.3, thought the magnitude of the change in the depth of poverty was much greater rising from 13.8 to 26.6. Although this sector only accounted for 2 percent of rural poverty in 1999, the rise in poverty among these households could affect the provision and quality of government services for needy groups, and creates incentives for graft.[12] These consequences are likely to be even greater in the urban sector where the contribution to urban poverty from civil servant households grew from 3.9 percent in 1993 to 13.5 percent in 1999, as the headcount ratio rose 128 percent to 50 percent, and the depth of poverty rose 222 percent to 19. By 1999, this sector was second only to agriculture in terms of its contribution to urban poverty, and third behind agriculture and trade in contributing to rural poverty.

Finally, individuals in households headed by individuals classified as unskilled labor also experienced large increases in poverty (see Table 8). With poverty rates some 20 percentage points below the national level in 1993, the increase to 81 percent of these individuals being classified as poor left this group with a 10 percentage point greater headcount ratio than the national level in 1999. These increases took place in both urban and rural areas, though in rural areas by 1999 over 90 percent were poor.

b. Household Characteristics

Poverty statistics disaggregated by characteristics of the household head appear in Table 10a. We find that female-headed households were more likely than male-headed households to be poor in 1993. For example, the headcount ratio of 72.8 percent and poverty depth of 32.4 for the former compare disfavorably to the 69.5 percent and 29.9, respectively, for the latter. The gap closed by 1999, however, when the slightly higher headcount ratio and the slightly lower poverty depth for female-headed households were not statistically different from the figures for male-headed households. When these households are disaggregated further by the marital status of the head, an interesting pattern emerges. Rates of poverty among individuals in female-headed households in which the head is divorced or widowed (74.5 percent in 1993 and 72.6 percent in 1999) were considerably higher than for those in which the female head was married (64.0 percent and 58.1 percent, respectively) or single for some other reason (54.2 and 60.6 respectively). We note that in the far majority of female-headed households, the head was either divorced (including separated) or widowed. For instance in 1993, 87 percent of female household heads were divorced or widowed, while in 1999, 80 percent were. Although it is far from certain, or for that matter verifiable with the data, the likelihood is very high that these women became heads of their respective households due to the disruption of their families following from death or divorce. And while such disruptions of their household could plausibly explain the higher poverty rates among female-headed

[12] We note that the government of Madagascar in collaboration with the World Bank is in the process of reforming wages of civil servants in an effort to address this very issue.

households, the econometric models in Section VII do not support such an hypothesis. Finally, despite ambiguous changes in poverty for the divorced/widowed female-headed household with the headcount ratio falling 3 percent while the depth of poverty rose 6 percent, the persistence with which these households remain in poverty, with rates and depths of poverty higher than the national level, is unambiguous.

Exploring the gender issue further, the evidence shows that the more women there are in the household, the greater is the probability that those in the household will be poor. Table 10a shows that in 1993, the index of poverty increased monotonically with the share of adult women to total adult household members. For instance, the headcount ratio among individuals in households in which less than a quarter of the members were women was 65 percent, compared to 74 percent for those households in which women made up more than three quarters of the adult members. Similarly, the depth of poverty increased from 28 to 34, respectively between these two groups. In 1999, while there was more poverty among the households with over three quarters women relative to those with less than a quarter women, those with the highest levels of poverty were in the category with between a half and three quarters women. Thus, while the changes are not monotonic, the general trend remains strong with the probability of poverty rising with the share of women in the household.

The relationship between the age of the household head and poverty among the household members takes on an inverted-U shape, with the incidence of poverty peaking at the 40 to 49 age group. In 1993, for example, the headcount ratio for members of households who's head was between the age of 40 and 49 was 72 percent, compared to 67 percent for the under 25 group, and to 69 for the over 60 group. Poverty rates for all of the age groups rose between 1993 and 1999, with the exception of the eldest group in which the headcount ratio dropped some 9 percent to 63 percent (though the depth of poverty remained statistically unchanged). We caution that these correlations are not *ceteris paribus* in that we do not control for differing levels of educational attainment and/or experience in the workplace, life cycle effects, or selection bias (i.e. given that life expectancy is estimated by the World Bank to be in the neighborhood of 58 years, it is the less poor who are more likely to survive beyond 60 years of age) in estimating these poverty rates. We thus reserve further comment on this topic for the discussion of the econometric models where we find that the opposite relationship emerges.[13]

In an effort to capture the relationship between household human capital and the probability that an individual is poor, we examine poverty among household groups characterized by the educational attainment of their members (see Table 10a). Individuals in households with few or no members with completed primary schooling are more likely to find themselves in poverty than those in households in which most members have at least a primary education. The 1993 figure of 79 percent poor among those individuals living in households with fewer than a quarter of the adult members educated is 25 percent higher than the 63 percent poor in households with over three quarters of the adult members with completed primary education. The 60 percent differential for the depth of poverty in 1993 (40 versus 25) suggests that not only is there

[13] Note that in the econometric models in section VII, we do not control for selection bias.

more poverty among less educated households, but that the degree of poverty for these households is greater. While the magnitude of the disparity between the headcount ratios remained unchanged in 1999 when poverty for all of the groups of households rose simultaneously, the difference in the depth of poverty narrowed to 48 percent (41.5 and 28.0, respectively).

As expected, the pattern of poverty among individuals in households characterized by share of adult members with at least secondary education mirrors the pattern for primary education although the magnitude of the difference between less and more educated households was larger. For instance, some 78 percent of those living in households with fewer than a quarter of the adult members having attained a secondary education were poor in 1993, while only 32 percent of those in households with over a quarter of the adult members educated at the secondary level or above were poor. The gap between these types of households narrowed in 1999, but primarily because poverty in the more educated group of households rose dramatically by 35 percent to 43 percent (which was actually a drop from a high of 54 percent in 1997).

Another way to capture human capital and earning capabilities in households is by the years of education of the adult member with the highest level of education. Classifying households in this manner, we find that although the rate of poverty in 1993 was lower among those living in households without educated adult members (77 percent) compared to those in which the most educated member had some primary education (78 percent), the degree of poverty (P_1) for the former group (39) was actually higher than for the latter (34). By 1999, however, there was no statistically distinguishable difference between those with some education (1 to 6 years) and those with no education, with headcount ratios of 80 percent and 79 percent and depths of poverty of 39 each for the two categories of households. Although for those with only a primary education the headcount ratio (depth) is more than 12 (18) percent higher than the national level in 1999, and although this suggests a low correlation between attaining a primary education (and not continuing on) and the ability of households to escape poverty, the results of our econometric models and decompositions find the opposite to be the case. This is discussed further in depth in section VIII.

c. Remoteness

A common theme that emerged from a workshop held to elicit input from interested parties prior to the launching of this study, was that casual empiricism suggests a high correlation between "remoteness" of households and the degree to which they are poor. Since empirically verifying this observation was not an objective in the collection of the data, there were no direct efforts to capture measures of "remoteness" by the survey team. Data from the community surveys conducted concurrently with the household surveys, however, do include questions related to distance to schools and health clinics, as well as access to various other services. Nonetheless, due to differences between the 1993 data on the one hand, and the 1997 and 1999 data on the other, comparisons can only be made between the latter two surveys for a composite index of

remoteness. Further, since remoteness is essentially a rural phenomenon, we limit our analysis to poverty among rural households.

In table 11, we report poverty estimates for 1997 and 1999 by quintile of a remoteness index that is the weighted sum of indicators of the existence in the community of (a) a road, (b) a bus stop, (c) access to agricultural extension services, and (d) access to modern fertilizer, as well as the distances to the nearest (e) school and (f) health clinic.[14] The first quintile of the index indicates the 20 percent of the individuals in rural areas who have little or no access to the services (including the need to travel great distances for health service and for schools), and as such are defined as the most remote segment of the rural population. The opposite extreme is the fifth quintile which is made up of individuals with the most access to the services. For both years and for both the headcount ratio and the poverty depth, poverty is greater for the most remote quintile relative to the least remote quintile. For example, in 1999 the headcount falls from 82.8 percent for the most remote to 65.9 percent for the least remote, while the poverty depth drops from 42.4 to 29.0 for the same groups, respectively. Further, with only a couple of exceptions, the poverty rates generally rise monotonically with the degree of remoteness.

In addition, the gap between the most and least remote rural households became wider in the two years from 1997 to 1999. The least remote quintile of the rural population experienced a drop in poverty with the headcount ratio (depth) falling from 72.6 (31.6) percent to 65.9 (29.0) percent, while the most remote quintile experienced rises both the headcount ratio and the depth of poverty, from 78.0 percent to 82.8 percent, and from 34.8 to 42.4, respectively.

d. Access to Land

Finally, we turn out attention to land access, an important source of income (and consumption) for agricultural households. Due to changes in the EPM questionnaires regarding land ownership and cultivation, and for the sake of comparability, we restrict our analysis to the area of land owned by those households interviewed in 1993 and in 1999. We find that pressure on land increased overall as the total area of land owned by households grew by over 9 percent between these survey years with farming households laying claim to previously unclaimed land. Despite this, a faster population growth rate led to an 8 percent fall of the average per capita land holding of households. Table 12 illustrates that the average household land holding dropped from 0.31 hectares per capita to 0.28 hectares per capita. Among agricultural households at both the national and rural levels, the average size of landholding fell by 6 percent, from 0.38 hectares per capita to 0.36 hectares per capita.

Figure 7 shows that the pattern growth in the overall ownership of land in rural areas is driven by small farmers as illustrated by the lower end of the distribution of per capita land holdings shifting to the right at a rate higher than the upper portion. Further,

[14] The weights for this index are derived through a factor analysis of the covariance in the indicators. See Sahn and Stifel (2000a) for a detailed description of the methodology.

the bulk of these increases in land holdings can be attributed to households with less than 0.4 hectares per capita, suggesting that (a) inequality in reported land ownership has declined, and (b) small-scale farmers own more land. We caution that these comparisons are made with respect to total land owned without regard for quality. Although the 1993 data includes indicators of whether the land was irrigated or not, the 1999 survey did not record such information. As such, we cannot directly address issues of land quality and expansion. Nonetheless, we can – and do in the econometric modeling below – draw inference on a plausible relationships between access to land, productivity and poverty.

Before developing this hypothesis, however, we need to have an idea of how access to land correlates with the probability of being poor in this data. We thus present in Table 12 the average per capita land holdings for groups of households ranked by deciles of their per capita consumption levels. Although the trend is not entirely monotonic, there is a clear tendency for the size of the land area owned to increase with consumption.[15] For example, at the national level in 1999, the average plot of land owned by the poorest 10 percent of the population was 0.17 hectares, whereas the richest 10 percent of the population owned on average 0.38 hectares of land. The pattern is more pronounced for rural agricultural households – the group most persistently vulnerable to poverty – with those in the richest decile owning plots that on average were 130 percent larger than those in the poorest decile in 1999. Further, for the rural agricultural households in particular, the pattern of land holdings across consumption deciles remains remarkably similar between 1993 and 1999. The exception is the second decile, in which the average land holding is 0.34 hectares per capita in 1993 and 0.24 hectares per capita in 1999. In general, poorer households – particularly in the rural agricultural sector – are those with smaller landholding, while richer households are those that own more land.

Another way to gain insight into the relationship between poverty and access to land is to examine the relative levels of poverty by the size of household land holdings. In Table 13, the incidence and depth of poverty are reported for individuals in rural and rural agricultural households. Here we see extremely high rates of poverty among those who live in households with between 0.001 and 0.2 hectares of land per person. In 1999, for example, more than nine out of ten of these very small-scale landowners in the rural agricultural sector were estimated to be poor. Surprisingly, those with less than 0.001 hectare of land per capita – essentially landless households, and henceforth referred to as landless – had considerably lower rates of poverty with less than seven out of ten with consumption levels below the poverty line. A possible explanation for this result is that some of these landless households have alternative income sources that support higher levels of consumption. Recall that the sectors are defined by those of the household head, and that other household members need not necessarily be involved in income generating activities in that sector. Results from the econometric models in the next section support this explanation.

When we consider the 92 (98) percent of the rural (rural agricultural) population that is not landless, there is a clear tendency in Table 13 for poverty to fall with the size

[15] Note that this table presents correlations without inferring causation. In fact, in the econometric models presented in section VII, the size of the land holdings is used as an explanatory variable.

of land holdings in a manner consistent with the patterns observed in Table 12. In the rural agricultural sector in 1999, for example, the headcount falls from a high of over 91 percent for the very small land holders, to 85 percent for those with 0.2 to 0.39 hectares of land per capita, to 64 percent for those with 0.4 to 0.79 hectares per capita, and to 48 percent for those with 0.8 hectares per person or more. Similar patterns are observed for the depth of poverty, falling from a high of 54 percent for those with less than 0.1 hectares per person to 16 percent for the largest landholding category.

The changes in poverty observed in the rural agricultural sector between 1993 and 1999 are especially telling. In spite of larger holdings among small-scale farmers, poverty rose for all groups of households with landholdings smaller than 0.4 hectares per capita (including the landless). The percent poor among individuals in rural agricultural households with less than 0.2 hectares rose from approximately 84 percent to just under 92 percent between 1993 and 1999. Poverty among those with between 0.2 and 0.4 hectares of land per capita also rose, but by 6 percent to 85 percent. Poverty rates actually fell for larger scale farmers, with the headcount dropping (statistically insignificantly) from 65 percent to 64 percent for those with land holdings between 0.4 and 0.8 hectares per capita, and from 54 percent to 48 percent for those with more than 0.8 hectares per capita. The depth of poverty followed a very similar pattern, although the degree of the changes in poverty were much greater (except for the 0.4 to 0.8 hectare per capita group, for which P_1 remained statistically unchanged).

The fact that our observations suggest that households moved between the mutually exclusive land-holding categories indicates, of course, that some households which initially had very small land holdings may have become better off (i.e. by acquiring enough land to become large scale farmers). For example, the share of the rural agricultural population with land holdings of 0.4 hectares per capita or greater rose some 3.7 percentage points to 31.1 percent. And with poverty rates in 1999 of less than 64 percent among these larger scale farmers, the probability of being poor dropped considerably for those farmers who previously owned less than 0.4 hectares of land per capita in 1993 (e.g. from over 80 percent). Nonetheless, most of the movement among households in the land holding categories in the rural agricultural sector was within the smallest categories (note the slight decline in the share of landless households), where the probability of being poor was at more than 85 percent in 1999. In other words, for the far majority of the small-scale land owners, poverty rates increased.

This evidence together suggests that small-scale farmers who are expanding their use of agricultural lands[16] are becoming poorer. A plausible explanation for this observation – one supported by qualitative analyses and upon which we draw inference in the econometric models and decompositions that follow – is that in the face of demographic pressures and the consequent shorter fallow periods[17] and declining

[16] Although tenancy and share-cropping are becoming more widespread (IMaTeP, 1998), owner-run farming is commonly practiced (IMaTeP, 1998; Freudenberger, 1999; and Minten and Zeller, 2000). Consequently, the inferred link between ownership of land and cultivation is not spurious.

[17] Freudenberger (1999) observed fallows declining from traditional 10-year periods to as short as 3-year periods in Tanala communities.

agricultural productivity, small-scale farmers are forced to expand their holdings of land. This is done principally through the clearing of previously uncultivated lands in forests and/or on hillside areas with infertile and fragile soils.[18] Despite the extensification of its use, the overall returns to the land appear to have fallen and consequently (at least among small holders) poverty rates rose. The direct consequences of this pattern of extensification for the farming households themselves – a vicious cycle of decreasing productivity leading to agricultural extensification into fragile lands, leading to further declines in productivity, and so on – are of concern enough. But the indirect external/communal effects of the subsequent environmental degradation – soil erosion and silting of low-land plots, breakdown of the watershed, loss of communal grazing lands (Freudenberger, 1999) – for the communities as a whole, make the matter all the more pressing. Although we are not able to directly confirm or refute this explanation, we use the econometric models and decompositions in sections VI and VII, to determine whether the EPM data provide evidence that is *consistent* with it.

V. Patterns of Change in Inequality:

Poverty analysis is restricted to the study of the lower end of the distribution of household consumption (or in the case of Madagascar, the lower three quarters of the distribution). To get a better idea of how all households in Madagascar fared relative to one another, we now turn to an assessment of the entire distribution and to measures of inequality. We start with a discussion of the levels and changes in inequality, and then pursue the link between changes in inequality and poverty.

The Lorenz curves that appear in Figure 8, show that national inequality unambiguously fell between 1993 and 1997. This is evident because each point on the 1993 Lorenz curve is below the point of the 1997 Lorenz curve corresponding to the same percentage of the population (with insignificant differences for the poorest decile) . In other words, the poorer segments of society contributed to a larger share of total consumption in 1997 than in 1993.

The very sharp falls in the Gini coefficient from 0.45 to 0.39, and in the Theil index from 0.53 to 0.29, respectively (see Table 14), during this period are consistent with the shift in the Lorenz curves pictured in Figure 8. The continued slight decline in these measures of inequality between 1997 and 1999, though, is driven primarily by a slight redistribution of consumption among the richest 35 percent of the population. The Lorenz curves for the poorest 65 percent of the population are substantively the same, and as such inequality among this segment of the economy remained unchanged.

[18] See Keck et al (1994), IMaTeP (1998), Freudenberger (1999) and Minten and Zeller (2000). Freudenberger (1999) points out that in the Tanala and Betsileo communities in the forest corridor in Fianarantsoa, large families with typically 8-10 children practice "homesteading" in which 2-5 hectares are cleared. While these households are better off than the very small holders who do not have sufficient resources with which to clear new lands, they nonetheless fall into the our category of small-scale farmers (i.e. those who own less than 0.4 hectares of land per capita).

Table 14 and the Lorenz curves in Figure 9 also show that rural inequality declined in a manner similar to that of the nation as a whole. The magnitude of the change, however, was greater with the Gini coefficient falling from 0.45 to 0.36, and the Theil index plummeting from 0.57 to 0.22, between 1993 and 1999, respectively.

Changes in urban inequality were more ambiguous. For instance, between 1993 and 1997, the Gini coefficient rose from 0.415 to 0.421, while the Theil index fell from 0.363 to 0.316. The crossing of the 1993 and 1997 Lorenz curves shows how these conflicting changes are possible, and further show that the poorest 60 percent of the urban population was worse off relative to the richest 40 percent. The poverty incidence curves in Figure 2 give some insight into why the Lorenz curves cross. While real consumption levels in urban areas fell on average by approximately 28 percent between 1993 and 1997, the consumption of the poorest 20 (40) percent fell by approximately 40 (37) percent. Although all urban residents were worse off in 1997, the poorer were even worse off and consequently the Lorenz curves cross. Between 1997 and 1999, urban inequality fell unambiguously as illustrated by the upward shift in the Lorenz curve in Figure 8, and by the fall in the Gini coefficient from 0.421 to 0.384, and the Theil index from 0.316 to 0.249.

In 1993, rural inequality as measured by the Gini coefficient and the Theil index, was higher in rural areas than in urban areas. Further, some 98 percent of national inequality (Theil index) could be attributed to unequal consumption levels within urban and rural areas rather than between them. By 1999, however, rural areas had a more equal distribution of consumption than did urban areas. Interestingly, while the share of the national population living in rural areas fell by 3.7 percentage points between 1993 and 1999, from 81.5 percent to 77.8 percent, respectively, the share of rural consumption to total consumption fell further by 6.2 percentage points from 75.3 percent to 69.1 percent. It is not surprising then that the share of national inequality attributable to the inequality of consumption between urban and rural consumption rose from 2 percent in 1993 to 8 percent in 1999. This change in the urban-rural distribution of consumption, however, took place primarily between 1997 and 1999, when the rural share of consumption fell 5.4 percentage points. This too is not surprising in light of the fact that rural consumption levels consistently fell over the entire 1993-1999 period, while urban consumption rebounded between 1997 and 1999 (see poverty incidence curves in Figure 2).

In all of the provinces, except Taomasina where the Lorenz curves cross (not shown), inequality fell between 1993 and 1999. Although not every province experienced monotonic declines, by 1999, each had converged to a similar level of inequality. For instance, the Gini coefficients were roughly 0.37, and the Theil indices were roughly 0.24 for all the regions in 1999. The three regions that experienced the largest increases in poverty between 1993 and 1999, Fianarantsoa, Mahajanga and Antsiranana, were also the regions that experienced the largest declines in the level of inequality.

To make the link between inequality and poverty, we must initially understand the two aggregate forces that affect levels of poverty. First and most obviously, distribution-neutral growth (i.e. where all income/consumption levels grow by the same rate) reduces poverty by reducing the share of the population below the poverty line, and by reducing the size of the consumption shortfalls of those who remain in poverty. We refer to this as the growth effect. Second, pure redistribution in the absence of growth (i.e. unchanged average income/consumption levels with a less disperse distribution or less inequality) typically leads to lower poverty because the measures of poverty are a function of consumption below the poverty line. In other words, if movement of the lower tail of the distribution to the right is a consequence of the entire distribution becoming less disperse, poverty typically falls.[19] This is referred to this as the redistribution effect. In Table 15, we illustrate a decomposition of changes in poverty in Madagascar into growth and redistribution effects. See Appendix 5 for a detailed discussion of this decomposition.

Declines in inequality (redistribution effect) throughout the period between 1993 and 1999 had a positive effect on poverty. For example, had mean consumption levels not fallen between 1993 and 1997, the lower level of national inequality would have translated into a 7.2 percentage point drop in the headcount ratio by 1997. On the other hand, had the fall in the mean consumption levels been evenly distributed across the distribution of individuals (i.e. had the poorer segments of the population been hit as equally hard as the richer segments), then the poverty headcount would have increased by five percentage points more than it actually did between 1993 and 1997. This conclusion that the growth effects outweigh the redistribution effects, applies to the 1993-1999 period, and is robust to the type of poverty measure.

For the two periods examined here (1993-1997 and 1997-1999), we see that only when the mean consumption level grows between 1997 and 1999 (even if very slightly) is there a decline in the levels of poverty. The conclusion that can be drawn from this analysis is that, especially for Madagascar where 70 percent of the population is poor, growth must be the driving force for poverty alleviation. While declines in inequality do have some effect vis-à-vis the reduction of poverty, unless they are accompanied by growth in average consumption levels, poverty will remain extremely high.

VI. Patterns of Change in Non-Monetary Indicators of Well-Being:

The emphasis placed thus far on household consumption as a welfare indicator does not preclude the use of other non-monetary measures to give an idea of how well-being has changed in Madagascar in the 1990s. In this section we consider a set of such measure and examine their evolution and their correlation with poverty as measured with our consumption aggregate.

[19] The link between a less disperse distribution and declines in poverty for Madagascar is complicated by the fact that over two-thirds of the national population is poor. It is not inconceivable that a mean-preserving contraction of the distribution could lower the consumption levels of those just above the poverty line and consequently raise the headcount ratio.

Enrollment in Schools

In section 3, we saw that the probability of being poor was greater for those households whose current stock of education or human capital was lower, than for those whose stock was high. We now turn to enrollment rates[20] of children 6 to 14 years of age, in part as a way of capturing future earnings potential (and thus a lower probability of being poor), as well as an intrinsic measure of well-being in and of itself. Table 16 illustrates that despite the slight decline in real GDP per capita and increase in poverty between 1993 and 1999, enrollment rates increased substantially from 51.4 percent to 67.5 percent. Most of these gains resulted from increased enrollments in public schools from 39.3 percent to 52.8 percent during this period.

Although enrollment rates grew in every province between 1993 and 1999, the increases were not spread evenly. For instance, in Mahajanga, a province that experienced a 43 percent rise in the poverty headcount during this period, the total enrollment rate increased a mere 8 percent from an already low rate of 49.5 percent. Further, enrollment rates stagnated at around 50 percent between 1993 and 1997, which is precisely the time period in which poverty skyrocketed in this province. It is also interesting to note that although the enrollment rate in Fianarantsoa rose by 74 percent between 1993 and 1997, it actually fell by 8 percent between 1997 and 1999. During the earlier period, the depth of poverty also improved there (though the headcount ratio did fall slightly), while in the latter period large increases in poverty corresponded to the deterioration in enrollment rates.

There is also a close correspondence between changes in poverty and enrollment rates in Toliara. This province, which was the poorest in 1993, also had the lowest enrollment rate of 31.7. Further the 12 percent drop in the poverty headcount ratio (and the 21 percent drop in the depth of poverty) occurred concurrently with the impressive 83 percent increase in enrollment from 31.7 percent to 58 percent.

The lower panel of Table 16 lists the enrollment rates by per capita household consumption quintile. During each survey year, total enrollment increased monotonically from the poorest to the richest quintile. Further, enrollment rates increased for each quintile over the 7 year period, with school attendance among children in the two poorest quintiles growing the most (by 77 percent and 38 percent, respectively). The enrollment rate among children in the richest quintile also grew by an impressive 29 percent between 1993 and 1999 to 82 percent.

Because the quintiles in Table 16 are defined by relative (not absolute) consumption levels, enrollment rates by absolute poverty status are shown in Table 17 in an effort – short of estimating models of school enrollments – to more clearly control for changes in income in assessing access to schooling. Consistent with enrollment rates increasing with the consumption quintile, total enrollment was lower among the poor

[20] Primary and secondary enrollment rates are aggregated in this analysis for comparative purposes because the EPM 1997 data does not permit their disaggregation. For a much more comprehensive analysis of education in Madagascar during this period, see Glick and Razakamantsoa (forthcoming).

than among the non-poor in each survey year and in both urban and rural areas. We also continue to see enrollment among the poorer groups increasing at rates faster than the less/non poor groups. At the national level, enrollment leapt some 39 percent from 47 percent to 63 percent among the extreme poor between 1993 and 1999. The 35 percent increase among the poor (which as a reminder, includes the non-poor), brought the 1999 enrollment rate for this group up to the 1993 level of the non-poor.

Access to schooling in rural areas increased considerably between 1993 and 1999, where enrollment among the poor and extreme poor grew by over 42 percent. These gains are from an admittedly low base. Only some 43 percent of the poor children between the ages of 6 and 14 living in rural areas attended school in 1993. The 34 percent increase in enrollment among the rural non-poor to 71 percent in 1999, still left this relatively well-off group trailing even the extreme poor in urban areas in terms of enrollment in 1999. Nonetheless, despite the obvious inequalities in access to schooling, access to schooling did improve.

Access to Basic Services

Access to other basic services such as electricity, sanitation, water and housing also showed improvements during the interval between 1993 and 1999. As illustrated in Table 18a, the percentage of individuals living in households with electric connections rose by some 44 percent, though most people in Madagascar (87 percent) still lacked direct access by 1999. Most of those with electric connections were urban dwellers and were among the richest 20 percent of the national population. By 1999, almost half of all urban residents lived in dwellings with access to electricity. This 17 percent increase, up from 38 percent in 1993, is more impressive when we consider that the urban population also grew by over 44 percent during this period. In rural areas, 180 thousand more individuals had access to electricity in 1999 than did in 1993, though this pales in comparison to the 11 million who continued to live without it.

All but one province as a whole benefited from increased electricity connections (see Table 18b). Interestingly, in Antsiranana, one of the provinces to experience a large rise in poverty, new electricity connections were not sufficient to keep up with population growth and consequently the share of the population with access fell slightly to a total of 10 percent. Mahajanga, another province to experience an especially large rise in poverty between 1993 and 1999, also witnessed among the slowest increase in access to electricity (42 percent), leaving it with a just rate under 10 percent. Access in Antananarivo also grew by about 30 percent, though this left the province with a national high of just one quarter of it's population with electricity connections. Starting at less than 5 percent of their populations with access in 1993, Fianarantsoa, Taomasina and Toliara all experienced over 74 percent increases in connections.

In Table 18a we distinguish between three levels of direct household access to sanitation – (a) piped connection (i.e. flush toilets), (b) piped connection or pit latrines, and (c) piped connection, pit latrines, or portable toilets (*tinettes*). Access to flush toilets was very low throughout the 1993-1999 period with the national rate remaining

unchanged at just under 2 percent. Even among the richest 20 percent of the population, only than 6 percent lived in dwellings with a flush toilet. When we consider flush toilets, latrines and *tinettes*, we find that direct access to such forms of sanitation rose by 37 percent between 1993 and 1999. Nonetheless, as of 1999, half of the Madagascar population still had to leave their dwellings for sanitation services.

Despite the low levels, access to sanitation services (as defined by our more encompassing measure) increased across the board. The poorest population quintile benefited the most with the rate of access increasing by some 82 percent to 36 percent, while the smallest gains were made by the richest quintile as access rose by 26 percent to 67 percent. The situation in rural areas, characterized by an extremely low rate of access in 1993 at 30 percent, improved markedly as the percentage of the population with direct access to sanitation services rose by 43 percent to 44 percent. Access in each province (Table 18b) increased, with the largest improvements found in Fianarantsoa, Taomasina and Antsiranana. It is noteworthy that in Mahajanga – the least poor province in 1993 that became the second poorest in 1999 – the percentage of the population with access to sanitation services remained unchanged at 21 percent, leaving it second only to Toliara (17 percent) with the lowest level of access.

By 1999, less than one fifth (19.1 percent) of the national population had access to sources of clean drinking water – either piped into dwelling or from public taps. As Table 18a illustrates, this was a 12 percent improvement from 1993 when 17 had access to publicly supplied water. In addition, among those in the poorest quintile, even fewer people had access to clean water in 1999 than in 1993. The fall in the rate from 10.8 percent to 7.7 percent for this segment of the population represents a decline from 270,000 to 223,000 in the absolute number of individuals in this quintile with access to publicly supplied water.

Those with access to clean drinking water were by and large urban dwellers. While less than 10 percent of the rural population had water access, just under 60 percent of the urban population did. And although the percentage of urban dwellers with access fell from 64 to 59 percent, the absolute number of individuals actually rose by approximately 460,000 due to the one third increase in the urban population between 1993 and 1999. When we turn to the provinces, we once again see that conditions in Antsiranana and Mahajanga deteriorated in terms of percentages. More precisely, even though more individuals in both regions had access to clean drinking water in 1999 than in 1993, because increases in the provision of publicly supplied water did not keep up with the growth of the population, the rates of access fell by some 10 and 16 percent, respectively. In the meantime, the percentages of the populations with access to publicly supplied water in the remaining four provinces all rose, with the largest increase of 63 percent taking place in Taomasina.

Quality of housing, as measured by absence of crowding (square-meters of space available per person), improved over the span of years between 1993 and 1999 (see Table 18). While the national average personal space rose by 10 percent to 5 m^2 per person, the dwellings of the poorest quintile improved the most as the space rose 19

percent to 3.2 m^2 per person. Nonetheless, this group still had 59 percent less space than the richest 20 percent of the population. Presumably because of differences in population density, urban dwellings were only 30 percent larger than rural ones. And as was the case with poverty and access to other basic services, improvements in housing quality were experienced in all of the provinces except for Antsiranana and Mahajanga. In these latter two provinces, crowding increased by 10 percent.

Child Malnutrition

Finally, we turn to nutritional outcomes of children under the age of five. We note here that indicators of nutrition or malnutrition are inherently different from all of the other measures of welfare discussed in the preceding analysis. On the one hand, because consumption, education and access to basic services are inputs into individual well-being, their impact on welfare is indirect. On the other hand, because nutritional indicators of height and weight for children are direct outcomes, they are *intrinsically important* in terms of the welfare of individuals (Sen 1987, 1999, Dreze and Sen, 1989). Having said this, and given that the mapping of the standardized height-for-age measure that we use here into measures of malnutrition is based on probability distributions (see the appendix for an explanation of the HAZ-score), we cannot make direct statements about individual well-being. Rather, our account of the levels and changes in malnutrition are limited to those for populations of children. In other words, we cannot infer that a particular child is better off than another because his/her z-score is larger. What we can do is to make inferences about groups of children, provided that the sample size is large enough. For this reason, and because of data limitations, we restrict the following analysis to the national, urban/rural, and regional levels.

Table 19 reports the results of applying FGT poverty measures to height-for-age z-scores (HAZ) for children under the age of five for the three EPM surveys, using –2 as the cut-off between the malnourished and the well-nourished. The incidence of malnutrition measured here is equivalent to what is commonly referred to as stunting, while the depth of malnutrition is more sensitive to the degree of malnutrition.[21] At the national level, the pattern of change in stunting was similar to that of poverty. The already very high level of 49.6 percent of the population of children stunted in 1993 rose slightly to 50.1 in 1997 before dropping to 48.7 in 1999. The depth of malnutrition followed the same pattern, though the larger magnitudes suggest that the bulk of the changes in malnutrition occurred among the children who were more malnourished. The patterns of change that were observed in urban and rural areas are generally consistent with changes in poverty in these areas as well. The exception being that in rural areas malnutrition declined between 1997 and 1999.

At the regional level, we also see changes in malnutrition that are generally consistent with the analyses based on poverty and access to basic services. For instance, between 1993 and 1999, stunting in Fianarantsoa increased from 51.5 percent to 55.3 percent leaving it with the highest level among all of the provinces. The depth of

[21] Sahn and Stifel (2000b) find that changes in the incidence of stunting are generally good indicators of changes in the higher order measures of malnutrition.

malnutrition in Fianarantsoa in 1999 was also the highest at 69.1. Further, stunting in Antsiranana and Mahajanga rose substantially and significantly. In Antsiranana, the percentage of children who were stunted rose from 33.6 percent in 1993 to 44.9 percent in 1999, while in Mahajanga the rate rose from 34.2 percent to 41.5 percent. Nonetheless, given the initially low (in relative terms) levels in these two provinces in 1993, stunting there remained among the lowest in the country in 1999. In Toliara, rises in malnutrition ran counter to the poverty trends, while declines in stunting in Antananarivo and Taomasina were consistent with changes in other indicators of well-being including poverty and access to basic services.[22]

VII. Econometric Examination of Determinants of Consumption and Changes in Poverty:

We now turn to the use of econometric methods to gain a better understanding of the determinants of consumption and, by extension, poverty. The advantage of this approach is that by simultaneously controlling for the effects of other possible determinants, we more accurately estimate the impact of various individual, household and regional characteristics on household consumption. We then (Section VIII) make the link between the models of consumption and poverty, and more importantly changes in poverty, through a decomposition method that permits us to isolate the effects of changes in the returns and endowments of certain household characteristics on changes in poverty (see Appendix 5 for a detailed discussion of this decomposition methodology).

Separate rural and urban models were estimated to explain levels of (log) per capita household consumption for 1993 and 1999.[23] Descriptive statistics of the explanatory variables in these models appear in Tables 20 and 21, respectively. Explanatory variables common to both models include household demographics, numbers of educated adults, characteristics of the household head, information on sources of income, size of land holdings and provincial dummies. In addition, the rural models include a proxy for remoteness – the distance to the nearest health center collected from the community data – as well as information on droughts and cyclones.[24] For both models, the left out-category is an individual from a landless agricultural household in Antananarivo province with a married male head of household. This household does not have any members involved in a non-agricultural enterprise, it does not own livestock,

[22] We warn the reader to interpret these results with caution given concerns over the quality of the age data. Nonetheless, the overall consistency of the trends in malnutrition and the other welfare indicators in this analysis is encouraging *vis-à-vis* the usefulness of the nutrition data.

[23] The exercise was limited to the 1993 and 1999 samples in an effort to maximize the number of common explanatory variables. The land data was particularly important in the decision to exclude the 1997 data. To justify the use of separate urban and rural models, differences in the estimated parameters common to both models were tested. The hypothesis that the urban and rural models are the same was firmly rejected for both years.

[24] The environment data was graciously provided by CNS (CARE SIRCat Project). The cyclone data provides the number of times the eye of a cyclone passed through the fivondronana by season (November-October). We caution that there is no information on the severity of the cyclone. The drought proxy is the number of dekads (10-day periods) in the previous year in which precipitation was less than 75 percent of the norm for that particular dekad.

and none of its members reported being sick in the two weeks prior to the interview. In the rural model, the left-out category is modified slightly in that it includes all types of agricultural households except those that rely on staple crops for their sole source of income. Because the dependent variable is the log of per capita household consumption, the parameter estimates represent the percentage change in consumption for a one-unit change in the explanatory variable.

To control for unobserved heterogeneity among communities, we estimate fixed effects models at the fivondronana level. Ideally, this would have been done at the community level, but because the models include community-level variables (e.g. remoteness proxies), dummies are included for all but one of the fivondronana to allow for identification of these community effects. Finally, we use sampling weights in the estimation and correct for the complex two-stage sampling design when estimating standard errors and test statistics.

Rural models

Table 22 presents the results of the rural models of log per capita household consumption for 1993 and 1999.[25] The models for both years, with over 2,600 observations each, have high explanatory power as the R^2s are 0.49 and 0.47, respectively. The signs of the estimated effects are mostly as expected, many parameter estimates are significantly different from zero, and tests of joint insignificance of the fivondronana fixed effects are firmly rejected (i.e. the fixed effects models cannot be rejected). The results of the models are as follows.

Beginning with household demographics, we are not surprised to find that, given the relationship between household size and poverty, more individuals (of any age/gender category) in the household significantly reduce consumption levels. Because the sign on the squared number of members is positive and significant, this effect declines with each additional member. The largest drain on household resources comes from infants under one year of age, with consumption falling by over 20 percent with the birth of a baby into the household. The negative effects generally decline with the age of the member, though there is a surprisingly small effect for children between the ages of one and five in 1999. Consistent with the results presented in Table 9, these models also show that households with more adult women have lower consumption levels than those with more adult males. A plausible hypothesis for this finding is that returns to male labor at low levels of consumption (the mean consumption levels for both years, FMG 212,777 and FMG 195,243, respectively, are well below the poverty line of FMG 313,945) is higher than for female labor, and/or that employment opportunities are more limited for adult women than for adult men.

The stock of education in the household is captured by variables that record the number of adult members with at most primary, secondary and tertiary levels of schooling. We find that returns to primary education are especially small. In fact, in

[25] For ease of exposition, the parameter estimates for the fivondronana fixed effects dummies are excluded from the table.

1993, these returns were not statistically significant. In 1999, while statistically significant, the returns of 4 percent remained considerably less that those for secondary levels of education (approximately 8 percent), which in turn were substantially less than those for higher levels of education. The general story that comes out of these results is that given the present quality of education, the level of attainment affects consumption positively, but not in a substantive manner until post-secondary levels. Further, while the returns do increase between 1993 and 1999, the changes are small.

Turning to characteristics of the household head, we find a positive and significant relationship between the age of the head and levels of consumption in 1993 (there is no statistical effect in 1999). Because of the negative sign on the quadratic, consumption levels increase with the head's age until he or she is 43.1, after which levels decline. Note that since the average age of the household head in 1993 is 43.6 (Table 20), consumption actually decreases with the age of the head for the 57 percent of the population living in households with a head older than the average. We note that once we control for education and other household characteristic, the relationship between consumption and the age of the household head estimated in this model is the opposite of that found in Table 10a. The difference stems largely from the likelihood that the effect captured in the models reflects work experience (increasing with age) and capability (decreasing with age for manual labor), whereas the probabilities in the Table 10a also encompass the correlation between other household characteristics (including education) and poverty.

Controlling for other household characteristics, the marital status of the head is not correlated with household consumption in 1999. In the 1993 model, however, for individuals in households in which the head is either separated or divorced, consumption is 12 percent less than for those in households in which the head is married. Finally, for both years, female-headed households are 11 percent poorer than male headed households in terms of consumption levels. Recall that we have controlled for education and for marital status, thus the hypothesis raised in section IV – that disruption of the household can plausibly explain the observed difference in poverty rates among male- and female-headed households – is not supported. Nonetheless, the strong and remarkably similar effects estimated for both years suggest that female-headed households are at a disadvantage in rural areas.

Now turning to indicators of household livelihood, we note that the models were estimated with and without these potentially endogenous variables. Tests of equivalence of the remaining common parameters could not be rejected, and thus while we leave it to the reader to determine the degree to which he or she has confidence in the livelihood effects, we are confident that the remaining parameter estimates are robust to their inclusion.

In 1993, rural households involved in non-agricultural enterprises were not statistically better off than other households. By 1999, however, these returns increased to the extent that those involved in non-agricultural enterprises consumed 10 percent more than agricultural households without such activities. Note that by controlling for

remoteness in these models, we capture a sense of exclusion from markets and insensitivity to macroeconomic shock. As such, given equal degrees of remoteness, the increased returns to non-agricultural enterprises in rural areas could be a result of the improved macroeconomic environment that persisted in 1999. The opposite was the case for returns to owning livestock. A highly significant positive return to owning livestock in 1993 was followed by returns that were statistically no different from zero in 1999. And while this change in returns is statistically significant, large emphasis should not be placed on this result because the quantity and quality of the livestock are not captured in the dummy variable included in the model. Lack of comparability in the 1993 and 1999 questionnaires with respect to accounting for the value of the livestock owned, restricted our choice of explanatory variables to a dummy indicating simple ownership of any form of livestock (including both cattle and poultry).

Interestingly, the vulnerability of agricultural households in which the sole source of income derives from the production of staple crops decreased between 1993 and 1999. In the 1993 model, such households consumed on average 8 percent less than all other agricultural households. By 1999, this difference was not statistically significant. This is a puzzling result since it cannot be entirely explained by households diversifying their income sources – the percentage of rural individuals in this category fell by only 2 percentage points from 26 percent in 1993, to 24 percent in 1999 (Table 20).

While the returns for households in the service sector were consistently and significantly 17 percent greater than for those in agriculture in both years, the returns to working in the industrial sector were not significant until 1999 when they rose to 16 percent. This latter result is not too surprising given the change in the macroeconomic environment between 1993 and 1999. Households in which the head was not working were not statistically different from those in agriculture. This results could be a statistical or measurement issue since less that 1 percent of households have formally unemployed heads, and under-employment is not captured by this indicator. Finally, a finding that we cannot explain is that the number of income sources does not affect the level of consumption. This could be the result of a non-linear relationship between consumption (income) and the number of income sources in that the poorest households may not have the resources to diversify their risk, while middle income households can, and while richer households do not need to spread their risk in such a manner (Collier and Gunning, 1999).

The estimated returns to agricultural land holdings (entered as a categorical variable to allow for non-linearities) first show that, except for those with extremely small holdings of less than 0.1 hectares per capita, household consumption increases for those who own land. *Ceteris paribus*, the landless – the left-out group – no longer have consumption levels that are statistically greater than small holders (except for the extremely small holders in 1999). As such, once we control for other determinants of consumption, the pattern of poverty among land holders observed in Table 13 in which landless have lower rates of poverty than other small-holders, breaks down. Second, returns to landholdings increase with the size of the plots owned, though the positive effects on consumption are only significantly different from zero for those households

with 0.2 or more hectares of land per capita (48 percent and 63 percent of all rural households in 1993 and 1999, respectively). Finally, the returns to land holdings decreased from 1993 to 1999 for those households with less than 0.4 hectares per capita, and increase for those with more land. As mentioned previously, because the measures of land in the EPM that are comparable between 1993 and 1999 do not permit disaggregation by land quality, we can only make inferences from these results. Nonetheless, the decreasing returns for those with less than 0.4 hectares of land per capita along with the increase in landholding among these households (see Figure 7) are *consistent* with the hypothesis that extensification of land use by these small holders in the presence of demographic pressures is leading to use of less productive and more fragile land, leading to a vicious cycle of poverty. This argument will be pursued more in the discussion of the decomposition results.

The proxy for remoteness included in the model – distance in kilometers to the nearest health clinic[26] – has a negative and significant effect on levels of consumption in rural areas in both years. Though the negative impact of remoteness increases three-fold between 1993 and 1999, with the difference being statistically significant, we warn that differences in the manner in which the questions in the community questionnaire are asked for the two years make us wary of direct comparisons.[27] As such, we emphasize the usefulness of this variable in (a) showing a negative relationship between remoteness and consumption (and its positive relation to poverty), and (b) controlling for remoteness to estimate the effects of other explanatory variables more precisely.

We now turn to estimates of the regional effects keeping in mind that these results pick up residual "unexplained" differences in consumption between the particular rural area and rural Antananarivo province. Ideally, once we control for *fivondronana* fixed effects as well as other explanatory variables, models that explain most of the variation in consumption would have insignificant parameter estimates for the region dummies. This is not the case here. We find that in a manner consistent with the rural poverty rates in 1993, consumption levels in rural Fianarantsoa province are higher than rural Antananarivo, though the magnitude (120%) is extremely high. This effect changed substantially and statistically by 1999, when we find consumption levels 30 percent lower in Fianarantsoa *ceteris paribus*. In the 1993 model, there was no statistical difference between similar rural households in Taomasina and Toliara, though by 1999 those in Taomasina were worse off, also in a manner consistent with differences in poverty rates, while those in Toliara were better off (contrary to the poverty rates; see Table 4). The effects of the two provinces with the least rural poverty in 1993, Antsiranana and Mahajanga also had large positive and significant effects in the 1993 model. With everything else held constant, the average rural consumption level in these two province was over 80 percent higher than in rural Antananarivo. The large and very significant changes in the parameters by 1999 to negative impacts are also in step with the substantial increases in poverty there as well.

[26] The "remoteness index" that appears in Table 11 is not entered as an explanatory variable for purposes of comparability. Few of the inputs into the index are available in the 1993 dataset.
[27] Further, the fact that the average reported distance in 1999 is half that of 1993 (see Table 20) is implausible given the authors' knowledge of developments in the health sector.

Finally, we turn to the effects of environmental proxies on rural consumption levels. Both the cyclone and drought variables represent the degrees of incidence of these phenomena over the two years prior to the survey. The indicators were aggregated in this manner to account not only for their immediate effect on agricultural production, but also for the lagged effect from the prior year. As expected, in the 1993 model, cyclones and droughts have negative and significant effects on consumption. And while the effect of droughts in 1999 is also negative and significant, we find a positive and significant relationship between cyclones and consumption levels. This surprising result could follow from the fact that there were no reported cyclones in the 1997-1998 season (see Table 20). The absence of heavy rains in the previous hear, coupled with more severe droughts than in other years (i.e. an average of 0.64 dekads with less than normal precipitation compared to less than 0.36 in the other years in the models), could mean that the cyclones that arrived in the 1998-1999 season brought much needed rain. Because the cyclone proxy available to us did not include an indicator of intensity (i.e. destructive power), we cannot confirm or refute this hypothesis.[28]

Urban models

Table 23 presents the results of the urban models of log per capita household consumption.[29] The models for both years, with 1,852 observations in 1993 and 2,240 observations in 1999, also have high explanatory power (R^2s of 0.49 and 0.56, respectively). Similar to the rural models, the estimated effects generally have the expected sign and are significantly different from zero. Tests of joint insignificance of the fivondronana fixed effects were also firmly rejected (i.e. the fixed effects models could not be rejected). The following provides a summary of the key results that differ from those of the rural models.

As in the rural models, returns to education increase with the level of schooling, with returns to primary education not being very large. The difference between the urban and rural models is that despite a reasonably large increase in returns to primary education in the urban models between 1993 to 1999 (from zero to 3.6 percent), increases in the returns to secondary and tertiary levels of education were small[30]. Nonetheless, returns to secondary education in urban areas were nearly double those in rural areas in 1999. In both urban and rural areas, the returns to a tertiary level of education (relative to no education) were over 38 percent in 1999.

Controlling for marital status and education levels of household members, we find that female-headed households in 1993 were no worse off than male headed households. At the same time, households headed by individuals who were divorced or widowed had

[28] The CARE SIRCat Project is vigorously pursuing the collection of richer data that includes intensities. This will be invaluable to future studies into the effects of environmental shocks on poverty.
[29] As with the rural models, the parameter estimates for the fivondronana fixed effects dummies are excluded from the table for ease of exposition.
[30] This is consistent with the findings of Glick (1999).

lower levels of consumption, and hence higher levels of poverty. This finding is consistent with the hypothesis that female-headed households in 1993 were poorer because of the marital status of the head (i.e. the women became heads because of a disruption to the family) and not because of her gender. By 1999, however, this story breaks down, as we find a statistically significant negative effect for female-headed households.

Distinctly different from the rural models, returns to non-agricultural enterprises in urban areas were positive and significant for both years, though they fell by three percentage points between 1993 and 1999. The latter result could be a result of the 26 percent increase in the share of the population involved in such income-earning activities. This is examined further in the decomposition in the next section. For both periods, households in the industrial and service sectors were at no advantage vis-à-vis agricultural households, with estimated parameter values statistically no different from zero. A first glance, the large and highly significant positive value in 1993 for those not working seems surprising. But given that this group accounts for less than 2 percent of the urban population (Table 21), and that the real issue in urban areas is underemployment – not unemployment – this finding makes sense. By 1999, however, this group of households was statistically no different from agricultural households. A particularly noteworthy result in these urban models is the disappearing gains accruing to civil servants between 1993 and 1999. The 13 percent consumption premium for civil servants relative to agricultural households in 1993 fell substantively and significantly to zero in 1999. As discussed previously, this finding occurs simultaneously with rises in the real minimum wage of public servants (Table 9) as well as a 60 percent increase in the share of the population living in households headed by a civil servant (Table 21). This suggests that between 1993 and 1999, the many entrants into government positions received wages at the lower end of the pay-scale, which, although rising, were insufficient to lift their households out of poverty.

In a manner similar for rural areas, returns to land holdings rise systematically with the size of the plot owned, and landless agricultural households are no better off than owners of very small plots. In addition, in 1993, the consumption levels of the landless are not statistically different from households that own up to 0.4 hectares per capita. We note that this result is non inconsistent with the previously hypothesized relationship between returns and extensification into fragile lands given that this process is primarily a rural phenomenon.

Finally, the unexplained regional effects relative to Antananarivo in the urban models are for the most part in concert with the changes in poverty that appear in Table 4. For example, the large negative effect for Fianarantsoa in 1993 is consistent with the poverty rate there that was more than 20 percentage points higher poverty than in Antananarivo. Similarly, the decrease in this effect is not surprising given the nearly 10 percentage point fall in poverty in urban Fianarantsoa. Further, in Mahajanga where urban poverty rose from a national low of 37 percent in 1993 to the second highest rate of 65 percent in 1999, the estimated region effect was positive and highly significant in 1993 and negative and highly significant in 1999. In Toliara, although the effects are not

very strong, the lack of change in the estimated parameters is also consistent with the relatively constant urban poverty rate of 70 percent in both of these years. For Taomasina, the negative signs for the region effects are consistent with the higher rates of urban poverty there. And while the unexplained drop in consumption levels compared to Antananarivo appear puzzling when examining the fall in the urban headcount ratio for this province, it is less so when we note that the depth of poverty rose there by 14 percent between 1993 and 1999. Finally, in Antsiranana where the urban poverty rate fell from 50 percent to 31 percent, we find that holding all other determinants equal, the unexplained regional effect of living in urban areas in this province was negative in 1993 and positive (though insignificant) in 1999.

VIII. Simulations:

We now turn to a decomposition method[31] that helps us to establish a link between the models of per capita household consumption and our subject of interest – changes in poverty. Although the models presented in the previous section are informative, because they describe variation around the average level of consumption, their interpretation is not directly enlightening to issues of poverty alleviation. The decomposition approach that we employ in this section allows us to simulate how a change in only, say, the returns to primary education between 1993 and 1999 contribute to the change in poverty. For our example, this is done by simulating the consumption levels of each household in the sample allowing only the returns to primary education (i.e. the parameter estimates) to change, while leaving all the other returns and all of the characteristics unchanged. Then, with the new simulated distribution in hand, we recalculate the poverty measures and compare these with the original poverty estimates. For our example, the difference between the simulated poverty measures and those calculated from the original consumption levels can then be attributed to the returns to primary education. We simulate changes in poverty that arise from temporal differences in each and every return (parameter) in our models. This set of changes is referred to as "returns effects" in Tables 24 and 25. We similarly simulate how changes in, say, the stock of primary education (i.e. changes in the numbers of adults with primary education) from 1993 to 1999 affect changes in poverty, *leaving the returns unchanged*. As with the returns effect, we simulate changes in the stock or endowment for each and every explanatory variable in the models.[32] This set of changes is referred to as "endowment effects" in Table 24 and 25.

Table 24 presents select returns and endowment effects from the models of consumption for rural areas in 1993 and 1999. Here we see that despite the low levels of

[31] This methodology was first proposed by Almeida do Reis and Paes de Barros (1991) and Juhn, Murphy and Pierce (1993) in the context of earnings equations, and was generalized by Bourguignon, Fournier and Gurgand (1998). See also Bouillon, Legovini and Lustig (1998), Ferreira and Paes De Barros (1999), and Bourguignon, Ferreira and Lustig (1999).

[32] Simulating changes in the "endowments" is not as straight forward as simulating changes in the "returns" when cross-sectional data is used as it is here. See Appendix 5 for a discussion of this procedure and for a more detailed discussion of the decomposition methodology in general.

returns to primary education[33], the small changes in these returns alone contributed to a 1.5 percentage point fall in the headcount ratio. In other words, had all of the endowments (explanatory variables) remained unchanged, and had *only* the returns to primary education changed, poverty in rural areas would have fallen by 1.5 percentage points between 1993 and 1999. In addition, the depth and severity of poverty would also have fallen by more than a percentage point. These changes in the returns to primary education lead to declines in poverty on a scale much greater than for secondary and tertiary levels of education, which follows from the fact that it is primarily poor households that have adult members who acquire at most primary levels of education. This simulation obviously only captures partial effects and cannot account for the impact of increasing returns to primary education on returns to secondary and tertiary levels of education.

In urban areas (Table 25), we find the same pattern, though the magnitude of the change in the returns to primary education is much larger (i.e. a 3.6 percentage point fall in the urban poverty rate due to changes in returns to primary education). Further, the impact of the change in the returns to secondary levels of education is quite large, though we note that this primarily affects those with consumption levels close to the poverty line given that the changes in the depth and severity of poverty are considerably smaller.

The endowment effects illustrate that increases in educational attainment between 1993 and 1999 have contributed to just under a 0.5 percentage point decrease in the national poverty rate, suggesting that some gains have been made. Clearly, more gains need to be made, but what this analysis suggests is that to get more "bang for your buck" in terms of poverty reduction, investments need to be made in primary schools despite – and because – of their low levels of return.

Turning to household livelihood effects, changes in both the returns and endowments of households involved in non-agricultural enterprises contributed to a decline in rural poverty of approximately 0.8 percentage points. This, as discussed earlier, could be a result of the improved macroeconomic environment in rural areas. Recall that this result follows once we control for remoteness (i.e. exclusion from markets). As such, although rural areas in general are not highly sensitive to macroeconomic policy shocks, which we hypothesize to be a result of remoteness, responses do occur both in terms of the supply (more enterprises) and the returns when market signals get through. In urban areas, the increase in the number of non-agricultural enterprises had a positive effect on the reduction of urban poverty between 1993 and 1999, as seen by the 0.4 percentage point decrease in the poverty rate due to the endowment effect. Nonetheless, the effect of the fall in returns to such enterprises led to an even larger worsening of urban poverty through the returns effect.

In rural areas, neither changes in the sectoral returns nor in the endowments lead to substantive changes in poverty, except surprisingly for agricultural households whose sole source of income comes from the production of staple crops. The unexplained decrease in the vulnerability of these households resulted in a 0.75 percentage point

[33] As measured by the effect of the number of adults with primary levels of education in the household.

contribution to declines in rural poverty as measured by the returns effect. In urban areas, changes in returns to the industrial and service sectors contributed to declining poverty, while returns to working in the civil service contributed to increasing poverty. The effects of changes in the endowments were not robust to the choice of the reference period (see Appendix 5).

Despite the increases in the total acreage of land owned and cultivated, the endowment effect for land is not robust. The effects are positive or negative depending on which economic structure (parameters) we apply in the decomposition. This is a result of the vastly changing return structure in which we find that decreases in land productivity for small-scale farmers with less than 0.4 hectares per capita contributed to increases in rural poverty, while increases in the productivity of land for larger scale farmers contributed to decreases in poverty. Note that the switching of the signs of the rural returns effects at 0.4 hectares per capita coincides with the distributions of land holdings that appear in Figure 7. The increases in land ownership stem entirely from those with less than 0.4 hectares of land per capita. As such, the decreasing returns observed in Table 24 plausibly stem from the lower productivity of fragile lands being brought into production. So despite the increase in the ownership of land by small-scale holders, poverty among this group has risen because productivity declined at a rate greater than the increase in land size.

The difference in the land-poverty relationship estimated for urban and rural areas is that in the urban case, the returns to land holdings increase for all categories of households (as manifested in all of the returns effects contributing to decreasing poverty rates), instead of decreasing for small holders as seen in the rural models. This, of course, is not inconsistent with the proposed hypothesis of extensification into fragile lands by small holders. Since the vicious cycle of decreasing returns and extensification into fragile lands is largely a rural phenomenon, the results of the urban and rural models combined indicate that efforts at increasing productivity need to be directed at rural small-scale farmers.

Finally, the provincial returns effects are best interpreted as changes in poverty in each of the regions that cannot be attributed to changes in the returns and/or endowments of any of the other explanatory variables in the models. Table 24 illustrates that except for Toliara province where 89 percent of the 11 percentage point fall in the rural headcount ratio can be attributed to determinants in the models ((11-1.19)/11), most of the changes in rural poverty in the other provinces are left unexplained. In rural Fianarantsoa, for example, almost the entire 10.6 percentage point increase in the headcount ratio is unexplained by our models. The urban models (Table 25) do not do much better in explaining changes in regional poverty. In Fianarantsoa, 52 percent (4.7 percentage points) of the 9.1 percentage point fall in the urban headcount ratio is left unexplained. Further, in Taomasina, the positive returns effects for both the urban and rural models suggest that poverty should have risen. While this was indeed the case for the depth and severity of urban poverty, the urban headcount ratio and all measures of poverty in rural areas instead declined there. This does not imply that the modeling and decomposition exercises are useless. On the contrary, practical insights (e.g. the

relationship between education and land on the one hand, and poverty on the other) have been gained. With the data available, the models are simply unable to capture unobserved characteristics of the different regions.

IX. Concluding Remarks:

This study takes advantage of a rich set of three nationally representative household surveys conducted by the Malagasy national statistical office (INSTAT), to examine changes in poverty in Madagascar from 1993 to 1999. The timing of this work is opportune in light of the Madagascar government's participation in the HIPC debt-relief initiative and it's efforts to develop a poverty reduction strategy. It should also contribute to a better understanding of the nature and evolution of poverty in this Indian Ocean country, and to provide insight into poverty alleviation efforts. Although many aspects of the correlates and determinants of the levels and changes in poverty are examined in depth, we wrap up with a brief highlight of some of the key findings.

The incidence of poverty in Madagascar rose from 70 percent in 1993, to 73.3 percent in 1997, before falling modestly to 71.3 percent in 1999. The pattern of change is consistent with macroeconomic indicators that saw real per capita GDP increase between 1993 and 1997, and fall thereafter following the tightening of both fiscal and monetary policies. These changes, however, were not equally felt around the country, as Antananarivo, Taomasina and Toliara provinces fared well given declines in poverty, and as Antsiranana, Fianarantsoa and Mahajanga experienced swelling among the ranks of their poor. Even after controlling for determinants of poverty such as household demographics, education levels, sectors of employment, size of land holdings, and environmental shocks, we remain unable to explain much of the observed regional variation in poverty with the data at hand.

A clear finding that emerges of this study is that poverty in Madagascar is primarily a rural and agricultural phenomenon. While urban poverty rates are admittedly high, they responded to macroeconomic shocks – increasing from 50 percent to 63 percent between 1993 and 1997, before falling back to 52 percent in 1999 – and pale in comparison to the high rates observed in rural areas. What is worse, rural poverty rose persistently throughout the entire period between 1993 and 1999. With extremely high headcount ratios of over 75 percent, and with more than 8 out of every 10 poor persons living in rural areas and/or involved in agricultural activities, addressing poverty in these areas is crucial to improving the well-being of the majority of the people in Madagascar. Given the lack of response in rural areas to the fiscal reforms that have established a more open and competitive market since 1996, it is evident that liberalizing the market, while necessary, is not sufficient to address the issue rural poverty. There exist severe structural constraints that hinder the abilities of the rural poor to escape poverty. This is captured in part by the strong correlation found in this study between "remoteness" (as measured by various proxies) and high levels of poverty. Development of rural infrastructure is one step that needs to be taken toward removing these constraints and toward alleviating the degree to which many households are "remote."

Alternative sources of income for farming households, such as non-agricultural enterprises, were found to contribute to the alleviation of poverty among rural households between 1993 and 1999. But the degree to which the market can absorb such activities is uncertain, as shown by decreasing returns to such activities in urban areas. As such, efforts need to be placed on improving the income earning capabilities of the more than 75 percent of the population involved in agricultural production. This is especially true given that the findings in this study suggest that the productivity of land owned by small holders fell. As demographic pressures lead to shorter fallow periods and decreasing productivity of existing lands, small-scale agricultural land owners have increased their holdings. Qualitative analyses suggests that the observed agricultural extensification is leading to the use of less fertile and more environmentally fragile land. While the available data does not permit the statistical testing of this hypothesis, the evidence presented in the report is consistent with the notion that an emphasis needs to be placed on increasing the productivity of small-scale farmers to help them escape the vicious cycle of decreasing productivity leading to exploitation of fragile lands, which leads to declining productivity, and so on. In addition, the introduction and/or strengthening of family planning services can help to alleviate the demographic pressures that contribute to this extensification and its consequences.

Finally, this study finds that improving the quantity and quality of educational services, especially at the primary level, will go a long way toward alleviating the burden of poverty in both urban and rural areas. Despite the low rates of return to primary and secondary levels of education with the present quality of schools, the extremely modest improvements found in these returns between 1993 and 1999 were also shown to have a significant impact on alleviating poverty. Efforts in this direction have already been made as evidenced by increasing enrollment rates of children age 6 to 14, and with a central position for education in the country's poverty reduction strategy. Nonetheless, many gains remain to be realized in terms of both access to schooling and quality of teaching.

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Appendix 1: EPM Data

The household-level data used for the analysis were collected by the Direction des Statistiques des Ménages (DSM) of the Institut National de la Statistique (INSTAT) in Madagascar. All three EPM surveys are nationally representative, and are also representative at the regional level (*faritany*) as well as the urban/rural level within each region. They all used two questionnaires: a household questionnaire, and a community questionnaire (relevant for rural areas only).

EPM 1993/4:

The *Enquete Permanente Aupres des Menages* (EPM) was a large-scale multi-purpose survey of 4,508 households. The data were collected in the twelve-month period between May 1993 and April 1994. To avoid biases across regions due to seasonality, the survey teams worked in cycles so that each stratum was sampled in each month. The sample was selected through a multi-stage sampling technique in which the strata were defined by the *faritany* and *millieu*, and the primary sampling units (PSU) were zones or communes. Each of the PSUs was selected systematically with probability proportional to size (PPS), and sampling weights defined by the inverse probability of selection are necessary to obtain accurate population estimates.

The sections of the questionnaire are as follows

Section 0: Household Identification
Section 1: Household Information (roster)
Section 2: Education
Section 3: Health
Section 4: Employment
Section 5: Migration
Section 6: Housing
Section 7: Agriculture
Section 8: Household Expenditures
Section 9: Non-Agricultural Enterprises
Section 10: Sources of Income
Section 11: Credit, Assets and Saving
Section 12: Anthropometrics

EPM 1997:

The first *Enquete Prioritaire Aupres des Menages* (EPM) was a priority survey of 6,350 households. The data were collected during the last three months of 1997. As with the 1993 survey, this sample was selected through a multi-stage sampling technique in which the strata were defined by the *faritany* and *millieu*, and the primary sampling units (PSU) were zones or communes. Each of the PSUs was selected systematically with

probability proportional to size (PPS), and sampling weights defined by the inverse probability of selection are necessary to obtain accurate population estimates.

The sections of the questionnaire are as follows

Section 0: Household Identification
Section 1: Household Information (roster)
Section 2: Migration
Section 3: Health
Section 4: Education
Section 5: Employment
Section 6: Housing
Section 7: Agriculture
Section 8: Non-Agricultural Enterprises
Section 9: Household Expenditures
Section 10: Household Assets
Section 11: Household Income
Section 12: Anthropometrics

EPM 1999:

The second *Enquete Prioritaire Aupres des Menages* (EPM) was a priority survey of 5,120 households. The data were collected during the the months of September, October and November 1999. Some 60 percent of the households in the sample were also interviewed in the 1997 EPM. Thus there is a partial panel of households representative for each stratification. The remaining 2,087 households were selected through a multi-stage sampling technique in which the strata were defined by the *faritany* and *millieu*, and the primary sampling units (PSU) were zones or communes. Each of the PSUs was selected systematically with probability proportional to size (PPS), and sampling weights defined by the inverse probability of selection are necessary to obtain accurate population estimates.

The sections of the questionnaire are as follows

Section 0: Household Identification
Section 1: Household Information (roster)
Section 2: Health and Anthropometrics
Section 3: Education
Section 4: Employment
Section 5: Housing
Section 6: Agriculture
Section 7: Household Expenditures
Section 8: Household Income

Appendix 2: Constructing a Consistent Consumption Aggregate as an Indicator of Welfare from 1993 to 1999 using the EPM

This appendix presents the methodology used in the collaborative effort between INSTAT, Cornell University, and World Bank staff to construct the prefered welfare indicator used in the analysis in the main body of this paper. The intention of the collaborative effort was to obtain baseline poverty and welfare data which are generally accepted. This note spells out the crucial choices made when working with the three household surveys

To understand the reliability of the poverty estimates in the analysis it is necessary to comprehend the technical issues that have been addressed at each stage of the estimation process. As explained in more detail below, we have opted to structure our welfare indicator (consumption per capita) in a way that will allow for welfare comparisons over time. Since the surveys changed significantly over the years, this implies that we place more trust in the relative comparison over time than in the absolute estimates. This understanding should facilitate the comparison of the figures reported in this study with the many estimates that from time to time have been reported in other studies on poverty in Madagascar.

Comparisons of household consumption aggregates for the 1993, 1997 and 1999 *Enquete Permanente/Prioritaire aupres des Menages* (EPM) household surveys are complicated by several methodological problems due to differing methods and designs. This follows in part because the 1993 survey was a year-long large-scale undertaking (P stands for *Permanente*), while the 1997 and 1999 surveys were three-month priority surveys (P stands for *Prioritaire*). In what follows, we highlight the specific issues encountered during the process of constructing the consumption aggregates and what measures, if any, were taken to address them.

Components Omitted from the Consumption Aggregate

Not all of the components that typically make up a household consumption aggregate (Deaton and Ziadi, 1999) were recorded in each survey. In an effort to ensure comparability over time, we consequently only included elements common to all three surveys in our welfare indicator. Appendix Table 2.1 presents the major consumption categories available in each survey, with those sections dropped because of lack of commonality crossed out.

Appendix Table 2.1: EPM files for consumption aggregates

Description	EPM93	Code	EPM97	Code	EPM99	Code
A. Food Items						
1. Purchased in market place	s8a.dta	*201-338 361-393*	s9.dta	*20-64 71-77*	s7.dta	*19-64 71-77*
2. Auto-consumption						
a. ~~elevage~~	s7f.dta	*271-296*	NA		s6a.dta	*q3 de tete*
b. crops	s7f.dta	*201-259 301-384*	s7b.dta	*q25 en kg*	s6b.dta	*q6 en kg*
3. ~~Gifts or remittances~~			NA		NA	
4. ~~In-kind payments~~	s8b.dta		NA		NA	
5. Amount spent outside home on...						
a. restaurants	s8a.dta	*351*	s9.dta	*78*	s7.dta	*78*
b. prepared foods	s8a.dta	*341-350*	s9.dta	*65-70*	s7.dta	*65-70*
c. ~~meals at work~~	NA		NA		NA	
d. ~~meals at school~~	NA		NA		NA	
e. ~~meals on vacation~~	NA		NA		NA	
B. Non-Food Items						
1. Daily use items	s8a.dta	*21-33 61-77 91-93 112-127*	s9.dta	*1-16 82-110*	s7.dta	*1-15 79-111*
2. Clothing & housewares	s8a.dta	*1-12 35-55*	s9.dta	*1-16 82-110*	s7.dta	*1-15 79-111*
3. Education expenses	s2a.dta	*q6-q13*	s9.dta	*1-4*	s3b.dta	*q1-q8*
4. Health expenses	s8a.dta	*81-86*	s9.dta	*5-10*	s7.dta	*1-9*
5. ~~Transportation to work~~						
6. ~~Auto-consumption from NFEs~~	s9d.dta		s8.dta		NA	
C. ~~Consumer Durables~~	s11b.dta		NA		NA	
D. Housing - rent	s8a.dta	*21*	s9.dta	*93*	s7.dta	*91*

The household survey questionnaires changed significantly between 1993, 1997 and 1999. To allow for comparability across the years, we had to exclude certain expenditure sections which had originally been included in the 1993 consumption aggregate. However, these were quite small in absolute size as the following list shows (in comparison to the 1993 estimate as used e.g. by Dorosh 1998)

a. *livestock autoconsumption:* 0.8 percent
b. *gifts, remittances and in-kind payments:* 2.9 percent
c. *Autoconsumption from non-food enterprises:* 0.6 percent

Further, we also excluded the durable consumer goods expenditure from the preferred consumption estimates (which had not also not been included in the original 1993 consumption aggregate).

The design of the expenditure section of each of the surveys allowed for multiple recall periods for *all* the expenditure items (i.e. food and non-food). That is, interviewers prompted the respondents to choose the recall periods (day, week, month year) over which expenditures on each individual item were reported. In other words, one household could report purchases of rice over a one-week period and purchases of clothing over a one-month period, while another household could report purchases of rice over a one-month period and purchases of clothing over a one-week period. Appendix

Table 2.2 shows how the frequencies of such chosen recall periods for many food-purchase items differ across the three surveys. This complicates the comparability of the aggregated expenditures across the surveys (see Demery and Mehra, 1996, and Scott and Amenuvegbe, 1990), but the reported variations are within reasonable margins in our judgement.

Appendix Table 2.2: Comparison of Recall Periods for Major Food Expenditures Items in EPM 1993, 1997 and 1999

1993 Code	1997/9 Code	Name	Share of 1993 Food Cons.	Recall Period	*Percent of Responses* 1993	1997	1999	*Difference from 1993* 1997	1999
201	19,20	Riz (dec)	40.2	Jour	49.1	44.6	33.0	-4.5	-16.1
				Sem	23.7	14.4	22.1	-9.3	-1.6
				Mois	21.2	39.2	32.5	18.1	11.4
				An	6.1	1.8	12.4	-4.2	6.3
202	21	Riz (paddy)	1.2	Jour	0.5	3.6	2.5	3.1	2.0
				Sem	11.8	10.6	13.0	-1.2	1.2
				Mois	16.8	25.9	30.2	9.1	13.4
				An	70.8	59.9	54.3	-10.9	-16.6
204	22	Mais	4.4	Jour	12.0	10.3	10.2	-1.7	-1.9
				Sem	38.1	39.1	36.9	1.0	-1.2
				Mois	32.9	38.5	35.7	5.6	2.8
				An	16.9	12.0	17.2	-4.9	0.3
203	23	Farine de Riz	0.1	Jour	2.2	5.2	8.5	3.0	6.3
				Sem	17.4	18.5	26.8	1.1	9.4
				Mois	57.6	61.8	28.2	4.2	-29.4
				An	22.8	14.5	36.6	-8.4	13.8
207	24	Farine autre	0.0	Jour	1.6	2.6	5.4	0.9	3.8
				Sem	12.1	18.7	14.6	6.6	2.5
				Mois	60.4	54.8	52.9	-5.6	-7.6
				An	25.8	23.9	27.1	-2.0	1.3
205	25	Farine de mais	0.1	Jour	7.6	3.3	3.6	-4.2	-4.0
				Sem	22.7	38.3	42.9	15.6	20.2
				Mois	52.1	50.8	34.5	-1.3	-17.6
				An	17.6	7.5	19.0	-10.1	1.4
211	26	Manioc vert	5.8	Jour	10.9	5.6	9.2	-5.2	-1.6
				Sem	47.7	43.3	48.4	-4.4	0.7
				Mois	28.8	43.7	31.2	14.8	2.4
				An	12.5	7.4	11.1	-5.2	-1.4
212	27	Manioc seche	1.1	Jour	13.8	5.7	8.4	-8.0	-5.4
				Sem	43.1	39.3	40.6	-3.8	-2.5
				Mois	26.2	37.2	34.4	11.0	8.2
				An	16.9	17.8	16.6	0.9	-0.3
217	28	Patates douces	1.9	Jour	9.2	5.2	6.4	-4.0	-2.8
				Sem	43.5	39.1	46.8	-4.4	3.4
				Mois	33.4	46.9	36.8	13.5	3.4
				An	14.0	8.8	9.9	-5.1	-4.0
216	29	Pomme de terre	1.0	Jour	4.5	6.7	9.6	2.2	5.1
				Sem	56.4	61.3	52.7	4.9	-3.8
				Mois	31.2	27.9	25.7	-3.3	-5.5
				An	7.8	4.1	12.0	-3.7	4.1

Apart from whole sections we excluded in the comparison, there are also a number of variations *within* sections which we report on below. This pertains both to the list of items as well as the way questions were asked.

a. Purchased Food

The number of food items included in the 1993 expenditure module is considerably larger than in 1997 and 1999: 118 versus 61. (See Appendix Table 2.3.) Only the items common to all three surveys were retained for the construction of the total expenditure variable. For 1993, the items deleted correspond to 4.9 percent of total expenditure.

Appendix Table 2.3: Food Expenditure Items in the EPM Surveys

Item Codes from 1999	1997	1993	Description
Cereals			
19	20	201	Riz décortiqué local
20	20	201	Riz décortiqué importe
21	21	202	Paddy
22	22	204	Mais
Flour			
23	23	203	Riz
24	24	207	Ble (wheat)
25	25	205	Mais
Tubers			
26	26	211	manioc vert
27	27	212	manioc seche
28	28	217	patates douces
29	29	216	pomme de terre
30	30	218, 213 - 215	autre tubercules
Legumineuses Sechees			
31	31	221,222	Haricots secs / pois du cap
32	32	223,224	Voanjobory / lentille
33	33	225	Arachides seches
34	34	227	Autre legumines
Fruit			
35	35	237	Avocat
36	36	231	Banane
37	37	236	Mangue
38	~~38~~		~~Papaye~~
39	39	234	Agrumes
40	40	242	Fruit seches
41	38, 41	232, 233, 235, 238-241,226	Autres
Vegetables			
42	42	257	Piment (pepper)
43	43	258	Bredes
44	44	251, 252	Oignons et tomates
45	45	253-256, 259	Autres
Meat & Fish			
46	46	271	Viandes de boeuf
47	47	272	Viandes de mouton/chevres
48	48	273	Viandes de porc
49	49	277	Poulet
50	50	278	Autres volailles
51	51	279	Poisson frais, congeles
52	52	281, 282	Crustaces
53	53	274	Les produits d'abats
54	54	281	Poisson seches, fumes
55	~~55~~		~~Conserves de viande-poisson~~

Appendix Table 2.3 (continued)

Item Codes from 1999	1997	1993	Description
Breeding Products			
57	57	291	Oeuf
58	58	295	Miel
59	59	292	Lait
Oil / fats			
60	60	301-303, 305, 307	Huiles
61	61	304, 306	Beurre - Margarine
Sugar / sweets			
62	62	311	Industriel
63	63	312	Gasy
64	64	313, 314	Confiseries
Prepared foods			
65	65	321	Pains
66	66	322	Beignet (Mofo gasy, Menakely)
67	67	293, 294, 337	Produit laitier
68	68	315-317, 371	Café, Cacao, Thé
69	69	333-336	Produit gelés, Conserves et Confit
70	70	341-350	Autres produits finis
Other food products			
71	71	361	Sel
72	72	362	Epices et condiments composés
Drinks			
73	73	372-375	Boisson san alcool
74	74	381-385	Boisson alcoolisé
Tobacco			
75	75	391	Cigarettes
76	76	392	Paraky
77	77	351	Cantine, gargote
78	78	351	Restaurant/Service hébergement/Salon de thé et autres

b. Autoconsumption of Food Items

The analysis of poverty dynamics across the three years has proven to be extremely sensitive to decisions made with respect to the treatment of autoconsumption so we paid specific attention to this (often very important category).

Livestock. We excluded autoconsumption of livestock from our preferred consumption aggregate because it was not recorded at all in the 1997 data, and only the number of consumed heads (têtes) was recorded in the 1999 data. Elevage autoconsumption accounts for approximately 1.5 percent of food consumption in the 1993 data.

Other Food Items. To allow for welfare comparisons between consumers who purchase food on the market and those that consume home-grown items, a common price for both consumer types needs to be determined. Ideally, a kilo of rice should be treated in the same manner for an individual who purchases it as for an individual who consumes his/her own production of it. In the tricky business of comparing levels of utility across

individuals, a kilo of rice should provide the same level of utility for each person ceteris paribus. So a kilo of rice consumed through autoconsumption should be valued at the same price as a kilo of rice consumed through purchases in the market place. Thus we impute the value of autoconsumption at market prices rather than farmgate prices.

We evaluated autoconsumption at retail prices using common mark-ups for all three survey years. In the 1997 (datasource: s7b.dta) and 1999 (s6b.dta) surveys, households were asked how much they sold in the market and how much they brought back in profit (i.e. price less transactions costs). From this information, we were able to calculate unit farmgate prices. In 1997, households were also directly asked the farmgate price, which roughly corresponds to the unit farmgate price. Retail price data from the 1999 community questionnaire (s6_commu.dta) were then used to calculate markup rates to apply to the farmgate prices to estimate market prices. This was done at the urban-rural level for six major crops (riz, mais, manioc, patates douces, haricot and bananes), with the remainder of the prices marked up at the median provincial-urban-rural rates for all food crops. As is discussed below regarding regional price deflation, unit prices calculated from the expenditure sections (s8.dta and s7.dta, respectively for 1997 and 1999) are suspect in large part, we believe, because of the quantity measures. It is for this reason that we did not use these retail unit prices to value autoconsumption, and that we used a standard markup rate calculated from the 1999 community data instead. We applied the standard mark-up rate to the 1997 and 1999 farmgate prices to value autoconsumption in these years at market prices. The 1997 community questionnaire did not include a price section.

Although the 1993 questionnaire did ask for the 'market' value of autoconsumed items, we opted to apply the 1997/1999 mark-up rates also to this survey. In the 1993 questionnaire, households were asked at what price they could purchase a unit of the good autoconsumed ("A quel prix pourriez-vous achete une unite de …?" See s7f.dta). This suggests that autoconsumption should be valued using this "market" price. However, when these prices were compared to the unit prices calculated from the expenditure section (s8a.dta) for those households that reported both purchases and autoconsumption of the same food item, the unit prices were on average 94 percent higher than the prices from the autoconsumption section. This is approximately the average markup rate calculated using the 1999 data. In order that we treat autoconsumption consistently across the three surveys, we decided to apply the same markup rates to the prices reported in the autoconsumption section for 1993 (s7f.dta) as we did to the prices in the 1997 and 1999 data. [34]

Finally, we also noted differences in the recall periods for autoconsumed items between 1993 data on the one hand, and the 1997 and 1999 data on the other. While in

[34] We tried to estimate markup rates for 1993 directly from the survey using unit prices calculated from the expenditure section. But an implausibly different structure of markup rates across regions and major food crops, led us to abandon this approach in favor of a common structure across the three years. Nonetheless, the Spearman rank correlation between consumption aggregates constructed using both methods of valuing autoconsumption was 0.999.

1997 and 1999, autoconsumption was recorded on an annual basis, the 1993 questionnaire allows for multiple recall periods to be selected by the respondent. Appendix Table 2.4 reports the frequency of response for each option for a handful of the items included. Note that for the most important items (e.g. rice, manioc, mais, etc.), only a small fraction of respondents reported their consumption on an annual basis. As it is not clear how the differences in the recall periods would impact on the aggregate consumption estimate, we did not make an adjustment for these differences in recall periods.

Appendix Table 2.4: Recall Periods for Food Autoconsumption in EPM 1993

Code	Name	Recall Period	Percent of Responses
201	Riz decortique	Jour	93.0
		Semaine	0.9
		Mois	1.4
		An	**4.7**
203	Farine de riz	Jour	18.8
		Semaine	6.3
		Mois	12.5
		An	**62.5**
204	Mais	Jour	48.7
		Semaine	26.9
		Mois	4.2
		An	**20.2**
205	Farine de mais	Jour	22.2
		Semaine	44.4
		Mois	11.1
		An	**22.2**
206	Autres cereales	Jour	28.6
		Semaine	35.7
		Mois	7.1
		An	**28.6**
207	Farine d'autres cereales	Jour	20.0
		Semaine	40.0
		Mois	20.0
		An	**20.0**
211	Manioc vert	Jour	48.6
		Semaine	32.9
		Mois	3.1
		An	**15.3**
212	Manioc sech,	Jour	60.7
		Semaine	27.0
		Mois	4.4
		An	**7.8**
213	Farine de manioc	Jour	23.1
		Semaine	38.5
		Mois	7.7
		An	**30.8**
214	Igname (oviala)	Jour	18.5
		Semaine	47.0
		Mois	9.6
		An	**24.8**
215	Taro (Saonjo)	Jour	35.6
		Semaine	37.1
		Mois	6.6
		An	**20.7**
216	Pomme de terre (ovy)	Jour	64.1
		Semaine	21.4
		Mois	1.0
		An	**13.5**

Appendix Table 2.5 reports the codes of the food items included in the autoconsumption sub-aggregate.

Appendix Table 2.5: Crop codes for EPM autoconsumption as they appear in the data

1997 Culture code	**1999** Culture code	*72 items* Culture Name	***1999*** *Culture code*	**1993** Culture code	*67 items* Culture Name
1	1	Riz	*1*	201	Riz d,cortiqu,
2	2	Mais		203	Farine de riz
3	3	Ble	*2*	204	Ma‹s (,pi)
4	4	Millet		205	Farine de ma‹s
6	6	Manioc	*3,4*	206	Autres c,r,ales
7	7	Igname		207	Farine d'autres c,r,ales
8	8	Taro	*6*	211	Manioc vert
9	9	Pomme de terre	*6*	212	Manioc sech,
10	10	Patates douces		213	Farine de manioc
11	11	Autres racines, tubercules	*7*	214	Igname (oviala)
12	12	Haricots	*8*	215	Taro (Saonjo)
13	13	Pois du cap	*9*	216	Pomme de terre (ovy)
14	14	Voanjobory	*10*	217	Patates douces (vomanga)
15	15	Lentilles	*11*	218	Autres racines et tubercules
16	16	Soja	*12*	221	Haricots secs
17	17	Arachides	*13*	222	Pois du cap
18	18	Noix de coco	*14*	223	Voanjobory
19	19	Noix d'anarcade	*15*	224	Lentilles
22	22	Tsiasisa	*17*	225	Arachides
23	23	Voatsoroka	*18*	226	Noix de coco
24	24	Lojo	*16,19-26*	227	Autres
25	25	Autres legumineuses	*31*	231	Bananes
26	26	Autres noix, grains	*32*	232	Pommes, poires
31	31	Bananes	*33,34*	233	Pˆches, prunes, abricots
32	32	Pommes	*36,37,41*	234	Agrumes (orange, mandarine)
34	34	Peches	*42*	235	Letchis
36	36	Abricots	*44*	236	Mangues
37	37	Oranges	*45*	237	Avocats
41	41	Autres agrumes	*46*	238	Ananas
42	42	Letchis	*94*	239	Canne … sucre
44	44	Mangues	*48*	240	Baies et raisins
45	45	Avocats	*50*	241	Fruits et baies sauvages
46	46	Ananas		242	Fruits sech,s
48	48	Autres baies	*50*	243	Autres fruits et baies
50	50	Autres fruits et baies	*55*	251	Tomates
55	55	Tomates	*56,57*	252	Bulbes (oignons, ails...)
56	56	Oignons	*58 -*	253	L,gumes … racines
58	58	Ails	*-*	254	Haricot-vert et autres l,gumineus
59	59	Carottes	*- 76*	255	L,gumes … fruit (concombres, pc
60	60	Navets	*77, 78*	256	Choux, choux-fleurs
61	61	Radis	*79*	257	Piments
63	63	Gingembres	*80 -*	258	BrŠdes et autres l,gumes … feuill
64	64	Autres legumes a racines	*- 91*	259	Autres l,gumes
65	65	petits pois		271	~~Viande de Boeuf~~
66	66	Haricots verts		272	~~Viande de Mouton/ChŠvre~~
68	68	Pousse de soja		273	~~Viande de Porc~~
69	69	Autres legumineuses vertes		274	~~Produit d'abat~~
70	70	Aubergines		276	~~Gibier/Gibier … plumes~~
72	72	Concombres		277	~~Poulet~~
73	73	Courges, Citrouille, Potirons		278	~~Autre volaille domestique~~
74	74	Courgettes		279	~~Poissons frais~~
76	76	Autres legumes a fruits		280	~~Crustac,s frais~~
77	77	Choux		281	~~Poissons/crustac,s sech,s~~
78	78	Choux-fleurs		283	~~Autres produits~~
79	79	Piments		291	~~Oeufs~~

c. Non-Food Expenditures

Appendix Table 2.6 reports the list of items in each survey and identifies those used for the expenditure variable creation. As with food expenditures, items listed in the questionnaire differed across the surveys. Only those that correspond closely were included in the consumption aggregate.

Appendix Table 2.6: Common Non-Food Expenditure Items

In order of EPM 1999

Code for …				Code for …			
1999	**1997**	**1993**		**1999**	**1997**	**1993**	
s7.dta	**s9.dta**	**s8.dta**	Description	**s7.dta**	**s9.dta**	**s8.dta**	Description
Section 3B in 1999: Depenses scolaires				*G. Culture, Sports, Loisirs*			
q1	1	q6	Droits de scolarite	88	91	61	Spectacles, Cinema, Videw
q2	1	q6	Frais de scolarite	89	92	74, 75	Livres, disques, cassettes et autres
q3			~~Frais generaux y compris droit de scolarite~~	90			~~Jeux de hasard~~
q4	3	q9	Fournitures scolarite et livres				
q5	2	q8	Uniforme et linge de sport	*H. Logement et Combustible*			
q6		q10	~~Transport pour l'ecole~~	91	93	21	**Loyer**
q7		q11	~~Nourriture pension et internat~~	92	94	22, 51-53	Entretien et reparation courant du logement
q8	4	q12	Autres depense	93	95	24	Electricite
		q13	Depense globales non ventilees	94	96	31	Eau
			- only if there is no detailed account of expenses	95	97	25	Petrole
				96	98	26	Gaz
A. Depense de sante				97	99	27	Charbon
1	5	84	Medicaments traditionnnels	98	100	28	Bois de chauffe
2	5	81	Medicaments pharmaceutiques	99	101	29	Bougies
3	6	81	Appareils et materiels therapeutiques	100	102		~~Allumettes~~
4	7	82	Frais de consultation des practicien modernes	101	103	33	Autres
5			~~Frais d'analyse medicale~~				
6	8		Frais de consultation des guerisseurs	*I. Ameublement - Equipement menager*			
7		85	~~Frais de transport~~	102	104		~~Tissus~~
8	9	83	Frais d'hospitalisation	103	105		~~Produit d'entretien courant (savon,cire,insect)~~
9	10	86	Autres dep. De sante, y compris assurances	104	106		~~Autres~~
B. Habillement et effets personnels				*J. Autres biens de services*			
10	11	5	Tissues d'habillement	105	107	91	Coiffure, sauna, etc.
11	12	1,2	Vetements neuf, access. d'hab et frais de cout	106	108	92	Produit de toilette
12	13	1,2	Vetement & accessories - friperies	107	109	92	Produit de beaute
13	14	10, 11,12	Chaussures & reparation (h, f, & enfants)	108	110	93	Autres
14	15		Produits de fantasie				
15	16	121,122	Bijouterie & autres effet personnels	*K. Securite*			
				109			~~Alarme~~
C. Transferts et Impots				110			~~Salarie gardienage~~
-- not included in consumption aggregate --				111			~~Chien (y compris entretien)~~
D. Depense allimentaires							
-- see "Food Expenditures" worksheet							
E. Hotel, Restaurant, Café							
-- see "Food Expenditures" worksheet							
F. Transport / Communication							
79	82	106	Pieces detachees				
80	83	107	Essence				
81	84	107	Librifiant				
82	85		Gas-oil				
83	86	108	Reparation des moyen de transport				
84	87	112	Telecommunication (P.T.T)				
85	88	110	Frais de transport public en ville				
86	89	111	Frais de transport public (voyages)				
87	90	109	Autres a preciser				

d. Education Expenditures

Regarding education expenditures, we included only those education expenditure items that matched across the three survey in our preferred consumption aggregate. For the 1993 and 1999 surveys, such data on education expenditures are reported in the

education sections (s2.dta and s3b.dta, respectively), with line items for each individual in the household over the age of 4. The 1997 questionnaire, however, was designed in such a way that education expenditures appear in the expenditure section (s9.dta) so that such outlays are aggregated across all family members. We assume that such aggregation across household members does not alter estimates significantly since (i) it is the same informant giving the answer (father or mother), (ii) expenditures in education are generally very well known (books, fees, transport), and (iii) 'aggregation' is normally only for a few school-aged children.

One important differences between the survey relates to expenses on professional training. One of the questions in the 1997 questionnaire includes professional training along with schooling expenses ("Droit et frais de scolarité y compris formation professionnelle"), whereas there are no questions about expenses for professional training in the 1999 questionnaire. We opted for including the question since we would have had to otherwise exclude schooling expenses in all three years – a major expenditure item. In all likelihood professional training expenses are absolutely marginal, especially for poorer households.

Housing

Only a limited number of households reported rental payment in each of the surveys (776 in 1993; 943 in 1997; and 710 in 1999), and even fewer of those lived in rural areas (88, 121 and 98, respectively). Nonetheless, we believe that housing is a very important indicator of welfare in Madagascar, and we therefore imputed rental payments for all households in the survey to capture the stream of benefits derived from such housing.

We used a simple imputation procedure, using all households that actually reported rental payments as our reference group. Because we were more interested in the quality of the predicted values than the parameter values in the models, we estimated OLS step-wise regression models with the objective of maximizing the R^2 and Spearman rank correlations between the imputed rents and the reported rents. Explanatory variables included housing characteristics (type of dwelling, number of rooms / surface area, quality of construction material, etc.), wealth indicators, and region dummies (Hentschel and Lanjouw, 1996). While some right-hand side variables are clearly endogenous, the predicted values are still consistent. Since there are so few rural observations, a single model was estimated for each year and urban-rural differences were captured with dummies and interactions.

Prices and Deflation

The consumption aggregates are deflated in two ways so that they can be compared directly (and so that tests of stochastic dominance can be conducted). The first form of deflation is regional so that all prices are in terms of urban Antananarivo. The second form of deflation is temporal so that all prices are in terms of those that prevailed

in November 1993. In other words, the real consumption aggregates for each year are expressed in November 1993, Antananarivo prices. The indices used for such deflation are taken up separately.

Regional Deflation

Since the statistical institute does not collect regional price indices, we estimated regional deflators directly from the survey data. We made initial attempts to use unit prices for all three years but the recorded price data showed huge, unexplainable variations even within regions (s9.dta and s7.dta) for 1997 and 1999 data. However, the price data recorded in the 1999 community questionnaire was much better and we hence chose this data source as our base for calculating regional price indices for 1999. As the price data recorded in the surveys for 1993 and 1997 showed the same variations (for the same product, quantity and region), we opted to apply the same *relative prices* as found in 1999 also to deflate the 1997 consumption aggregates. For 1993, the unit prices calculated from the survey varied much less and we could hence base our relative price calculation on the survey itself for that year.

For purposes of comparability between the 1993 and 1999 price indices, only food prices for items available in all six regions in each survey were used. The basic food bundle consisted of 20 items, accounting for 69 percent of the 1993 food consumption aggregate. Prices for some key commodities such as cassava, potatoes and sweet potatoes, had to be dropped because of problems related to the unit of measure in the 1999 community questionnaire.[35] We calculated weights for these 20 food items as the average 1993 consumption shares of each food item in the basket of 20 commodities, and we applied these to the price vectors. The indices with urban Antananarivo as the base are as follows in Appendix Table 2.7:

Appendix Table 2.7: Regional Deflators

Urban

	1993	1997	1999
Antananarivo	1.00	1.00	1.00
Fianarantsoa	0.89	0.92	0.92
Taomasina	0.93	0.97	0.97
Mahajanga	0.81	0.97	0.97
Toliara	0.89	0.92	0.92
Antsiranana	0.99	0.98	0.98

[35] For example, local units used for many observations on cassava were "piles" of which there are typically two sizes, the smaller of which costs FMG 450 and the larger of which costs FMG 900. Both sized piles were estimated to weigh 1.0 kg in many cases by the interviewers. Further, in practice prices per kilogram vary not by the price attached to a pile (which remains constant) but by the size of the pile. Thus the bimodal distribution of cassava prices was determined to be artificial and could be extremely misleading when using median prices to calculate regional price variation.

Rural

	1993	1997	1999
Antananarivo	0.95	0.94	0.94
Fianarantsoa	0.85	0.92	0.92
Taomasina	0.82	0.93	0.93
Mahajanga	0.77	0.92	0.92
Toliara	0.81	0.94	0.94
Antsiranana	0.91	0.91	0.91

Temporal Deflation

We employed the Antananarivo price index calculated by the Institut National de la Statistiques (INSTAT) to make the three consumption aggregates comparable over time. Since the Antananarivo price index is estimated monthly, we were able to deflate the consumption aggregates over the time span of each survey as well as to correct for inflation between survey periods, so that the reference period is November 1993.[36]

Determination of Poverty Line

Our derivation of the poverty line requires a short explanation. Normally, in poverty analysis the poverty line is derived from a basic nutritional basket (providing a specific calorie amount) and associated necessary non-food expenditures (like housing, basic services, clothing etc). This is the way the World Bank derived the 1993 poverty line as well based on the 1993 EPM survey.

However, in our case, we have a somewhat different situation since the derivation of our preferred consumption aggregate was motivated by making the welfare indicator comparable over time. That is, we had to change the consumption aggregate which several researchers derived for the 1993 survey because otherwise we would not have been able to make poverty comparisons over time. On the other hand, we did not want to alter the estimates for 1993 which in themselves were consistent and fine.

To square these two objectives – to leave the 1993 poverty rate unchanged and at the same time obtain consumption aggregates which are comparable in time – we have derived the poverty line endogenously. That is, we have chosen the FMG amount as the cut-off point which reproduces exactly the 1993 poverty rate of 70.0 percent.[37] Following this logic, we obtained a poverty line of 313,945.05 FMG (per capita per year) in November 1993 urban Antananarivo prices. Since our regional and temporal deflation

[36] The Antananarivo price data includes weights for what are referred to as "Malgache" and "Europeans", the latter of which refers to the well-to-do population of the capital city. The price indices we used were those calculated only using the Malgache weights to more closely reflect the consumption bundle of the poorer majority of the population.

[37] The 1996 Madagascar Poverty Assessment (World Bank, 1996) discusses the methodology used at the time to construct the poverty line. (pp.44-46). This poverty line was originally applied to the 1993 where, *given the consumption aggregate constructed at the time*, a national poverty rate of 70% was established.

brings all welfare levels to November 1993 Antananarivo prices, we apply the same poverty line in all three years.

Appendix 3: Measures of Poverty, Inequality and Malnutrition

Poverty Measures

We use the Foster, Greer and Thorbecke (1984) class of poverty measures in this study. The so-called FGT $P_{á}$ measure is defined as,

$$P_a = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{z - y_i}{z}\right)^a I(y_i \le z),$$

where y_i is the level of individual welfare (real per capita consumption in our case), z is the poverty line, $á$ is the poverty sensitivity parameter, and $I()$ is an indicator function that takes on a value of one if its argument is true and zero otherwise.

Three particular indices within this class are of interest and used in the study. The first, and most commonly reported, is the headcount ratio (also known as the poverty incidence or rate), which is simply defined as the ratio of the population that is poor to the total population. This is the FGT measure when $á$ takes on a value of zero,

$$P_0 = \frac{1}{N}\sum_{i=1}^{N} I(y_i \le z) = \frac{q}{N},$$

where q is the number of poor individuals, and N is the population size. This shows explicitly how individuals are defined to be poor, i.e. their level of real per capita consumption is less than or equal to the poverty line. A drawback to the headcount ratio is that all those who are poor are treated equally in the measurement of poverty regardless of how much their consumption falls short of the poverty line. In other words, suppose that the consumption levels of the poorest of the poor doubles, but the increase iss not large enough to lift them out of poverty, then poverty remains unchanged when measured by the headcount ratio. To overcome this weakness and to capture changes in the distributions of consumption below the poverty line, more distributionally sensitive measures of poverty, such as the depth (P_1) and severity (P_2) of poverty are commonly employed. The depth of poverty is the FGT measure when $á$ takes on a value of one,

$$P_1 = \frac{1}{N}\sum_{i=1}^{N} 1*\left(\frac{z - y_i}{z}\right) I(y_i \le z),$$

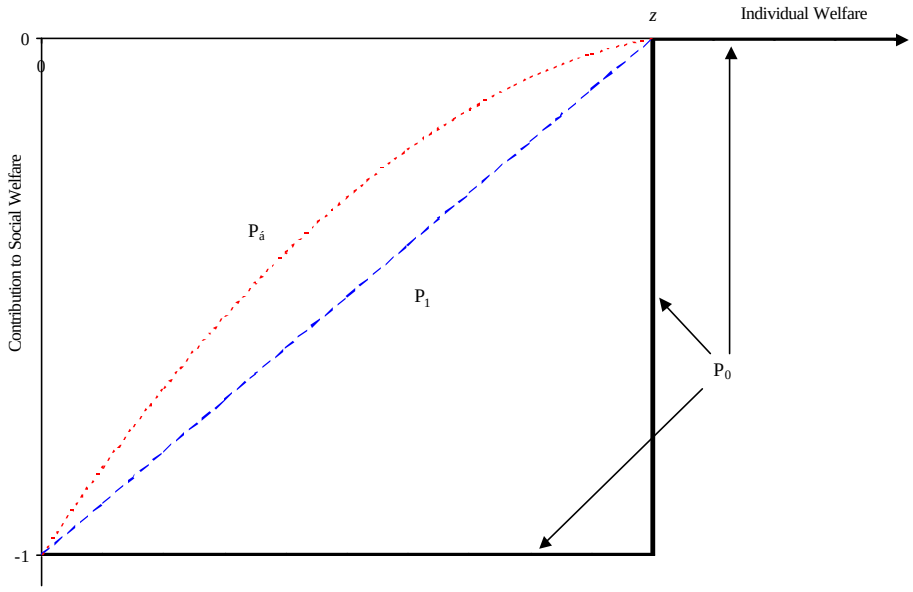
while the poverty severity index is the FGT measure when $á$ takes on a value of two,

$$P_2 = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{z - y_i}{z}\right)*\left(\frac{z - y_i}{z}\right) I(y_i \le z).$$

These two measures are simply weighted averages of the normalized poverty gaps (or consumption shortfall: $z - y_i$), where the poverty gap is defined to be zero for the non-poor. In the case of P_1, each individual has an indentical weight of one, while for P_2, the weight for each individual is the poverty gap itself. Thus the latter places more weight on the poorer individuals in society.

To give a little more insight into the meaning of these more distributionally sensitive measures of poverty, note that $P_á$ can also be thought of as an additive measure of national social welfare. Appendix Figure 3.1 (borrowed from Deaton 1997) illustrates the value of each individual's contribution to social welfare. On the horizontal axis is the level of welfare of the individual, as measured by real per capita consumption in this study. The vertical axis illustrates the contribution of each individual to the level of national social welfare (i.e. poverty).

Appendix Figure 3.1: Social Welfare and Alternative Poverty Sensitivity Parameters



Note that the social welfare function we use – the FGT poverty measure[38] – is actually a measure of dis-welfare, with a maximum level of welfare taking on a value of zero, and the worst possible level of welfare taking on a value of one. Thus in Appendix Figure 3.1 we can think of our poverty measures as the negative value of social welfare (which we intuitively think of as an increasing function of well-being) as illustrated by the vertical axis. In this figure, the most an individual can contribute to the national welfare is minus one. Starting with the headcount ratio (P_0), the figure shows that the contribution to social welfare of individuals with consumption levels at or below the poverty line is minus one. This is the case regardless of the degree to which the individual's consumption falls short of the poverty line. With this measure we also see that it is possible to make a transfer from a non-poor individual to a poor individual

[38] The aggregate FGT measure is simply the average of all of the individual $P_á$ contributions.

without a changing the level of poverty – as long as the consumption level of the non-poor (poor) individual remains above (below) the poverty line. These characteristics of the headcount ratio are intuitively unappealing.

The contribution of each individual's poverty gap (P_1) to the aggregate P_1 measure is illustrated by the piece-wise linear line from –1 on the vertical axis to the poverty line (z) on the horizontal axis, from which point it takes on a value of zero for all levels of consumption above z. The depth of poverty is simply the average of these poverty gaps, and as Appendix Figure 3.1 makes clear, this value of this measure depends on the size of the consumption short fall (gap). Further, a transfer from a non-poor person (leaving that person non-poor) to a poor person lowers the level of poverty since the poverty gap for that particular individual becomes smaller. While this is intuitively appealing, transfers among the poor do not affect the level of poverty as measured by P_1 because this is a simple average of the poverty gaps. This brings us to the depth of poverty (P_2). Each individual's contribution to this measure of poverty is represented by the concave line linking –1 on the vertical axis with the poverty line (z) on the horizontal axis. As with P_0 and P_1, the contribution of the non-poor is zero, but now the contribution of those further below the poverty line have greater weight than those closer to the poverty line. Again, transfers from non-poor to poor lower the level of poverty, but now given the concavity of the measure, transfers from less poor to poorer individuals lower the aggregate level of poverty.

Inequality Measures

We use a graphical approach (Lorenz curves) as well as a numerical approach (Gini coefficient and Theil's entropy measure) in our analysis of changes in inequality for Madagascar. Although we only discuss the latter here, each of these measures satisfies four desirable properties:

1. *Anonymity Principle:* What particular individuals own what particular share of total income should not affect any measure of income inequality.
2. *Population Principle:* If every individual (and his/her income) in the economy is cloned, then the measure of income inequality should remain unchanged.
3. *Relative Income Principle:* If the incomes of every individual in the economy is scaled up/down by the same proportion, then the measure of income inequality should remain unchanged.
4. *Pigou-Dalton Transfer Principle:* If a regressive transfer is made (i.e. from a poorer individual to a richer individual), then the measure of income inequality should increase.

The Gini coefficient is most easily interpreted as twice the area between the Lorenz curve and the 45 degree line. So at one extreme (complete equality), where all individuals have the same levels of income and the Lorenz curve is identical to the 45 degree line, the Gini coefficient takes on a value of zero. At the other extreme (complete inequality), were all individuals except for one have incomes of zero, and the Lorenz curve is a reverse L (and hence the area between the Lorenz curve and the 45 degree line

– the area under the 45 degree line – is 0.5), then the Gini takes on a value of 1. The Gini can also be computed as using the following formula

$$\text{Gini} = \frac{1}{\bar{y}N(N-1)} \sum_{i>j} \sum_{j} \left| y_i - y_j \right| .$$

One drawback to using the Gini coefficent is that it cannot be decomposed in a straightforward and easily interpretable manner. For this reason we also measure inequality using Theil's entropy index,

$$\text{Theil} = \frac{1}{N} \sum_{i=1}^{N} \frac{y_i}{\bar{y}} \ln\left(\frac{y_i}{\bar{y}} \right).$$

This measure, which also takes on a value of 0 (1) for complete inequality (equality), can be completely decomposed into inequality due to inequality *within* distinct groups, as well as due to inequality of incomes *between* these distinct groups.

Finally, we appeal to the Gini and Theil indices because they are complete measures of inequality. In other words, even when the Lorenz curves cross, and as such no statements can be made about changes in inequality using these curves[39], the Gini and Theil measures permit statements to be made. Nonetheless, in cases where the Lorenz curves do cross, it is entirely possible, as in the case of Taomasina between 1993 and 1997, for inequality defined by the Gini coefficent to increase, while inequality defined by Theil's entropy measure decreases.

Nutrition Indicators

The indicators of nutritional status available in the EPM are anthropometric measures of weight and height for all children between the age of 3 and 59 months. From these measures, along with reported ages of children, normalized measures of weight-for-height, height-for-age, and weight-for-age can be constructed as follows

$$z\text{-}score = \frac{x_i - x_{median}}{s_x},$$

where x_i is a given measurement such as height or weight for child i, x_{median} is the median of that measurement for a healthy and well-nourished child from a reference population of the same age or height and of the same gender, and s_x is the standard deviation from the mean of the reference population. Note that the z-score for the reference population has a standard normal distribution in the limit. Thus, a child is typically said to be malnourished (in a given space) if his or her z-score is two standard deviations below the mean of the reference population (zero).

[39] Lorenz curves are said to be "incomplete" measures of inequality because they do not permit complete rankings of all possible distributions of income by degrees of inequality (i.e. when the curves cross).

As recommended by the World Health Organization (WHO, 1993), the standard reference population used here is that of the United States National Center for Health Statistics. Studies such as Martorell and Habicht (1986) which found that less than 10 percent of worldwide variation in height is due to differences in genetics or race among children of the same sex under the age of ten, help to establish the appropriateness of using such a reference population.

The height-for-age z-score (HAZ) is an indicator of a child's long-term nutritional status. Children who are "stunted" are those whose past chronic nutritional deprivations leave them shorter than expected for their age and gender cohorts in the reference population. The weight-for-height z-score (WHZ), on the other hand, reflects short-term nutritional status. Current nutritional stress manifests itself in acute "wasting" of children independent of chronic malnutrition. The third measure, the weight-for-age z-score (WAZ), captures a combination of "stunting" and "wasting." We limit our analysis to malnutrition as measured by standardized height for age (HAZ).

Appendix 4: Tests of Stochastic Dominance – Methodology and Results

We employ standard tests of welfare dominance to compare distributions of our real per capita household consumption measures over time. The idea is to make ordinal judgments on how poverty changes for a wide class of poverty measures over a range of poverty lines. We start by discussing the concept of welfare dominance, and then explain how to estimate the orderings and to perform statistical inference on them. The discussion follows Ravallion (1994) and Davidson and Duclos (1998) closely.

First-Order Dominance

Consider two distributions of welfare indicators with cumulative distribution functions, F_A and F_B, with support in the nonnegative real numbers. Let

$$D_A^1(x) = F_A(x) = \int_0^x dF_A(y).$$

If $D_A^1(x) \leq (<) D_B^1(x)$ for all $x \in \Re_+$ (i.e. F_A is everywhere below F_B), then distribution *A* is said to (strictly) first order dominate distribution *B*. In terms of welfare economics, the interpretation is that up to the poverty line *x*, *A* is a better distribution than *B* for any welfare function that is both *increasing* in the welfare variable (e.g consumption) and *anonymous*, in the sense that we do not care that one particular person's welfare falls, as long as another's rises by more than enough to compensate. If we can say this for a broad range of poverty lines, then we have a quite general conclusion that *A* is preferable to *B*.

Since $D_A^1(x)$ is also the poverty *headcount* ratio (P_0) where the *x* is the poverty line, it follows that first order dominance implies that poverty as measured by P_0 is lower for distribution *A* than for distribution *B* regardless of the poverty line chosen. Dominance results can also be considered up to a maximum allowable poverty line if we aren't concerned with relative changes in the upper ends of the distribution.

Second-Order Dominance

If the two distributions cross within the range of poverty lines that we consider relevant, then first order dominance does not hold, and we know that different poverty lines and measures will rank the distributions differently. In other words, depending on the poverty line or measure chosen, we might simultaneously conclude that poverty increased or decreased. In this case, we can still make a fairly general welfare statement if second order dominance holds. In particular, if *A* second-order dominates *B*, then *A* is a better distribution than *B* for all welfare functions that are *increasing*, *anonymous*, and that *favor equality*. To define second-order dominance, let $D_A^2(x)$ be the area under F_A up to *x*,

$$D_A^2(x) = \int_0^x D_A^1(y)dy.$$

If $D_A^2(x) \leq (<) D_B^2(x)$ for all x (i.e. the area under F_A up to x is less the area under F_B up to x), then distribution A is said to (strictly) second order dominate distribution B.

"s" Order Dominance

If, to use Ravallion's (1994) terminology, the "poverty deficit" curves (D^2) cross, then higher orders of dominance can be checked. To generalize, let

$$D_A^s(x) = \int_0^x D_A^{s-1}(y)dy,$$

for any integer, $s \geq 2$. Now distribution A is said to (strictly) dominate distribution B at order s if $D_A^s(x) \leq (<) D_B^s(x)$. These higher orders of dominance reflect welfare functions that are *increasing*, *anonymous*, and *favor even more equality*[40].

Davidson and Duclos (1998) show that $D^s(x)$ can be equivalently expressed as

$$D^s(x) = \frac{1}{(s-1)!}\int_0^x (x-y)^{s-1} dF(y).$$

This formulation makes it easy to see that second order dominance implies that the *poverty gap* (P_1) is less for distribution A than for distribution B for all possible poverty lines (x). Further, third order dominance implies an unambiguous change in the *squared poverty gap* (P_2). To generalize even further, welfare dominance of order s implies that the Foster-Greer-Thorbecke poverty measure P_{s-1} is less for distribution A than for distribution B for all possible poverty lines. Foster and Shorrocks (1988) show that while first-order dominance is a sufficient condition for higher-order dominance, it is not a necessary condition. Thus if we find that a distribution first-order dominates another, then we know how poverty as measured by any of the FGT P_a measures has changed over the relevant range of poverty lines.

Estimation

Davidson and Duclos (1998) also show that if we have a random sample of N independent observations on the welfare variable, y_i, from a population, then a natural estimator of $D^s(x)$ is

$$\hat{D}^s(x) = \frac{1}{N(s-1)!}\int_0^x (x-y)^{s-1} d\hat{F}(y)$$

[40] In the limit, as s , the only relevant social welfare function is a Wralsian one in which social welfare is determined entirely by the poorest individual in society. Thus A will dominate B at order only if the poorest individual in A is better off than the poorest individual in B.

$$= \frac{1}{N(s-1)!}\sum_{i=1}^{N}(x-y_i)^{s-1}I(y_i \le x)$$

where $\hat{F}$ is the empirical cumulative distribution function of the sample, and $I(\cdot)$ is an indicator function, which is equal to one when it's argument is true, and equal to zero when false.

We apply this estimator to two independent samples for each of our indicators. Thus,

$$\text{var}(\hat{D}_A^s(x) - \hat{D}_B^s(x)) = \text{var}(\hat{D}_A^s(x)) + \text{var}(\hat{D}_B^s(x)),$$

which is easy to estimate since $\hat{D}^s(x)$ is a sum of *iid* variables. Simple *t* statistics are constructed to test the null hypothesis,

$$H_0 : \hat{D}_A^s(x) - \hat{D}_B^s(x) = 0,$$

for a series of test points up to an arbitrarily defined highest reasonable poverty line[41]. In cases where the null hypothesis is rejected and the signs are the same on all of the *t* statistics, then dominance of order *s* is declared. The tests were conducted up to *s* = 3, after which "no dominance" is declared.[42]

Results

Appendix Table 4.1 presents the results of applying dominance tests to the distributions of real per capita consumption for 1993, 1997 and 1999 by various areas of residence. First we note that at the national level, although the headcount ratios differed significantly between each of these year, the results are only robust to the choice of the poverty line for the 1993 to 1997 period. A glance at Figure 1 clarifies this outcome since we see that between 1993 and 1999, the lower tails of the distributions cross. If a policymaker's objective is to reduce poverty among the poorest of the poor, then he/she would find the 1999 distribution to be preferable to the 1993 distribution. For the 1997 to 1999 comparison, the fact that the distributions overlap for between FMG 100,000 and FMG 200,000, means that given the confidence intervals around them, we cannot say with certainty that one distribution is not higher or lower than the other, and hence whether poverty in this range was higher or lower in 1999 than in 1997

In urban areas, the large changes observed in the headcount ratio throughout the 1993 to 1999 period are robust to the poverty line as we find that the 1993 distribution of per capita consumption first order dominates the 1997 and 1999 distributions. In other words, for any possible poverty line, there was less urban poverty in 1993 than in 1997

[41] We take advantage of Stata's "svymean" command to correct for the complext multi-stage sampling design of the EPM in estimating these test statistics.

[42] Foster and Shorrocks, 1988, show that eventually one distribution will dominate the other at a higher order. But it is difficult to interpret orders of dominance greater than two, much less three.

and 1999. We find this result despite the observation that the 1999 distribution of urban per capita consumption first order dominates the 1997 distribution. In rural areas, no definitive statement can be made regarding changes poverty despite statistically significant changes in the headcount ratios for each of the periods under consideration. Figure 2 shows how close these distributions are to each other below FMG 100,000. Since these are sampling estimates of the true distributions, the standard errors around them prevent us from making definitive statements about which dominates the other.

The results of the testing the among the regional distributions reveal interesting results. In Antananarivo between 1993 and 1997, the headcount ratio fell (insignificantly) by 1.6 percentage points. Nonetheless, we find that because of a crossing at FMG 225,000 (see Figure 3), the 1993 distribution third order dominates the 1997 distribution. So despite a smaller percentage of it's population living in poverty in 1997, the well-being of the poorest 50 percent deteriorated, and consequently for all possible poverty lines, P_2 was higher in 1997 than in 1993. Conversely, in Fianarantsoa during this same period, the headcount ratio rose by 1.1 percentage points at the same time that we observe the 1997 distribution third order dominating the 1993 distribution. In Figure 3, we see that this follows from a crossing of the distributions at FMG 250,000. So for the case of Fianarantsoa, despite the improvements in the levels of consumption for the poorest 60 percent of the population, the share of the population living in poverty rose.

Appendix Table 4.1: Changes in Poverty in Madagascar: 1993, 1997 & 1999

	Dominance Tests[a]			Headcount (P_0)			Changes		
	1993 -1997	1993 -1999	1997 -1999	1993	1997	1999	1993 -1997	1993 -1999	1997 -1999
National	-1 **	..	..	70.0	73.3	71.3	3.3 **	1.3 *	-2.0 **
Urban	-1 **	-1 **	1 **	50.1	63.2	52.1	13.1 **	2.0 *	-11.1 **
Rural	..	..	..	74.5	76.0	76.7	1.5 *	2.2 **	0.7
Antananarivo	-3 **	..	1 *	68.0	66.4	61.7	-1.6	-6.2 **	-4.6 **
Fianarantsoa	3 *	..	-1 **	74.2	75.1	81.1	1.1	7.0 **	5.9 **
Taomasina	-2 *	..	2 **	77.9	79.8	71.3	2.0	-6.6 **	-8.5 **
Mahajanga	-1 **	-1 **	-2 **	53.2	73.8	76.0	20.6 **	22.8 **	2.2
Toliara	..	1 **	1 **	81.1	82.0	71.6	0.8	-9.5 **	-10.4 **
Antsiranana	..	-1 **	-1 **	60.2	62.3	72.6	2.1	12.4 **	10.3 **

Source: INSTAT, Cornell University and World Bank Staff estimates from EPM data
Note: Poverty measures have been multiplied by 100
Note: * and ** indicate 90 and 95 percent level of confidence, respectively
[a] Orders of stochastic dominance with positive (negative) value indicating less (more) malnutrition and ".." indicating no dominance up to order 3.

Appendix 5: Decomposition Methodology

a. Regional Decompositions

With this decomposition, we concentrate on how aggregate changes in poverty, as measured by our indicators, follow from the relative gains or losses of the poor within specific sectors as opposed to population shifts between sectors. We shall illustrate this decomposition, proposed by Ravallion and Huppi (1991), for two sectors (*u* for urban, and *r* for rural).

First we note that the decompositions follows directly from the additively separable nature of the FGT class of poverty measures. Given the definition of the FGT poverty measures from Appendix 3, and since the $P_{\acute{a}}$ poverty measure is a sum of *iid* random variables, it follows that for *M* distinct subgroups of the population

$$P_a = \sum_{j=1}^{M} \frac{N_j}{N} P_{aj} \qquad \text{for} \qquad N = \sum_{j=1}^{M} N_j \ ,$$

where $P_{\acute{a}j}$, the poverty measured for subgroup *j* is

$$P_{aj} = \frac{1}{N_j} \sum_{i=1}^{N_j} \left(\frac{z - y_{ij}}{z} \right)^a I(y_{ij} \le z) \ .$$

If we have $P_{\acute{a}}$ poverty measures for two distributions (*A* and *B*) of per capita consumption, simple mathematical manipulations can be used to break the difference in these measures into four components:

$$P_a^B - P_a^A = \underbrace{(P_{au}^B - P_{au}^A) n_u^A}_{\substack{\text{Intrasectoral effects:} \\ \text{Change in urban poverty at} \\ \text{survey A population share}}} + \underbrace{(P_{ar}^B - P_{ar}^A) n_r^A}_{\substack{\text{} \\ \text{Change in rural poverty at} \\ \text{survey A population share}}}$$

$$+ \underbrace{\sum_{j=u}^{r} (n_j^B - n_j^A) P_{aj}^A}_{\substack{\text{Change in poverty arising} \\ \text{from population shifts} \\ \text{(migration)}}} + \underbrace{\sum_{j=u}^{r} (P_{aj}^B - P_{aj}^A)(n_j^B - n_j^A)}_{\substack{\text{Interaction between sectoral} \\ \text{changes and population shifts}}}$$

where P_{aj}^t is the poverty measured in sector *j* for distribution (or time) *t*, and n_j^t is the population share of sector *j* at time *t*. The first two components, the urban and rural intrasectoral effects, show how changes in poverty in each of the sectors contribute to the aggregate change in poverty. The third component is the contribution of changes in the distribution of the population across the two sectors. Ravallion and Huppi (1991) note that the final component can be interpreted as a measure of the correlation between population shifts and changes in poverty within the sectors. This method of decomposing

the changes in poverty is applied at the urban-rural and regional levels as well as at the urban-rural-regional level.

b. Growth and Redistribution Decompositions

Another way to decompose change in poverty over time is into change in the mean and change in the distribution, as in Datt and Ravallion (1992). Because poverty measures are a function of the observations below the poverty line, any movement in the lower end of the of the distribution to the right (i.e. higher welfare levels) will show a reduction in poverty. This movement could occur because the mean of the distribution increased, with the distribution constant; or because the distribution became less disperse, with the mean constant; or from some combination.

To see how these components of the total change in poverty can be captured, we follow Datt and Ravallion (1992) in considering a class of poverty measures that are fully characterized by the poverty line (z), the mean of the distribution (μ), and the Lorenz curve (L)[43]. For date t the poverty measure can be written as

$$P_t = P\left(z, \mu_t, L_t\right).$$

A change in poverty between period t and $t+n$ can then be decomposed as follows:

$$P_{t+n} - P_t = \underbrace{G(t, t+n; r)}_{\substack{\text{growth} \\ \text{component}}} + \underbrace{D(t, t+n; r)}_{\substack{\text{redistribution} \\ \text{component}}} + \underbrace{R(t, t+n; r)}_{\text{residual}}$$

where the growth component is defined as the change in poverty due to a change in the mean of the distribution, while holding the Lorenz curve constant at that of the reference year r,

$$G(t, t+n; r) \equiv P(z, \mu_{t+n}, L_r) - P(z, \mu_t, L_r).$$

Similarly, the redistribution component is defined as the change in the Lorenz curve while keeping the mean of the distribution constant at that of the reference year r,

$$D(t, t+n; r) \equiv P(z, \mu_r, L_{t+n}) - P(z, \mu_r, L_t).$$

As Datt and Ravallion (1992) point out, the residual $R(\bullet)$ is present whenever a change in the poverty measure due to changes in the mean (distribution) also depends on the precise distribution (mean) (i.e. when the poverty measure is not additively separable in μ and L). Although the residual can be forced to disappear by averaging the components using the initial and final years as reference year, we do not do so to avoid arbitrarily apportioning this effect to either the growth or redistribution components.

[43] The FGT is one such class of poverty measures.

c. Returns and Endowment Decompositions

The first step for this decomposition method entails estimating models of per capita consumption for 1993 and 1999 (henceforth referred to as periods 1 and 2, respectively). The models that are estimated take on the following form:

$$\underset{N_t\times 1}{y_t} = \underset{N_t\times 1}{\alpha_t} + \underset{N_t\times k}{X_t}\,\underset{k\times 1}{\beta_t} + \underset{N_t\times 1}{\varepsilon_t}\ , \qquad \varepsilon_t \sim N(0,\sigma_t^2)\,, \qquad \text{for } t = 1,2$$

Where y_t is per capita household consumption in time period t, X is the vector of exogenous explanatory variables, and μ_t is a normally distributed random disturbance term. In addition, we include α_t, which is a constant shift variable multiplied by a vector of ones.

If we apply our FGT poverty measures to the distribution of per capita household consumption (y),

$$P_t = P(y_t) = P(\alpha_t + X_t\beta_t + \varepsilon_t),$$

it follows that changes in P_t can be decomposed by estimating the effects of changing one or more of the arguments of $P(\bullet)$. In other words, by allowing only X to change, we isolate the effects of changes in household demographics, household education, characteristics of the household head, sources of income, and community characteristics respectively, on the total change in poverty. This is referred to as the "endowment effect." Similarly, if $\hat{\alpha}$ is allowed to change while everything else is held constant, then the effect of changes in the "returns" to the "endowments" on changes in poverty are isolated. This is referred to as the "returns effect." The contribution of changes in the error structure to changes in the distribution of consumption, and hence poverty, is isolated in a similar manner. Finally, changes in the constant term (α) reflect changes in the average level of consumption that the models are unable to explain.

Before illustrating the decomposition more specifically, note that the normality assumption with respect to the distribution of the error terms permits us to rescale the residuals in the following way,

$$\underset{N_2\times 1}{\tilde{\varepsilon}_1} = \frac{\sigma_1^2}{\sigma_2^2}\underset{N_2\times 1}{\varepsilon_2} \qquad \tilde{\varepsilon}_1 \sim N(0,\sigma_1^2)$$

$$\underset{N_1\times 1}{\tilde{\varepsilon}_2} = \frac{\sigma_2^2}{\sigma_1^2}\underset{N_1\times 1}{\varepsilon_1} \qquad \tilde{\varepsilon}_2 \sim N(0,\sigma_2^2)\,.$$

Thus $\tilde{e}_2$ can be applied to endowments for the first-year survey (X_1) and $\tilde{e}_1$ can be applied to endowments for the second-year survey (X_2) and provides a means of isolating the effect of changes in the distribution of residuals on the change in nutrition poverty.[44]

The change in total poverty is decomposed as follows:

$$\begin{aligned}
\Delta P &= P(y_2) - P(y_1) \\
&= P(\alpha_2 + X_2\beta_2 + \varepsilon_2) - P(\alpha_1 + X_1\beta_1 + \varepsilon_1) \\
&= \underbrace{[P(\alpha_1 + X_1\beta_2 + \varepsilon_1) - P(\alpha_1 + X_1\beta_1 + \varepsilon_1)]}_{\text{Returns Effect}} \\
&+ \underbrace{[P(\alpha_2 + X_2\beta_2 + \varepsilon_2) - P(\alpha_2 + X_1\beta_2 + \tilde{\varepsilon}_2)]}_{\text{Endowment Effect}} \\
&+ \underbrace{[P(\alpha_2 + X_1\beta_2 + \tilde{\varepsilon}_2) - P(\alpha_2 + X_1\beta_2 + \varepsilon_1)]}_{\text{Residual Effect}} \\
&+ \underbrace{[P(\alpha_2 + X_1\beta_2 + \varepsilon_1) - P(\alpha_1 + X_1\beta_2 + \varepsilon_1)]}_{\text{Unexplained Change (Constant Effect)}},
\end{aligned}$$

when the first year endowments and second year returns define the reference (hereafter, first year reference). Note that the arrows indicate the terms that change within each effect. Similarly, the reference population from the second year (e.g. endowments) can be used with the returns from the first year (hereafter, second year reference), giving the following decomposition,

$$\begin{aligned}
\Delta P &= \underbrace{[P(\alpha_2 + X_2\beta_2 + \varepsilon_2) - P(\alpha_2 + X_2\beta_1 + \varepsilon_2)]}_{\text{Returns Effect}} \\
&+ \underbrace{[P(\alpha_1 + X_2\beta_1 + \tilde{\varepsilon}_1) - P(\alpha_1 + X_1\beta_1 + \varepsilon_1)]}_{\text{Endowment Effect}} \\
&+ \underbrace{[P(\alpha_1 + X_2\beta_1 + \varepsilon_2) - P(\alpha_1 + X_2\beta_1 + \tilde{\varepsilon}_1)]}_{\text{Residual Effect}}
\end{aligned}$$

[44] The procedure that Juhn, Murphy and Pierce (1993) follow requires estimating the distribution function of the residuals and using the function evaluated at the average parameter values as the reference distribution. In the absence of a practical interpretation of this combination of the parameter values, we do not follow their procedure.

$$+ \quad \left[P(\underset{\uparrow}{\alpha_2} + X_2\beta_1 + \varepsilon_2) - P(\underset{\uparrow}{\alpha_1} + X_2\beta_1 + \varepsilon_2)\right].$$

Unexplained Change (Constant Effect)

Because these reference period options are path dependent, the generated results are unlikely to be identical. Nonetheless, there is no reason to expect the qualitative results to differ wildly. As Bourguignon et al (1998) point out, path consistency can be used as a test of robustness. In other words, in a manner similar to the use of confidence intervals, if a given effect is estimated to be positive for one reference and negative for another, then the effect is not robust. Conversely, if the effect is positive or negative for both reference options, then it can be considered a robust result.

This is the general spirit of the decomposition[45]. But what is more informative is a further decomposition of the returns and endowment effects into the contributions to changes in poverty from the various explanatory variables. Let's start by illustrating how to further break down the returns effect for the first-year reference. Note again that the aggregate returns effect is

$$R \quad = \quad P(\alpha_1 + X_1\underset{\uparrow}{\beta_2} + \varepsilon_1) - P(\alpha_1 + X_1\underset{\uparrow}{\beta_1} + \varepsilon_1).$$

Now if we define

$$\beta_1^j = \begin{bmatrix} \beta_1^1 \\ \vdots \\ \beta_2^j \\ \vdots \\ \beta_1^K \end{bmatrix}, \quad \text{for} \qquad j \in [1\ ,\ K],$$

then the portion of the returns effect attributable to only changes in the returns to explanatory variable j, is

$$R_j^1 \quad = \quad P(\alpha_1 + X_1\underset{\uparrow}{\beta_1^j} + \varepsilon_1) - P(\alpha_1 + X_1\underset{\uparrow}{\beta_1} + \varepsilon_1).$$

For the second year reference,

$$R_j^2 \quad = \quad P(\alpha_2 + X_2\underset{\uparrow}{\beta_2} + \varepsilon_2) - P(\alpha_2 + X_2\underset{\uparrow}{\beta_2^j} + \varepsilon_2).$$

Now if R_j^1 and R_j^2 have the same sign, then we take the average effect and report it. If the signs are opposite, we conclude that the individual return effect is not robust, and do

[45] Our *fivondronona* fixed-effects formulation complicates the decomposition because the *fivondronana* in the two surveys are not common. In other words, X_1 and X_2 do not include exactly the same explanatory variables. One way around this problem is to calculate changes due to these fixed effects as a residual. We find it more informative to concentrate on the further decomposition of the returns and endowment effects for the common explanatory variables.

not report it. This is done for all of the explanatory variables, though for the sake of exposition, we only present the more interesting results.

The decomposition of the endowment effects follows along identical lines, except that it is complicated by the mapping of individual household characteristics across the two cross-sectional data sets. Let's consider how this is done in the case of years of education for the most educated household member. Because none of the same households were sampled in both 1993 and 1999[46], we have no record of the years of eduction in 1999 for the households in the 1993 sample, nor do we know the years of education in 1993 for the 1999 sample of households. We infer these levels in the following way. (1) Sort both samples by years of education within urban and rural areas for each province. Those with the same years of education are sorted randomly within the area of residence. (2) For each area of residence, calculate the maximum number of quantiles possible for both years (limited by the number of observations in the smaller of the two area samples for 1993 and 1999, and by the capability of a 1-to-1 merge) by the rankings determined by the sort from the previous step. (3) Finally, merge the years of education in 1993 (1999) to the 1999 (1993) sample by quantile and area of residence. This gives the 1993 (1999) sample with all of the original explanatory variables except for the years of education which are from 1999 (1993) – X^{j}_{1993} (X^{j}_{1999}) where j is the years of education. With this mapping, the effect of changes in endowment of years of education to changes in poverty can be isolated in the same manner that the returns effects are decomposed.

[46] If by chance they were, we have no way to identify them.

Figure 1: Poverty Incidence Curves for Madagascar

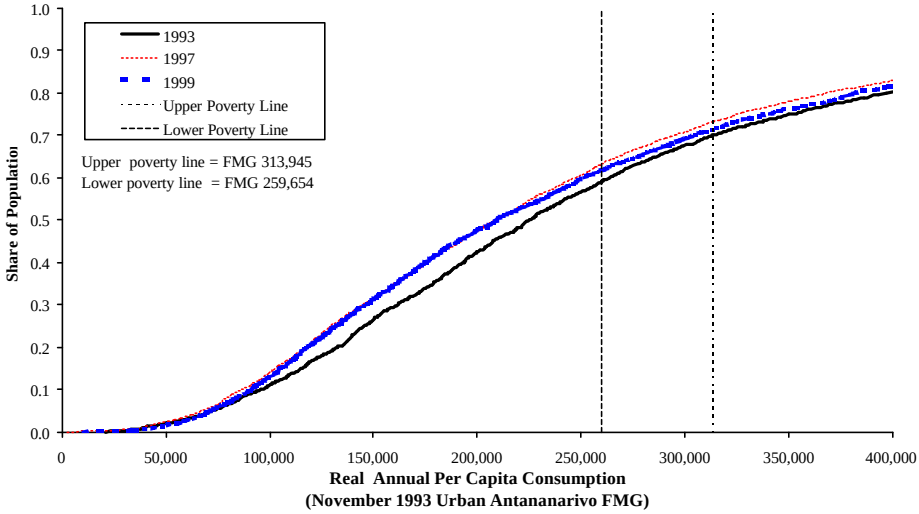
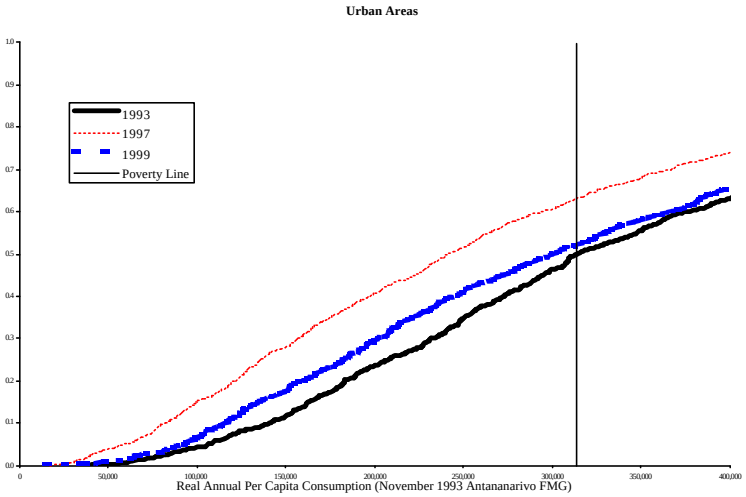


Figure 2: Poverty Incidence Curves by Area of Residence in Madagascar



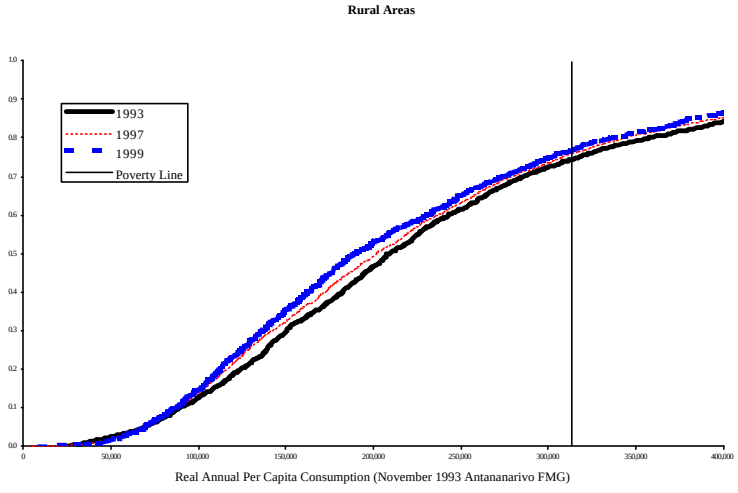


Figure 3: Poverty Incidence Curves by Province in Madagascar

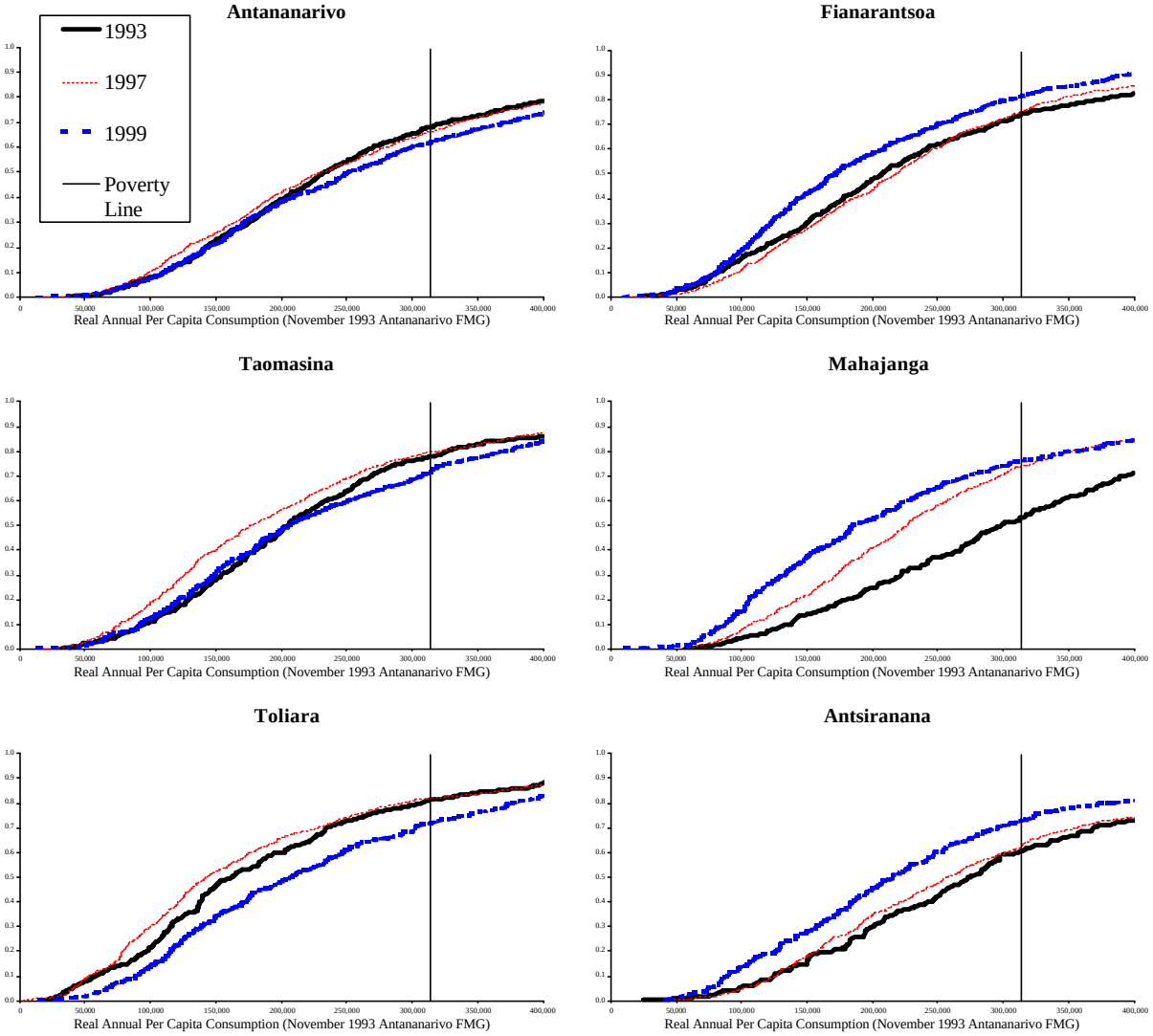


Figure 4: Ranking of Regions by Poverty in Madagascar

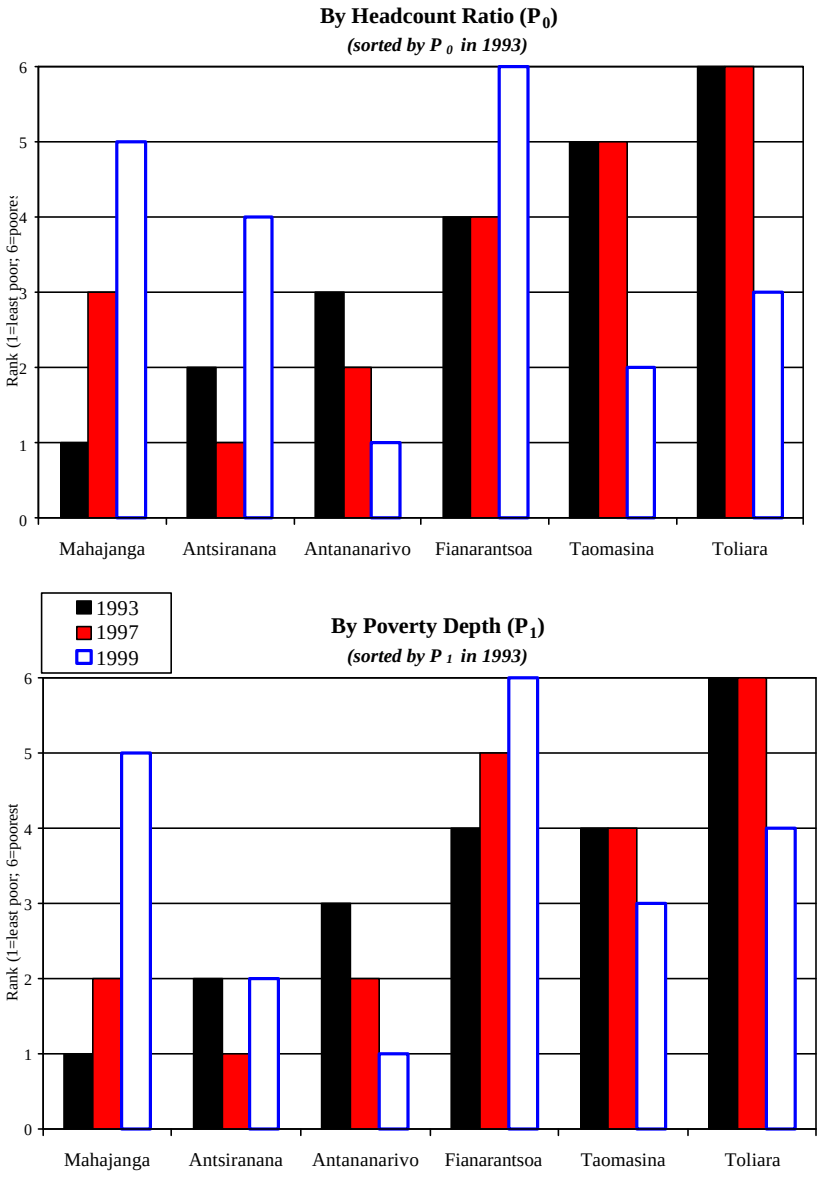


Figure 5: Poverty Incidence Curves for Urban Madagascar

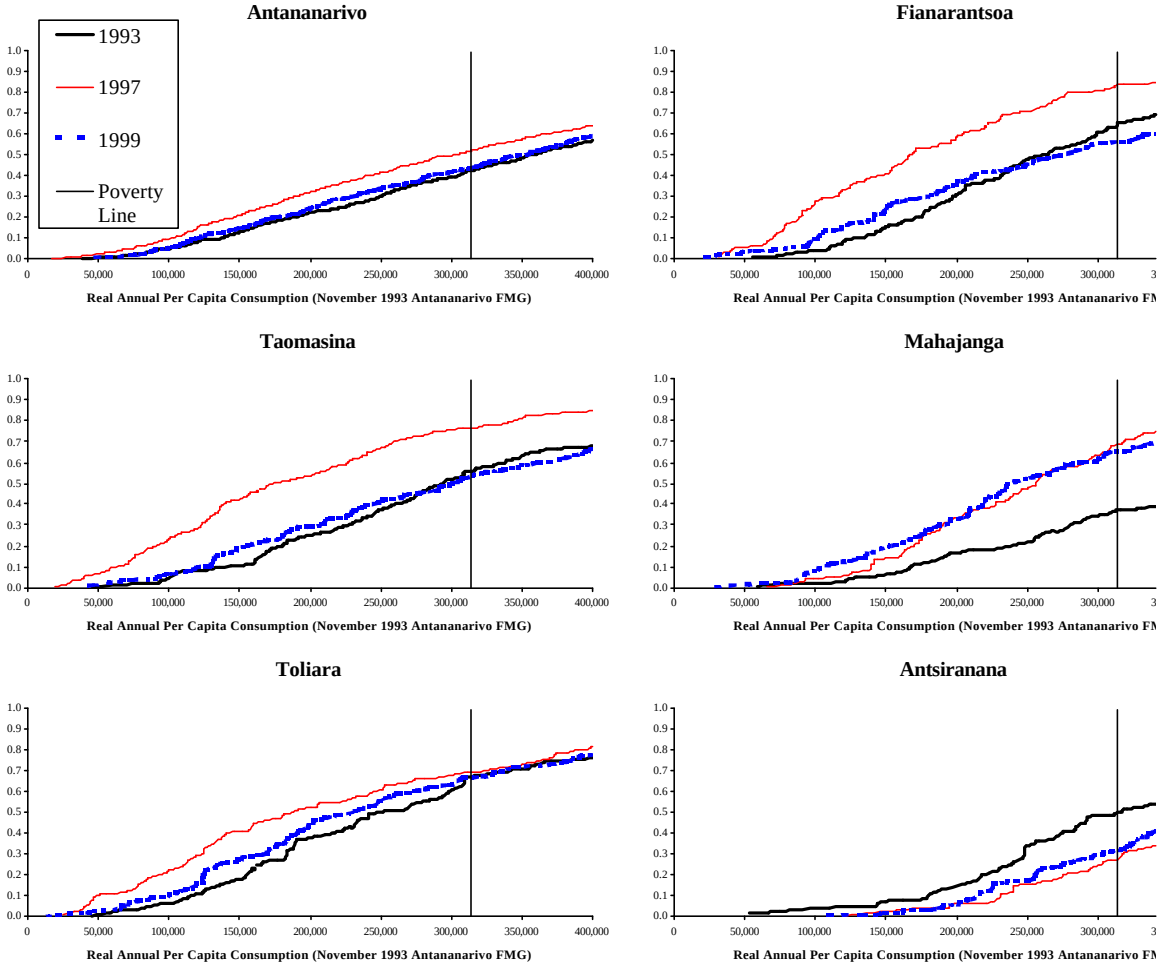


Figure 6: Poverty Incidence Curves for Rural Madagascar

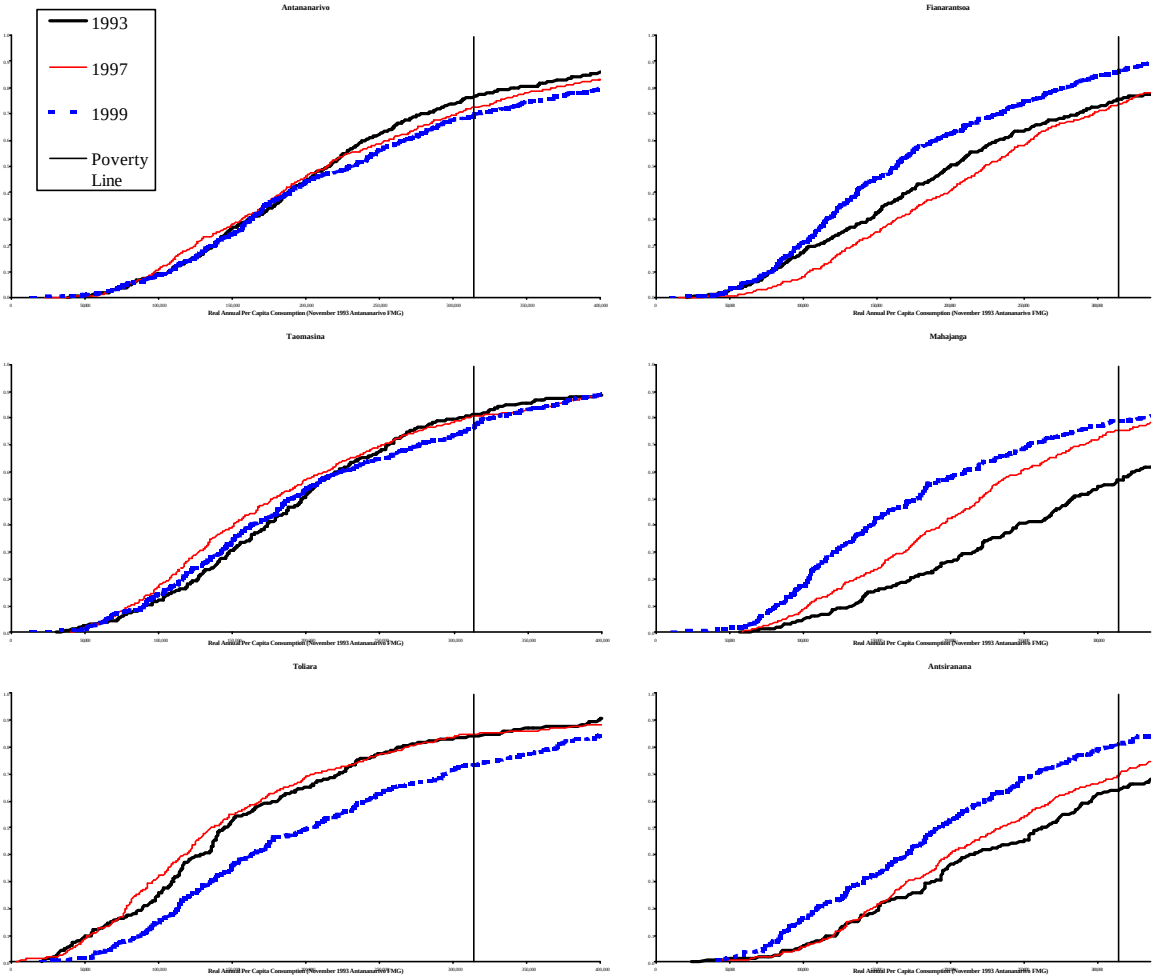


Figure 7: Distribution of Land Holdings in Madagascar

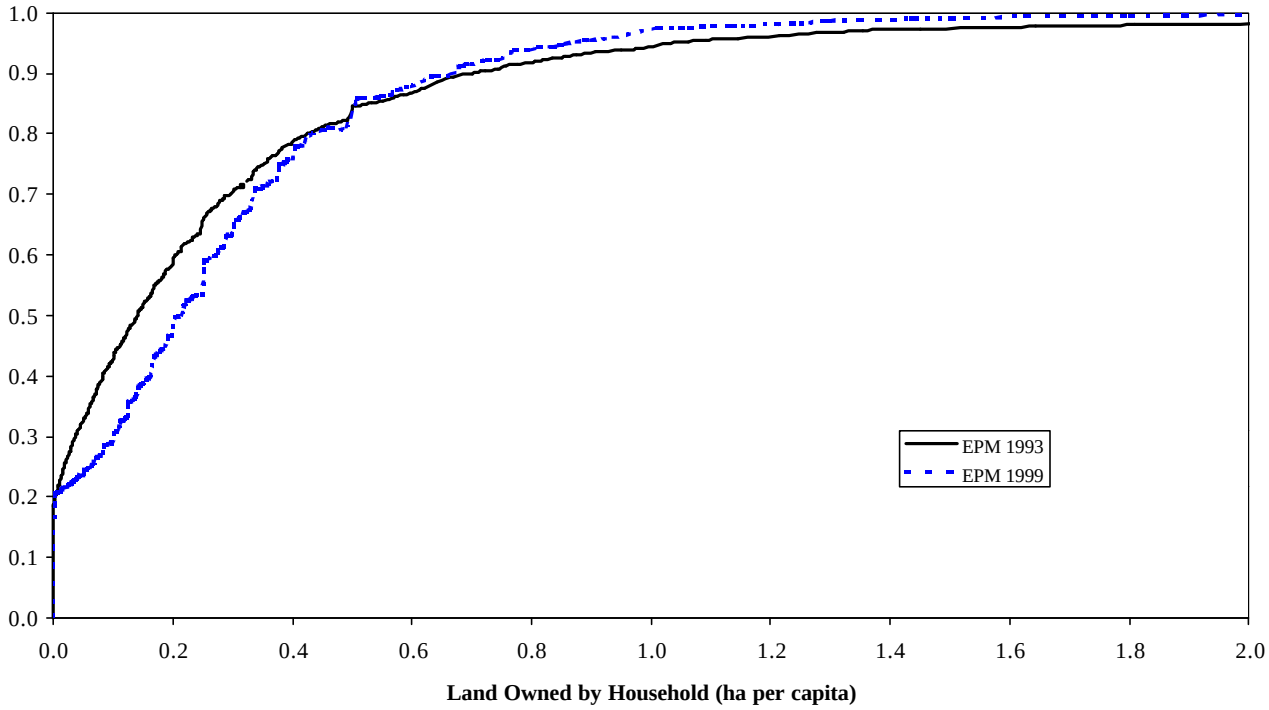


Figure 8: Lorenz Curves for Madagascar

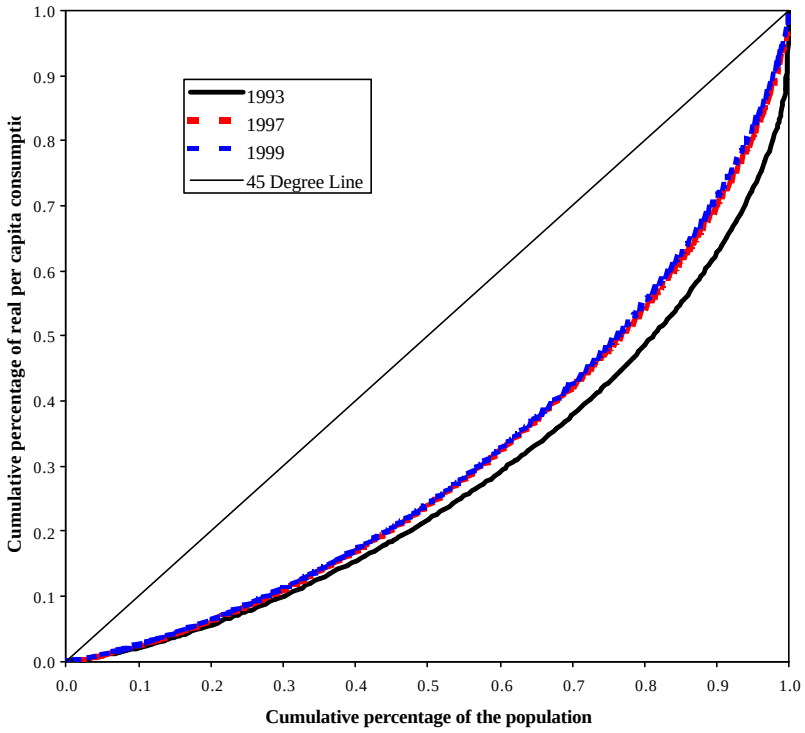


Figure 9: Lorenz Curves for Urban and Rural Areas in Madagascar

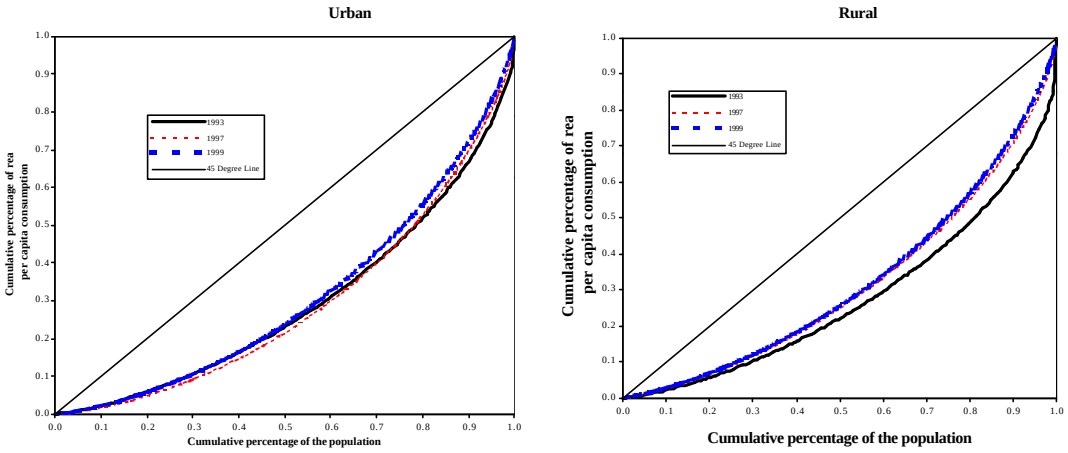


Table 1: Changes in GDP and Inflation for the EPM Survey Years

				Average Annual Change		
	1993	1997	1999	1993-1997	1997-1999	1993-1999
GDP (millions of 1984 FMG)	1,900	2,046	2,225	1.9%	4.3%	2.7%
Per Capita GDP (1984 FMG)	155,253	149,662	154,070	-0.9%	1.5%	-0.1%
Annual Inflation Rate[a]	12.1	7.3	9.8	24.8%	8.5%	20.3%

Source: Direction des Syntheses Economiques/INSTAT

[a] Average annual inflation rate is reported instead of changes in inflation rates

Table 2: Poverty in Madagascar

	Headcount (P_0)						Depth (P_1)					
	1993		1997		1999		1993		1997		1999	
	P_0	*Share*	P_0	*Share*	P_0	*Share*	P_1	*Share*	P_1	*Share*	P_1	*Share*
Poor (Upper Poverty Line)												
National	70.0	*100.0*	73.3	*100.0*	71.3	*100.0*	30.3	*100.0*	33.6	*100.0*	32.8	*100.0*
Urban	50.1	*13.2*	63.2	*18.6*	52.1	*16.3*	17.5	*10.7*	29.6	*19.0*	21.4	*14.5*
Rural	74.5	*86.8*	76.0	*81.4*	76.7	*83.7*	33.1	*89.3*	34.7	*81.0*	36.1	*85.5*
Province												
Antananarivo	68.0	*29.3*	66.4	*25.5*	61.7	*24.2*	27.8	*27.7*	29.1	*24.4*	26.0	*22.1*
Fianarantsoa	74.2	*20.4*	75.1	*20.7*	81.1	*21.3*	33.7	*21.5*	32.0	*19.3*	40.2	*22.9*
Taomasina	77.9	*17.9*	79.8	*17.9*	71.3	*15.5*	33.7	*18.0*	39.3	*19.3*	32.6	*15.4*
Mahajanga	53.2	*9.8*	73.8	*11.3*	76.0	*14.6*	18.6	*7.9*	29.1	*9.7*	36.5	*15.2*
Toliara	81.1	*15.7*	82.0	*17.3*	71.6	*15.7*	42.8	*19.1*	46.4	*21.4*	33.7	*16.0*
Antsiranana	60.2	*6.9*	62.3	*7.1*	72.6	*8.7*	22.0	*5.8*	23.9	*6.0*	32.0	*8.4*
Extreme Poor (Lower Poverty Line)												
National	59.0	*100.0*	63.1	*100.0*	61.7	*100.0*	23.0	*100.0*	26.3	*100.0*	25.8	*100.0*
Urban	37.6	*11.8*	54.0	*18.5*	43.2	*15.6*	12.1	*9.7*	23.5	*19.2*	15.9	*13.8*
Rural	63.8	*88.3*	65.6	*81.5*	67.0	*84.4*	25.5	*90.3*	27.1	*80.8*	28.6	*86.2*
Province												
Antananarivo	57.3	*29.3*	55.7	*24.9*	51.3	*23.2*	20.4	*26.7*	22.3	*23.9*	19.5	*21.1*
Fianarantsoa	63.8	*20.9*	63.7	*20.4*	71.2	*21.6*	26.4	*22.1*	24.2	*18.6*	32.6	*23.6*
Taomasina	66.8	*18.3*	71.3	*18.6*	61.4	*15.4*	25.4	*17.8*	31.7	*19.8*	25.6	*15.4*
Mahajanga	38.5	*8.4*	60.7	*10.8*	67.4	*15.0*	12.8	*7.2*	21.1	*9.0*	29.1	*15.5*
Toliara	73.8	*16.9*	75.5	*18.6*	63.6	*16.1*	35.5	*20.8*	39.5	*23.3*	26.7	*16.2*
Antsiranana	46.2	*6.3*	50.5	*6.7*	62.6	*8.7*	15.3	*5.3*	17.0	*5.4*	24.5	*8.2*

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data

Note: Contribution to national poverty in *italics*

Note: Poverty measures have been multiplied by 100

Table 3: Decomposition of Changes in Poverty in Madagascar into Intra- and Inter-Sectoral Effects by Area of Residence

Reference year is 1993				Intra-sectoral Effects		Inter-Sectoral	Residual
	1993	1997	Difference	Urban	Rural	Effect	Effect
Levels							
Incidence (P_0)	70.0	73.3	3.3	2.4	1.2	-0.8	0.4
Depth (P_1)	30.3	33.6	3.3	2.2	1.3	-0.5	0.3
Severity (P_2)	16.7	19.3	2.6	1.7	1.0	-0.3	0.2
Share of Total Change							
			100.0	74.0	38.2	-23.2	11.0
			100.0	66.5	38.3	-14.5	9.8
			100.0	63.8	38.7	-11.8	9.3
Share of Total Population							
1993			100.0	18.5	81.6	..	..
1997			100.0	21.6	78.4	..	..

Reference year is 1993				Intra-sectoral Effects		Inter-Sectoral	Residual
	1993	1999	Difference	Urban	Rural	Effect	Effect
Levels							
Incidence (P_0)	70.0	71.3	1.3	0.4	1.8	-0.9	0.0
Depth (P_1)	30.3	32.8	2.6	0.7	2.4	-0.6	0.0
Severity (P_2)	16.7	18.7	2.0	0.5	1.9	-0.4	0.0
Share of Total Change							
			100.0	29.9	144.0	-73.3	-0.6
			100.0	28.1	93.5	-23.1	1.4
			100.0	25.9	91.7	-18.6	1.1
Share of Total Population							
1993			100.0	18.5	81.6	..	..
1999			100.0	22.2	77.8	..	..

Reference year is 1997				Intra-sectoral Effects		Inter-Sectoral	Residual
	1997	1999	Difference	Urban	Rural	Effect	Effect
Levels							
Incidence (P_0)	73.3	71.3	-2.0	-2.4	0.5	-0.1	-0.1
Depth (P_1)	33.6	32.8	-0.8	-1.8	1.1	-0.03	-0.1
Severity (P_2)	19.3	18.7	-0.6	-1.3	0.8	-0.01	0.0
Share of Total Change							
			100.0	119.0	-27.2	4.3	4.0
			100.0	225.1	-137.8	4.5	8.2
			100.0	225.5	-136.1	2.4	8.2
Share of Total Population							
1997			100.0	21.6	78.4	..	..
1999			100.0	22.2	77.8	..	..

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data

Table 4: Regional Poverty in Madagascar by Area of Residence: 1993, 1997 & 1999

	Incidence (P_0)						Depth (P_1)					
	1993		1997		1999		1993		1997		1999	
	P_0	*Share*	P_0	*Share*	P_0	*Share*	P_1	*Share*	P_1	*Share*	P_1	*Share*
Urban Poverty												
Total	50.1	*100.0*	63.2	*100.0*	52.1	*100.0*	17.5	*100.0*	29.6	*100.0*	21.4	*100.0*
Antananarivo	42.4	*33.6*	52.0	*30.9*	43.3	*30.4*	15.9	*36.2*	23.0	*29.2*	17.5	*29.9*
Fianarantsoa	64.9	*16.6*	83.1	*20.2*	55.8	*14.5*	22.4	*16.4*	42.0	*21.9*	25.2	*15.9*
Taomasina	55.8	*12.6*	76.3	*20.2*	52.6	*15.1*	18.5	*12.0*	39.9	*22.5*	21.1	*14.8*
Mahajanga	37.3	*9.4*	68.2	*11.3*	65.2	*15.9*	11.6	*8.3*	23.2	*8.2*	25.3	*15.0*
Toliara	66.9	*17.2*	69.1	*14.6*	66.5	*20.4*	25.0	*18.4*	37.3	*16.9*	29.8	*22.2*
Antsiranana	49.5	*10.6*	27.0	*2.8*	31.3	*3.8*	14.3	*8.7*	6.2	*1.4*	7.8	*2.3*
Rural Poverty												
Total	74.5	*100.0*	76.0	*100.0*	76.7	*100.0*	33.1	*100.0*	34.7	*100.0*	36.1	*100.0*
Antananarivo	76.2	*28.6*	72.1	*24.3*	69.3	*23.0*	31.6	*26.7*	31.5	*23.3*	29.5	*20.8*
Fianarantsoa	75.3	*21.0*	73.6	*20.9*	85.9	*22.6*	35.3	*22.1*	30.1	*18.7*	43.1	*24.1*
Taomasina	81.1	*18.8*	80.8	*17.4*	76.4	*15.6*	36.0	*18.7*	39.2	*18.5*	35.7	*15.5*
Mahajanga	56.7	*9.9*	75.1	*11.3*	78.8	*14.4*	20.2	*7.9*	30.6	*10.1*	39.4	*15.3*
Toliara	84.2	*15.4*	84.9	*18.0*	73.1	*14.8*	46.5	*19.2*	48.5	*22.4*	34.8	*15.0*
Antsiranana	63.7	*6.3*	69.5	*8.1*	80.6	*9.7*	24.5	*5.5*	27.5	*7.0*	36.7	*9.4*

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data
Note: Contribution to national poverty in *italics*
Note: Poverty measures have been multiplied by 100

Table 5: Decomposition of Changes in Poverty in Madagascar into Intra- and Inter-Sectoral Effects by Province

Reference year is 1993				Intra-sectoral Effects						Inter-Sectoral	Residual
	1993	1997	Difference	Antananarivo	Fianarantsoa	Taomasina	Mahajanga	Toliara	Antsiranana	Effect	Effect
Levels											
Incidence (P_0)	70.0	73.3	3.3	-0.5	0.2	0.3	2.6	0.1	0.2	0.6	-0.3
Depth (P_1)	30.3	33.6	3.3	0.4	-0.3	0.9	1.4	0.5	0.2	0.5	-0.1
Severity (P_2)	16.7	19.3	2.6	0.5	-0.4	0.9	0.7	0.5	0.1	0.4	-0.1
Share of Total Change											
			100.0	-14.7	6.4	9.7	81.0	3.4	5.1	17.3	-8.2
			100.0	11.6	-9.6	27.0	40.4	14.6	4.6	14.9	-3.5
			100.0	18.9	-14.3	32.6	28.4	18.9	3.0	14.6	-2.0
Share of Total Population											
1993			100.0	30.2	19.3	16.1	12.9	13.5	8.0	..	..
1997			100.0	28.2	20.2	16.5	11.2	15.5	8.4	..	..

Reference year is 1993				Intra-sectoral Effects						Inter-Sectoral	Residual
	1993	1999	Difference	Antananarivo	Fianarantsoa	Taomasina	Mahajanga	Toliara	Antsiranana	Effect	Effect
Levels											
Incidence (P0)	70.0	71.3	1.3	-1.9	1.4	-1.1	2.9	-1.3	1.0	0.0	0.2
Depth (P1)	30.3	32.8	2.6	-0.5	1.3	-0.2	2.3	-1.2	0.8	0.1	0.0
Severity (P2)	16.7	18.7	2.0	-0.2	0.9	0.0	1.6	-1.0	0.5	0.1	0.0
Share of Total Change											
			100.0	-148.5	107.2	-84.2	232.8	-102.1	78.5	1.0	15.3
			100.0	-21.3	49.1	-6.9	89.7	-47.8	31.2	5.2	0.7
			100.0	-8.6	45.2	2.5	78.0	-49.7	27.1	7.2	-1.8
Share of Total Population											
1993			100.0	30.2	19.3	16.1	12.9	13.5	8.0	..	..
1999			100.0	27.9	18.7	15.5	13.7	15.6	8.6	..	..

Reference year is 1997				Intra-sectoral Effects						Inter-Sectoral	Residual
	1997	1999	Difference	Antananarivo	Fianarantsoa	Taomasina	Mahajanga	Toliara	Antsiranana	Effect	Effect
Levels											
Incidence (P0)	73.3	71.3	-2.0	-1.3	1.2	-1.4	0.3	-1.6	0.9	-0.1	0.1
Depth (P1)	33.6	32.8	-0.8	-0.9	1.7	-1.1	0.8	-2.0	0.7	-0.1	0.1
Severity (P2)	19.3	18.7	-0.6	-0.6	1.4	-0.8	0.7	-1.7	0.5	-0.1	0.1
Share of Total Change											
			100.0	64.8	-59.7	70.1	-12.5	80.0	-42.9	3.5	-3.3
			100.0	111.6	-212.1	141.3	-106.2	251.7	-86.8	16.8	-16.4
			100.0	105.2	-227.5	137.7	-122.6	289.2	-83.0	19.1	-18.1
Share of Total Population											
1997			100.0	28.2	20.2	16.5	11.2	15.5	8.4	..	..
1999			100.0	27.9	18.7	15.5	13.7	15.6	8.6	..	..

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data

Table 6: Decomposition of Changes in Poverty in Madagascar into Intra- and Inter-Sectoral Effects by Province and Area of Residence

Reference year is 1993

				Intra-sectoral Effects												Inter-Sectoral	Residual
				Antananarivo		Fianarantsoa		Taomasina		Mahajanga		Toliara		Antsiranana			
	1993	1997	Difference	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Effect	Effect
Levels																	
Incidence (P_0)	70.0	73.3	3.3	0.7	-0.9	0.4	-0.3	0.4	0.0	0.7	1.9	0.1	0.1	-0.4	0.3	-0.3	0.6
Depth (P_1)	30.3	33.6	3.3	0.5	0.0	0.5	-0.9	0.4	0.4	0.3	1.1	0.3	0.2	-0.2	0.2	0.0	0.5
Severity (P_2)	16.7	19.3	2.6	0.4	0.2	0.4	-0.8	0.3	0.5	0.1	0.6	0.3	0.2	-0.1	0.1	0.0	0.4
Share of Total Change																	
			100.0	21.5	-28.1	13.2	-9.1	13.1	-1.4	22.0	59.6	1.6	2.5	-13.6	10.6	-9.0	17.1
			100.0	15.4	-0.5	13.8	-26.3	13.3	13.4	8.1	32.9	8.7	6.4	-4.8	5.4	-1.4	15.5
			100.0	13.9	7.1	14.0	-31.5	13.1	18.3	4.7	24.2	10.3	9.1	-2.9	3.1	1.6	15.2
Share of Total Population																	
1993			100.0	7.3	22.8	2.4	16.9	2.1	14.1	2.3	10.6	2.4	11.1	2.0	6.0	..	..
1997			100.0	8.1	20.1	3.3	16.9	3.6	12.9	2.3	9.0	2.9	12.6	1.4	7.0	..	..

Reference year is 1993

				Intra-sectoral Effects												Inter-Sectoral	Residual
				Antananarivo		Fianarantsoa		Taomasina		Mahajanga		Toliara		Antsiranana			
	1993	1999	Difference	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Effect	Effect
Levels																	
Incidence (P_0)	70.0	71.3	1.3	0.1	-1.6	-0.2	1.8	-0.1	-0.7	0.6	2.3	0.0	-1.2	-0.4	1.0	-1.0	0.5
Depth (P_1)	30.3	32.8	2.6	0.1	-0.5	0.1	1.3	0.1	0.0	0.3	2.0	0.1	-1.3	-0.1	0.7	-0.5	0.3
Severity (P_2)	16.7	18.7	2.0	0.1	-0.1	0.1	0.9	0.0	0.1	0.2	1.4	0.1	-1.1	-0.1	0.5	-0.3	0.1
Share of Total Change																	
			100.0	5.3	-124	-17.1	142	-5.3	-52.9	51.4	185	-0.8	-97.6	-28.4	80.9	-75.9	37.5
			100.0	4.4	-18.9	2.5	51.6	2.1	-1.1	12.4	79.1	4.4	-50.8	-5.0	28.7	-20.7	11.1
			100.0	3.5	-7.3	4.4	45.0	2.4	6.4	8.5	71.2	4.6	-53.0	-3.3	24.5	-14.2	7.2
Share of Total Population																	
1993			100.0	7.3	22.8	2.4	16.9	2.1	14.1	2.3	10.6	2.4	11.1	2.0	6.0	..	..
1999			100.0	8.1	19.8	3.0	15.7	3.3	12.2	2.8	10.9	3.6	12.1	1.4	7.2	..	..

Reference year is 1997

				Intra-sectoral Effects												Inter-Sectoral	Residual
				Antananarivo		Fianarantsoa		Taomasina		Mahajanga		Toliara		Antsiranana			
	1997	1999	Difference	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Effect	Effect
Levels																	
Incidence (P_0)	73.3	71.3	-2.0	-0.7	-0.6	-0.9	2.1	-0.9	-0.6	-0.1	0.3	-0.1	-1.5	0.1	0.8	-0.2	0.2
Depth (P_1)	33.6	32.8	-0.8	-0.4	-0.4	-0.6	2.2	-0.7	-0.4	0.0	0.8	-0.2	-1.7	0.0	0.6	-0.2	0.2
Severity (P_2)	19.3	18.7	-0.6	-0.3	-0.3	-0.4	1.7	-0.5	-0.3	0.0	0.7	-0.2	-1.5	0.0	0.5	-0.2	0.2
Share of Total Change																	
			100.0	35.1	28.2	45.1	-104	42.5	28.3	3.3	-16.2	3.8	74.1	-3.0	-38.8	9.3	-7.8
			100.0	56.9	52.8	71.5	-282	86.4	56.1	-6.0	-101	27.7	220	-2.9	-82.3	27.8	-24.7
			100.0	54.4	49.5	65.3	-291	85.1	53.6	-8.1	-116	35.8	250	-1.1	-80.7	29.7	-26.0
Share of Total Population																	
1997			100.0	8.1	20.1	3.3	16.9	3.6	12.9	2.3	9.0	2.9	12.6	1.4	7.0	..	..
1999			100.0	8.1	19.8	3.0	15.7	3.3	12.2	2.8	10.9	3.6	12.1	1.4	7.2	..	..

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data

Table 7: Poverty in Madagascar by Economic Sector of Household Head

		Population Share			Headcount (P_0)						Depth (P_1)					
					1993		1997		1999		1993		1997		1999	
		1993	1997	1999	P_0	*Share*	P_0	*Share*	P_0	*Share*	P_1	*Share*	P_1	*Share*	P_1	*Share*
National		**100**	**100**	**100**	**70.0**	***100***	**73.3**	***100***	**71.3**	***100***	**30.3**	***100***	**33.6**	***100***	**32.8**	***100***
1	Agriculture	74.4	71.3	70.5	76.1	*80.9*	76.5	*74.4*	77.4	*76.5*	33.9	*83.3*	35.3	*74.8*	36.5	*78.4*
2	Fishing & livestock	0.9	1.8	2.1	61.7	*0.8*	84.5	*2.1*	72.8	*2.1*	33.8	*1.0*	42.9	*2.3*	34.5	*2.2*
3	Other primary activities	0.8	0.9	1.7	62.2	*0.7*	71.3	*0.9*	79.4	*1.9*	33.9	*0.9*	33.5	*0.9*	41.7	*2.2*
4	Food & drink industry	0.6	0.8	0.8	59.3	*0.5*	58.0	*0.6*	59.1	*0.7*	19.2	*0.4*	30.1	*0.6*	26.6	*0.6*
5	Mining	0.3	0.2	0.5	41.9	*0.2*	59.9	*0.2*	74.8	*0.5*	9.5	*0.1*	31.6	*0.2*	35.9	*0.5*
6	Manufacturing	3.7	1.7	3.0	57.0	*3.0*	57.3	*1.3*	54.3	*2.3*	22.5	*2.7*	24.2	*1.2*	22.4	*2.1*
7	Energy	0.2	0.3	0.0	45.9	*0.1*	28.1	*0.1*	7.4	*0.0*	13.2	*0.0*	10.9	*0.1*	1.9	*0.0*
8	Construction	1.6	1.0	1.1	70.1	*1.6*	68.6	*0.9*	54.1	*0.8*	27.1	*1.4*	32.4	*1.0*	21.2	*0.7*
9	Trade	4.7	5.2	5.4	54.6	*3.7*	66.0	*4.7*	54.3	*4.1*	20.2	*3.2*	29.4	*4.5*	22.3	*3.7*
10	Transport	2.6	1.6	2.1	46.0	*1.7*	68.6	*1.5*	47.0	*1.4*	15.7	*1.3*	25.8	*1.2*	15.5	*1.0*
11	Private health	0.4	0.1	0.5	56.2	*0.3*	55.2	*0.1*	15.3	*0.1*	33.6	*0.4*	22.4	*0.1*	1.8	*0.0*
12	Private education	2.7	0.4	0.4	43.6	*1.7*	62.3	*0.3*	39.9	*0.2*	10.6	*0.9*	28.3	*0.3*	12.7	*0.1*
13	Banking & insurance	0.4	0.2		17.1	*0.1*	30.2	*0.1*	0.0	*0.0*	2.2	*0.0*	13.2	*0.1*	0.0	*0.0*
14	Government services	2.5	5.5	5.3	30.2	*1.1*	62.7	*4.7*	52.1	*3.9*	8.7	*0.7*	26.8	*4.4*	22.2	*3.6*
15	Other services	4.5	9.0	6.5	59.7	*3.8*	65.2	*8.0*	60.3	*5.5*	24.3	*3.6*	30.5	*8.2*	24.5	*4.9*
Urban		**18.5**	**21.6**	**22.2**	**50.1**	***100***	**63.2**	***100***	**52.1**	***100***	**17.5**	***100***	**33.6**	***100***	**21.4**	***100***
1	Agriculture	23.5	26.8	26.6	70.1	*32.8*	75.3	*32.0*	64.2	*32.8*	24.1	*32.3*	38.9	*35.3*	27.3	*34.0*
2	Fishing & livestock	2.1	2.1	3.3	56.0	*2.3*	70.2	*2.3*	55.8	*3.5*	24.3	*2.9*	32.9	*2.3*	30.2	*4.6*
3	Other primary activities	0.9	1.6	2.7	23.1	*0.4*	74.5	*1.9*	58.2	*3.0*	5.9	*0.3*	34.3	*1.9*	33.4	*4.3*
4	Food & drink industry	1.6	1.7	1.3	68.5	*2.2*	27.8	*0.8*	55.9	*1.4*	21.1	*1.9*	12.7	*0.7*	25.7	*1.5*
5	Mining	0.2	0.3	0.4	50.6	*0.2*	45.2	*0.2*	15.7	*0.1*	13.2	*0.2*	20.8	*0.2*	2.8	*0.1*
6	Manufacturing	9.3	5.2	8.2	46.1	*8.5*	46.2	*3.8*	53.0	*8.3*	16.5	*8.7*	17.8	*3.1*	22.7	*8.7*
7	Energy	0.4	0.9	0.9	59.0	*0.5*	33.4	*0.5*	8.2	*0.1*	16.9	*0.4*	13.0	*0.4*	2.1	*0.1*
8	Construction	3.6	2.7	3.1	63.2	*4.6*	70.9	*3.0*	55.3	*3.3*	21.7	*4.5*	33.2	*3.0*	20.7	*3.0*
9	Trade	16.1	11.9	13.5	49.1	*15.8*	62.6	*11.8*	49.4	*12.8*	17.8	*16.4*	29.4	*11.8*	20.2	*12.7*
10	Transport	10.2	5.4	6.8	38.0	*7.7*	67.4	*5.7*	40.0	*5.2*	11.7	*6.8*	24.7	*4.5*	14.2	*4.5*
11	Private health	0.9	0.8	0.4	38.4	*0.7*	49.6	*0.6*	25.9	*0.2*	13.7	*0.7*	18.9	*0.5*	2.9	*0.1*
12	Private education	5.0	0.9	1.2	21.9	*2.2*	50.6	*0.7*	37.7	*0.9*	6.2	*1.8*	20.1	*0.6*	9.0	*0.5*
13	Banking & insurance	1.4	1.1		23.2	*0.6*	34.7	*0.6*	0.0	*0.0*	3.0	*0.2*	15.1	*0.6*	0.0	*0.0*
14	Government services	8.9	14.5	14.1	21.8	*3.9*	57.7	*13.3*	49.8	*13.5*	6.0	*3.0*	24.8	*12.2*	19.3	*12.7*
15	Other services	16.0	24.0	16.5	54.8	*17.5*	59.9	*22.8*	46.8	*14.8*	21.7	*19.9*	28.1	*22.8*	17.3	*13.3*
Rural		**81.5**	**78.4**	**77.8**	**74.5**	***100***	**76.0**	***100***	**76.7**	***100***	**33.1**	***100***	**34.7**	***100***	**36.1**	***100***
1	Agriculture	85.9	83.4	82.9	76.5	*88.2*	76.6	*84.1*	78.6	*85.0*	34.5	*89.4*	35.0	*84.1*	37.4	*85.9*
2	Fishing & livestock	0.6	1.7	1.8	66.0	*0.6*	89.2	*2.0*	81.8	*1.9*	41.1	*0.8*	46.2	*2.3*	36.8	*1.8*
3	Other primary activities	0.7	0.7	1.5	73.0	*0.7*	69.3	*0.6*	90.7	*1.7*	41.7	*0.9*	32.9	*0.6*	46.1	*1.9*
4	Food & drink industry	0.4	0.4	0.7	50.8	*0.3*	91.1	*0.5*	60.8	*0.5*	17.4	*0.2*	49.1	*0.6*	27.1	*0.5*
5	Mining	0.4	0.1	0.4	40.7	*0.2*	69.7	*0.1*	92.2	*0.5*	9.1	*0.1*	38.8	*0.2*	45.7	*0.5*
6	Manufacturing	2.3	0.7	1.5	66.7	*2.1*	79.2	*0.8*	56.3	*1.1*	27.8	*2.0*	37.0	*0.8*	21.9	*0.9*
7	Energy				0.0	*0.0*	0.0	*0.0*	0.0	*0.0*	0.0	*0.0*	0.0	*0.0*	0.0	*0.0*
8	Construction	1.1	0.5	0.5	75.3	*1.1*	65.4	*0.5*	52.0	*0.3*	31.2	*1.0*	31.3	*0.5*	22.2	*0.3*
9	Trade	2.2	3.4	3.1	63.6	*1.9*	69.4	*3.1*	60.4	*2.4*	24.2	*1.6*	29.3	*2.8*	24.9	*2.1*
10	Transport	0.9	0.6	0.8	67.3	*0.8*	71.7	*0.5*	64.5	*0.7*	26.3	*0.7*	28.7	*0.5*	18.8	*0.4*
11	Private health	0.2	0.0	0.2	72.5	*0.2*	100.0	*0.0*	8.3	*0.0*	51.7	*0.3*	50.3	*0.0*	1.0	*0.0*
12	Private education	2.2	0.3	0.1	54.8	*1.6*	73.0	*0.3*	46.0	*0.1*	12.8	*0.8*	35.8	*0.3*	23.2	*0.1*
13	Banking & insurance				0.0	*0.0*	0.0	*0.0*	0.0	*0.0*	0.0	*0.0*	0.0	*0.0*	0.0	*0.0*
14	Government services	1.1	3.1	2.8	45.7	*0.7*	69.2	*2.8*	55.3	*2.0*	13.8	*0.5*	29.3	*2.6*	26.6	*2.0*
15	Other services	1.8	4.9	3.7	69.6	*1.7*	72.5	*4.7*	77.5	*3.7*	29.3	*1.6*	33.7	*4.7*	33.7	*3.5*

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data
Note: Contribution to national poverty in *italics*
Note: Poverty measures have been multiplied by 100

Table 8: Poverty in Madagascar by Select Household Groups

	Headcount (P_0)			Depth (P_1)		
	1993	1997	1999	1993	1997	1999
National	**70.0**	**73.3**	**71.3**	**30.3**	**33.6**	**32.8**
1 Small-scale farming	79.3	80.0	82.2	37.3	38.4	40.2
Staple crops only	*85.3*	*76.7*	*83.9*	*39.4*	*36.7*	*42.5*
Other crops included	*74.4*	*81.9*	*81.2*	*35.4*	*39.2*	*38.5*
2 Medium- & large-scale farming	72.0	71.9	70.7	29.5	31.1	31.2
3 Unskilled labor	50.4	84.3	81.3	15.6	45.9	36.4
4 Others	58.8	63.7	55.1	24.6	28.3	23.7
Urban	**50.1**	**63.2**	**52.1**	**17.5**	**33.6**	**21.4**
1 Small-scale farming	77.5	78.9	71.1	26.0	42.7	31.1
Staple crops only	*82.4*	*74.7*	*72.6*	*19.4*	*41.6*	*32.4*
Other crops included	*78.3*	*81.7*	*71.3*	*31.9*	*43.3*	*29.9*
2 Medium- & large-scale farming	58.1	59.3	51.7	17.9	19.9	20.3
3 Unskilled labor	44.7	82.4	63.0	14.5	48.2	31.9
4 Others	44.7	56.5	47.0	16.6	24.2	18.6
Rural	**74.5**	**76.0**	**76.7**	**33.1**	**34.7**	**36.1**
1 Small-scale farming	79.4	80.1	83.3	38.2	37.8	41.1
Staple crops only	*85.5*	*77.0*	*85.5*	*40.8*	*36.1*	*43.8*
Other crops included	*74.2*	*81.9*	*81.8*	*35.6*	*38.7*	*39.1*
2 Medium- & large-scale farming	72.6	72.4	72.2	30.0	31.5	32.0
3 Unskilled labor	62.9	87.0	93.7	18.0	42.7	39.5
4 Others	69.1	72.0	65.1	30.5	32.9	29.9

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data
Note: Contribution to national poverty in *italics*
Note: Poverty measures have been multiplied by 100
Note: Small-scale farms are defined as those that cultivate 0 to 1.5 hectares of land

Table 9: Minimum Public Sector Real Wages in Madagascar

	1993	1997	1999
Minimum wage in 1990 constant FMG	39,707	58,925	64,620

Source: Secrétariat Pemanent à la Prévision Macro-économique,
Ministère des Finances et de l'Economie
Note: Deflated using a traditional sector consumer price index

Table 10a: Poverty in Madagascar by Characteristics of the Household Head and Gender

	Incidence (P_0)						Depth (P_1)					
	1993		1997		1999		1993		1997		1999	
	P_0	*Share*	P_0	*Share*	P_0	*Share*	P_1	*Share*	P_1	*Share*	P_1	*Share*
National	**70.0**	***100***	**73.3**	***100***	**71.3**	***100***	**30.3**	***100***	**33.6**	***100***	**32.8**	***100***
Gender of Household Head												
Male	69.5	*84.8*	73.2	*87.0*	71.4	*86.7*	29.9	*84.4*	33.3	*86.2*	32.7	*86.1*
Female	72.8	*15.2*	73.5	*13.0*	70.4	*13.3*	32.4	*15.6*	35.9	*13.8*	33.9	*13.9*
Marital Status of Household Head												
Married	70.2	*78.8*	73.8	*78.8*	71.9	*78.2*	30.2	*78.5*	33.7	*78.6*	32.9	*77.6*
Divorced/Widowed	72.9	*17.5*	72.3	*13.5*	70.3	*14.3*	31.8	*17.6*	34.1	*13.9*	33.3	*14.7*
Other Single	56.3	*3.7*	69.8	*7.7*	66.8	*7.5*	25.7	*3.9*	31.5	*7.5*	31.6	*7.7*
Marital Status of Female Heads												
Married	64.0	*0.5*	76.5	*1.1*	58.1	*0.7*	38.7	*0.7*	39.6	*1.3*	27.8	*0.7*
Divorced/Widowed	74.5	*14.0*	74.3	*10.2*	72.6	*11.3*	32.8	*14.3*	36.1	*10.8*	34.8	*11.8*
Other Single	54.2	*0.7*	67.7	*1.7*	60.6	*1.3*	22.4	*0.7*	32.9	*1.8*	31.0	*1.4*
Marital Status of Male Heads												
Married	70.2	*78.4*	73.7	*77.7*	72.0	*77.5*	30.1	*77.8*	33.7	*77.3*	32.9	*76.9*
Divorced/Widowed	67.1	*3.5*	67.0	*3.4*	62.6	*3.0*	27.9	*3.4*	28.8	*3.2*	28.5	*3.0*
Other Single	56.9	*2.9*	70.4	*6.0*	68.2	*6.2*	26.6	*3.2*	31.0	*5.7*	31.7	*6.3*
Age of Household Head												
Under 25	67.2	*4.9*	69.1	*4.6*	70.1	*2.7*	28.2	*4.7*	29.1	*4.3*	29.2	*2.4*
25 - 39	69.4	*39.3*	72.9	*37.9*	71.2	*32.5*	29.3	*38.4*	32.9	*37.2*	32.1	*31.9*
40 - 49	71.9	*24.2*	76.1	*28.5*	74.9	*32.6*	32.6	*25.4*	36.5	*29.7*	35.4	*33.4*
50 - 59	70.7	*16.0*	72.6	*15.1*	72.8	*17.7*	32.0	*16.7*	33.3	*15.1*	33.9	*17.9*
60+	68.9	*15.6*	71.0	*13.9*	63.0	*14.5*	28.1	*14.7*	32.0	*13.7*	28.8	*14.4*
Share of Adult Members Who are Women												
0 <= and <= 0.25	65.4	*8.0*	71.4	*8.3*	66.3	*8.2*	27.9	*7.9*	32.5	*8.2*	31.1	*8.3*
0.25< and <= 0.50	69.4	*63.4*	72.2	*65.8*	71.1	*64.9*	29.9	*63.2*	32.2	*64.0*	32.0	*63.4*
0.50< and <= 0.75	72.2	*20.3*	77.3	*19.0*	74.7	*20.0*	30.8	*20.1*	37.8	*20.2*	35.9	*20.9*
0.75< and <= 1.00	74.1	*8.3*	74.9	*6.9*	69.4	*6.9*	34.0	*8.8*	37.5	*7.6*	34.2	*7.3*

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data

Note: Contribution to national poverty in *italics*

Note: Poverty measures have been multiplied by 100

Table 10b: Poverty in Madagascar by Characteristics of Household Members

	Incidence (P_0)						Depth (P_1)					
	1993		1997		1999		1993		1997		1999	
	P_0	*Share*	P_0	*Share*	P_0	*Share*	P_1	*Share*	P_1	*Share*	P_1	*Share*
National	**70.0**	***100***	**73.3**	***100***	**71.3**	***100***	**30.3**	***100***	**33.6**	***100***	**32.8**	***100***
Share of Adult Members With at Least Primary Education												
0<= and <= 0.25	78.8	*21.6*	81.6	*14.3*	81.8	*15.8*	40.0	*25.4*	41.2	*15.8*	41.5	*17.3*
0.25< and <= 0.50	78.0	*19.7*	75.0	*18.8*	79.3	*15.6*	34.4	*20.1*	35.7	*19.5*	39.9	*17.0*
0.50< and <= 0.75	71.8	*14.9*	74.2	*18.3*	77.0	*15.9*	31.2	*15.0*	35.1	*18.9*	37.0	*16.6*
0.75< and <= 1.00	63.0	*43.7*	70.2	*48.5*	65.3	*52.8*	24.6	*39.5*	30.4	*45.8*	28.0	*49.1*
Share of Adult Members With at Least Secondary Education												
0<= and <= 0.25	77.6	*79.5*	79.0	*69.3*	79.9	*70.5*	35.0	*82.8*	37.8	*72.2*	38.6	*73.9*
0.25< and <= 0.50	63.1	*12.5*	70.7	*18.4*	69.5	*16.5*	24.5	*11.3*	30.1	*17.0*	29.7	*15.3*
0.50< and <= 0.75	48.9	*4.0*	54.7	*4.1*	51.9	*4.6*	17.3	*3.3*	22.6	*3.7*	20.0	*3.9*
0.75< and <= 1.00	32.1	*4.0*	53.6	*8.2*	43.2	*8.4*	9.3	*2.7*	21.2	*7.1*	16.5	*7.0*
Years of Education of Adult Member with Highest Level of Education												
None	76.9	*17.8*	81.1	*11.4*	79.3	*12.5*	39.0	*20.9*	40.2	*12.4*	38.9	*13.3*
1 to 6	78.3	*57.1*	78.9	*51.8*	80.7	*51.5*	34.4	*58.0*	37.1	*53.1*	38.9	*54.0*
7 to 10	64.2	*18.4*	73.1	*23.8*	69.2	*25.1*	24.9	*16.5*	32.6	*23.2*	30.3	*23.8*
11+	36.9	*6.7*	53.6	*13.0*	44.6	*10.9*	10.9	*4.6*	21.6	*11.4*	16.7	*8.9*
Share of Adult Member Employed												
None	51.5	*0.4*	65.6	*1.4*	58.5	*1.4*	18.1	*0.4*	30.6	*1.4*	26.5	*1.4*
0< and <= 0.25	66.7	*7.4*	78.0	*21.6*	73.7	*23.9*	28.2	*7.2*	36.4	*22.0*	34.8	*24.5*
0.25< and <= 0.50	72.0	*45.4*	75.0	*47.4*	73.4	*43.7*	31.9	*46.5*	34.6	*47.7*	33.3	*43.1*
0.50< and <= 0.75	74.6	*31.5*	73.0	*21.7*	70.3	*21.3*	33.0	*32.2*	33.7	*21.8*	33.6	*22.1*
0.75< and <= 1.00	59.6	*15.3*	57.4	*7.9*	61.7	*9.7*	23.0	*13.7*	23.7	*7.1*	26.4	*9.0*
Dependency Ratio [a]												
0	49.9	*7.5*	47.9	*4.2*	53.4	*4.9*	18.2	*6.3*	18.0	*3.4*	19.4	*3.9*
0< and <= 0.5	69.8	*24.4*	68.7	*15.9*	68.9	*16.7*	29.1	*23.5*	31.1	*15.6*	32.3	*17.0*
0.5< and <= 1.0	76.0	*30.6*	74.4	*23.0*	69.6	*21.6*	33.8	*31.5*	33.6	*22.7*	31.8	*21.4*
1.0< and <= 1.5	74.9	*14.7*	77.3	*13.9*	76.8	*13.1*	32.8	*14.9*	35.6	*13.9*	36.1	*13.4*
greater than 1.5	69.1	*22.8*	77.2	*43.0*	74.3	*43.6*	31.1	*23.7*	36.5	*44.3*	34.8	*44.3*

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data

Note: Contribution to national poverty in *italics*

Note: Poverty measures have been multiplied by 100

[a] Dependency ratio is number of non-employed members divided by number of employed members

Table 11: Poverty in Rural Madagascar by Degree of Remotene

	Headcount (P_0)				Depth (P_1)			
	1997		1999		1997		1999	
	P_0	*Share*	P_0	*Share*	P_1	*Share*	P_1	*Share*
Rural	**76.0**	***100***	**76.7**	***100***	**34.7**	***100***	**36.1**	***100***
Quintile of Remoteness Index								
Most remote	78.0	*20.3*	82.8	*20.0*	34.8	*19.8*	42.4	*21.8*
2nd quintile	78.2	*20.1*	78.9	*21.9*	38.1	*21.4*	35.6	*21.0*
3rd quintile	74.5	*20.2*	78.9	*20.4*	32.7	*19.4*	37.7	*20.7*
4th quintile	77.0	*20.2*	77.7	*20.2*	36.6	*21.0*	36.5	*20.1*
Least remote	72.6	*19.3*	65.9	*17.5*	31.6	*18.4*	29.0	*16.4*

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data
Note: Contribution to national poverty in *italics*
Note: Poverty measures have been multiplied by 100

Table 12: Household Land Holdings by Consumption Decile

	Mean Per Capita Household Land Holdings (hectares)							
Consumption	National		Rural		Rural Agricultural		Agricultural	
Decile	1993	1999	1993	1999	1993	1999	1993	1999
Poorest	0.20	0.17	0.21	0.19	0.21	0.20	0.21	0.20
2	0.30	0.21	0.32	0.23	0.34	0.24	0.34	0.24
3	0.25	0.25	0.27	0.27	0.29	0.29	0.28	0.29
4	0.26	0.24	0.29	0.27	0.31	0.29	0.30	0.28
5	0.24	0.29	0.26	0.33	0.29	0.36	0.29	0.35
6	0.29	0.28	0.34	0.33	0.40	0.37	0.38	0.36
7	0.31	0.32	0.38	0.38	0.43	0.43	0.40	0.42
8	0.38	0.34	0.47	0.41	0.50	0.45	0.49	0.43
9	0.37	0.35	0.49	0.48	0.54	0.56	0.53	0.53
Richest	0.46	0.38	0.64	0.57	0.81	0.74	0.83	0.70
National	0.31	0.28	0.35	0.33	0.38	0.36	0.38	0.36

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data

Table 13: Poverty by Landholdings in Rural Areas

Size of land holding (HA/capi	Share of Rural Population 1993	1999	Incidence (P_0) 1993	1999	Depth (P_1) 1993	1999
All Rural Households						
0-0.001	7.8	7.9	58.0	68.9	24.7	31.0
0.001-0.09	26.2	9.4	84.2	86.2	40.6	49.2
0.1 - 0.19	18.1	20.3	82.4	87.9	38.3	46.3
0.2 - 0.39	22.8	34.6	79.5	84.1	33.2	38.8
0.4 - 0.79	15.6	20.8	64.7	62.6	25.9	24.6
0.8 or more	9.6	7.1	50.7	46.4	21.7	15.5
Rural Agricultural Households						
0-0.001	2.8	2.4	61.1	69.8	30.1	35.6
0.001-0.09	26.0	7.8	86.3	91.7	43.1	54.1
0.1 - 0.19	18.8	20.8	82.9	91.1	38.2	48.6
0.2 - 0.39	25.0	37.9	80.1	85.0	33.7	39.8
0.4 - 0.79	17.2	23.2	65.3	63.9	26.1	25.3
0.8 or more	10.2	7.9	53.9	47.5	23.2	15.8

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data

Table 14: Inequality in Madagascar

	Population Share 1993	1997	1999	Consumption Share 1993	1997	1999	Gini 1993	1997	1999	Theil 1993	1997	1999
National	**100**	**100**	**100**	**100**	**100**	**100**	**0.451**	**0.392**	**0.382**	**0.531**	**0.285**	**0.251**
Urban	18.5	21.6	22.2	24.7	25.5	30.9	0.415	0.421	0.384	0.363	0.316	0.249
Rural	81.5	78.4	77.8	75.3	74.5	69.1	0.449	0.378	0.361	0.570	0.268	0.222
Within-group inequality										*97.7*	*98.4*	*92.1*
Between-group inequality										*2.3*	*1.6*	*7.9*
Antananarivo	30.2	28.2	27.9	30.3	32.2	33.1	0.413	0.397	0.374	0.348	0.288	0.237
Fianarantsoa	19.3	20.2	18.7	18.0	20.4	15.1	0.462	0.376	0.368	0.541	0.304	0.243
Taomasina	16.1	16.5	15.5	12.8	14.1	15.3	0.363	0.382	0.374	0.264	0.255	0.244
Mahajanga	12.9	11.2	13.7	18.7	11.0	12.5	0.493	0.307	0.378	0.845	0.160	0.242
Toliara	13.5	15.5	15.6	9.0	12.4	15.2	0.405	0.455	0.377	0.289	0.385	0.240
Antsiranana	8.0	8.4	8.6	11.2	9.9	8.8	0.511	0.345	0.380	0.713	0.200	0.257
Within-group inequality										*94.4*	*96.8*	*96.5*
Between-group inequality										*5.6*	*3.2*	*3.5*

Source: INSTAT, Cornell University and World Bank Staff estimates from EPM data

Table 15: Decomposition of Changes in Poverty in Madagascar into Growth and Redistribution Effects

	1st Year	2nd Year	Total Diff.	Growth Effect	Redistr Effect	Residual Effect
Levels				***1993-1997***		
Headcount (P_0)	70.0	73.3	3.3	8.3	-7.2	2.2
Depth (P_1)	30.3	33.6	3.3	7.7	-4.0	-0.3
Severity (P_2)	16.7	19.3	2.6	5.7	-2.5	-0.6
Percent of Total Change						
Headcount (P0)			100	252	-219	67
Depth (P1)			100	231	-121	-10
Severity (P2)			100	216	-95	-22
Levels				***1993-1999***		
Headcount (P_0)	70.0	71.3	1.3	7.9	-8.2	1.5
Depth (P_1)	30.3	32.8	2.6	7.5	-4.4	-0.5
Severity (P_2)	16.7	18.7	2.0	5.5	-2.9	-0.6
Percent of Total Change						
Headcount (P0)			100	629	-648	119
Depth (P1)			100	292	-171	-21
Severity (P2)			100	271	-143	-28
Levels				***1997-1999***		
Headcount (P_0)	73.3	71.3	-2.0	-0.2	-1.5	-0.2
Depth (P_1)	33.6	32.8	-0.8	-0.2	-0.5	0.0
Severity (P_2)	19.3	18.7	-0.6	-0.2	-0.4	0.0
Percent of Total Change						
Headcount (P0)			100	12	76	12
Depth (P1)			100	31	70	-1
Severity (P2)			100	29	71	0

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data

Table 16: Enrollment Rates of Children Age 6-14

	Public			Private			Total		
	1993	1997	1999	1993	1997	1999	1993	1997	1999
National	39.3	49.8	52.8	12.1	16.2	14.7	51.4	66.0	67.5
Province									
Antananarivo	38.7	47.7	49.4	25.6	28.6	28.2	64.3	76.3	77.6
Fianarantsoa	31.8	51.5	50.5	6.6	15.4	11.2	38.4	66.9	61.7
Taomasina	47.5	62.9	65.6	8.0	9.3	9.1	55.5	72.2	74.7
Mahajanga	43.7	42.4	42.8	5.8	8.5	10.6	49.5	50.9	53.4
Toliara	27.2	35.3	49.6	4.5	11.0	8.4	31.7	46.2	58.0
Antsiranana	58.2	63.5	68.7	8.1	11.7	7.5	66.3	75.3	76.2
Consumption Quintile									
Poorest	27.7	44.9	50.0	3.8	8.8	6.1	31.6	53.7	56.0
2nd	39.4	52.0	57.1	9.2	12.7	9.9	48.6	64.7	67.0
3rd	48.0	51.4	53.8	11.2	14.9	13.9	59.1	66.3	67.7
4th	48.6	51.0	54.3	13.1	21.4	16.3	61.6	72.4	70.5
Richest	33.2	50.7	48.3	30.0	27.4	33.4	63.2	78.1	81.8

Source: Glick and Razakamantsoa (forthcoming) from EPM data

Enrollment = percentage of children age 6-14 currently enrolled in school

Table 17: Enrollment Rates of Children Age 6-14 by Poverty Status

	Public			Private			Total		
	1993	1997	1999	1993	1997	1999	1993	1997	1999
National									
Extreme poor	38.0	49.2	53.4	7.5	12.5	9.8	45.6	61.7	63.2
Poor	39.3	49.3	53.7	8.1	13.3	10.4	47.4	62.6	64.1
Non-poor	39.3	51.6	50.0	24.9	26.5	28.3	64.2	78.1	78.3
Urban									
Extreme poor	55.0	48.4	50.3	13.3	24.1	22.9	68.3	72.5	73.2
Poor	56.4	49.4	50.3	15.3	26.1	23.6	71.7	75.5	73.9
Non-poor	36.1	38.5	41.3	53.1	50.0	50.2	89.2	88.5	91.4
Rural									
Extreme poor	35.7	49.3	54.0	6.8	10.0	7.4	42.4	59.4	61.4
Poor	36.7	49.3	54.4	7.0	10.5	7.9	43.7	59.8	62.2
Non-poor	40.7	56.4	54.6	12.4	17.9	16.7	53.1	74.2	71.3

Source: Glick and Razakamantsoa (forthcoming) from EPM data

Enrollment = percentage of children age 6-14 currently enrolled in school

Table 18a: Access to Basic Services in Madagascar

Type of Service		Total	National Quintiles					By Area		By Group	
			Poorest	2nd	3rd	4th	Richest	Urban	Rural	Poor	Non poor
Electricity connection, percent	*1993*	9.1	0.2	2.0	4.9	11.5	27.2	39.5	2.3	3.1	23.4
	1999	13.1	1.8	4.2	8.2	13.9	37.7	46.4	3.6	5.7	31.5
Sanitation connection, percent											
piped connection -- (1)	*1993*	1.8	0.0	0.1	0.4	1.3	7.2	9.6	0.0	0.3	5.3
	1999	1.6	0.1	0.4	0.5	0.9	6.1	6.7	0.2	0.4	4.7
(1) + latrines -- (2)	*1993*	35.0	18.6	32.3	34.8	38.4	50.6	66.7	27.8	29.6	47.5
	1999	45.0	31.2	37	45.1	49.2	62.4	71.6	37.4	39.0	59.8
(2) + "tinettes"	*1993*	36.2	19.6	33.4	35.2	39.6	53.1	70.4	28.4	30.4	49.6
	1999	49.5	35.6	41.4	50.7	53.1	66.9	77.9	41.4	43.5	64.5
Public Water Supply	*1993*	17.0	10.8	11.0	12.8	19.1	31.2	63.6	6.4	12.1	28.3
	1999	19.1	7.7	11.2	16.6	22.3	37.6	58.5	7.8	12.4	35.4
Absence of Crowding	*1993*	4.5	2.7	3.5	4.3	4.9	7.1	5.3	4.3	3.6	6.4
(m^2 per person)	*1999*	5.0	3.2	4.0	4.4	5.2	7.9	6.0	4.6	4.0	7.1
Population (millions)	*1993*	12.3	2.5	2.5	2.5	2.5	2.5	2.3	10.0	8.6	3.7
	1999	14.6	2.9	2.9	2.9	2.9	2.9	3.3	11.4	10.4	4.2

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data

Table 18b: Access to Basic Services in Madagascar by Province

Type of Service		Total	Province					
			Antananarivo	Fianarantsoa	Taomasina	Mahajanga	Toliara	Antsiranana
Electricity connection, percent	*1993*	9.1	19.0	3.5	4.4	6.6	2.6	10.3
	1999	13.1	24.6	6.1	10.3	9.4	8.9	10.0
Sanitation connection, percent								
piped connection -- (1)	*1993*	1.8	3.3	0.9	1.1	1.7	0.4	2.4
	1999	1.6	2.2	1.7	1.5	1.5	0.2	2.3
(1) + latrines -- (2)	*1993*	35.0	66.7	16.5	38.2	20.3	8.8	21.3
	1999	45.0	81.1	33.4	54.3	19.7	15.8	29.4
(2) + "tinettes"	*1993*	36.2	68.0	17.2	39.2	20.7	10.1	25.2
	1999	49.5	82.3	34.4	71.2	20.7	16.6	42.8
Public Water Supply	*1993*	17.0	31.2	5.2	7.2	20.1	14.4	11.1
	1999	19.1	33.5	8.4	11.7	17.3	19.7	10.0
Absence of Crowding	*1993*	4.5	5.1	4.6	3.8	5.2	2.9	5.3
(m^2 per person)	*1999*	5.0	5.9	5.7	4.1	4.7	3.6	4.8
Population (millions)	*1993*	12.3	3.7	2.4	2.0	1.6	1.7	1.0
	1999	14.6	4.1	2.7	2.3	2.0	2.3	1.3

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data

Table 19: Malnutrition (Stunting) in Madagascar: 1993, 1997 & 1999

FGT Poverty Measures Applied to Anthropometric Z-scores ("poverty line" = -2)

	Incidence (P_0)						Depth (P_1)					
	1993		1997		1999		1993		1997		1999	
	P_0	*Share*	P_0	*Share*	P_0	*Share*	P_1	*Share*	P_1	*Share*	P_1	*Share*
National	**49.6**	***100***	**50.1**	***100***	**48.7**	***100***	**62.6**	***100***	**68.8**	***100***	**60.0**	***100***
Urban	43.7	*13.4*	46.4	*14.8*	44.7	*7.3*	53.7	*13.0*	65.9	*15.3*	56.1	*7.5*
Rural	50.6	*86.6*	50.8	*85.2*	49.1	*92.7*	64.2	*87.0*	69.3	*84.7*	60.3	*92.5*
Antananarivo	56.6	*36.3*	55.9	*23.4*	46.7	*23.3*	68.9	*34.9*	81.0	*24.7*	62.5	*25.3*
Fianarantsoa	51.5	*16.1*	64.7	*21.9*	55.3	*20.8*	76.3	*18.9*	99.5	*24.5*	69.1	*21.1*
Taomasina	55.4	*18.7*	51.8	*18.5*	50.5	*17.3*	75.9	*20.3*	72.3	*18.7*	56.1	*15.6*
Mahajanga	34.2	*8.3*	38.6	*11.4*	41.5	*13.4*	32.6	*6.2*	47.3	*10.1*	46.0	*12.0*
Toliara	47.7	*14.6*	39.9	*16.1*	51.2	*17.3*	59.3	*14.4*	46.3	*13.6*	64.3	*17.6*
Antsiranana	33.6	*5.9*	47.0	*8.7*	44.9	*7.9*	37.1	*5.2*	61.2	*8.3*	58.2	*8.3*

Source: INSTAT, Cornell University and World Bank Staff estimates from EPM data
Note: Contribution to national Malnutrition in *italics*
Note: Malnutrition measures have been multiplied by 100

Table 20: Descriptive Statistics for Explanatory Variables for Rural Models of Consumption

	1993		1999			
	Mean	S.E.	Mean	S.E.	Diff	z-stat
Log of household per capita consumption	12.268	0.036	12.182	0.029	-0.086	-0.34
Number of children 0-1	0.247	0.014	1.098	0.033	0.852	3.90 **
Number of children 1-5	1.126	0.031	0.232	0.012	-0.894	-4.32 **
Number of children 6-14	1.784	0.043	1.894	0.045	0.109	0.37
number of female adults	1.481	0.030	1.510	0.030	0.029	0.12
number of male adults	1.461	0.031	1.513	0.032	0.052	0.21
Number of seniors	0.273	0.015	0.243	0.013	-0.029	-0.18
Number of adults with primary education	1.546	0.052	1.661	0.061	0.114	0.34
Number of adults with secondary education	0.447	0.045	0.603	0.047	0.156	0.51
Number of adults with tertiary education	0.016	0.005	0.018	0.005	0.002	0.02
1 if at least one HH member was sick	0.492	0.016	0.402	0.016	-0.090	-0.50
Age of hhhead	43.640	0.386	45.162	0.339	1.522	1.79 +
1 if female hh head	0.132	0.009	0.122	0.009	-0.010	-0.08
Head separated/divorced	0.080	0.006	0.068	0.007	-0.012	-0.10
Head single	0.013	0.002	0.014	0.002	0.000	0.00
Head widowed	0.080	0.007	0.068	0.007	-0.012	-0.10
1 if involved in ent. non-agric	0.218	0.021	0.282	0.021	0.064	0.31
1 if family has live stock	0.818	0.014	0.846	0.017	0.028	0.16
Produce only agric staple & have 1 income sou	0.260	0.023	0.238	0.020	-0.023	-0.11
Industry	0.032	0.006	0.031	0.006	-0.001	-0.01
Services	0.093	0.012	0.101	0.014	0.009	0.05
Not working	0.003	0.001	0.006	0.002	0.003	0.06
Number of unemployed in the hh	0.102	0.021	0.272	0.041	0.170	0.68
Number of income sources	1.338	0.026	1.306	0.026	-0.032	-0.14
Landless	0.078	0.015	0.079	0.015	0.001	0.01
Land (0.0001 - 0.09 ha/capita)	0.262	0.017	0.094	0.010	-0.168	-1.02
Land (0.1 - 0.19 ha/capita)	0.181	0.011	0.203	0.012	0.022	0.15
Land (0.2 - 0.39 ha/capita)	0.228	0.013	0.346	0.014	0.118	0.72
Land (0.4 - 0.79 ha/capita)	0.156	0.010	0.208	0.011	0.052	0.36
Land (0.8 or more ha/capita)	0.096	0.011	0.071	0.006	-0.025	-0.19
Distance from health center, in km	11.543	2.027	5.668	0.459	-5.875	-3.73 **
Antananarivo	0.280	0.012	0.254	0.012	-0.026	-0.17
Fianarantsoa	0.208	0.010	0.202	0.013	-0.006	-0.04
Toamasina	0.172	0.010	0.156	0.012	-0.016	-0.11
Mahajanga	0.130	0.010	0.140	0.014	0.010	0.07
Toilara	0.137	0.011	0.155	0.015	0.019	0.12
Antsiranana	0.074	0.006	0.092	0.007	0.018	0.16
Cyclones (number by season, nov-oct)	0.156	0.023	0.173	0.032	0.017	0.07
Cyclones in prior season	0.119	0.025	0	0	-0.119	-0.75
Drought proxy (dekads < 75% normal prec)	0.355	0.043	0.639	0.113	0.284	0.72
Drought in prior year	0.246	0.056	0.144	0.043	-0.103	-0.33

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data

Note: Cyclone & drought data were provided by CNS (CARE SIRCat Project)

+, * and ** significant at 10%, 5% and 1% levels, respectively

Table 21: Descriptive Statistics for Explanatory Variables for Urban Models of Consumption

	1993		1999			
	Mean	S.E.	Mean	S.E.	Diff	z-stat
Log of household per capita consumption	12.702	0.034	12.591	0.044	-0.111	-0.40
Number of children 0-1	0.198	0.012	0.789	0.039	0.591	2.62 **
Number of children 1-5	0.873	0.034	0.160	0.012	-0.713	-3.30 **
Number of children 6-14	1.637	0.054	1.635	0.052	-0.002	-0.01
number of female adults	1.745	0.038	1.726	0.039	-0.020	-0.07
number of male adults	1.641	0.039	1.614	0.039	-0.027	-0.10
Number of seniors	0.223	0.015	0.266	0.018	0.043	0.24
Number of adults with primary education	1.321	0.047	1.225	0.061	-0.096	-0.29
Number of adults with secondary education	1.462	0.077	1.620	0.080	0.158	0.40
Number of adults with tertiary education	0.231	0.024	0.178	0.024	-0.053	-0.24
1 if at least one HH member was sick	0.536	0.017	0.346	0.016	-0.190	-1.05
Age of hhhead	44.122	0.367	46.531	0.426	2.409	2.71 **
1 if female hh head	0.208	0.010	0.178	0.012	-0.030	-0.20
Head separated/divorced	0.106	0.007	0.073	0.008	-0.033	-0.27
Head single	0.031	0.004	0.029	0.005	-0.003	-0.03
Head widowed	0.097	0.008	0.103	0.008	0.006	0.05
1 if involved in ent. non-agric	0.375	0.025	0.472	0.022	0.097	0.45
1 if family has live stock	0.376	0.031	0.403	0.029	0.026	0.11
Industry	0.122	0.013	0.132	0.011	0.010	0.06
Services	0.598	0.029	0.519	0.025	-0.079	-0.34
Not working	0.019	0.003	0.023	0.004	0.004	0.05
Civil Service	0.088	0.009	0.141	0.014	0.053	0.35
Number of unemployed in the hh	0.276	0.031	0.478	0.049	0.202	0.71
Number of income sources	1.832	0.042	1.519	0.031	-0.314	-1.16
Landless	0.672	0.029	0.632	0.032	-0.040	-0.16
Land (0.0001 - 0.09 ha/capita)	0.136	0.014	0.080	0.012	-0.056	-0.35
Land (0.1 - 0.19 ha/capita)	0.059	0.009	0.083	0.011	0.024	0.17
Land (0.2 - 0.39 ha/capita)	0.076	0.018	0.103	0.013	0.028	0.15
Land (0.4 - 0.79 ha/capita)	0.032	0.006	0.075	0.010	0.044	0.35
Land (0.8 or more ha/capita)	0.026	0.005	0.027	0.005	0.001	0.01
Antananarivo	0.397	0.020	0.366	0.028	-0.032	-0.14
Fianarantsoa	0.128	0.011	0.135	0.019	0.007	0.04
Toamasina	0.113	0.009	0.150	0.017	0.037	0.23
Mahajanga	0.126	0.010	0.127	0.024	0.001	0.00
Toilara	0.129	0.033	0.160	0.022	0.031	0.13
Antsiranana	0.107	0.009	0.063	0.007	-0.044	-0.35

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data

+, * and ** significant at 10%, 5% and 1% levels, respectively

Table 22: Rural Models of Per Capita Household Consumption in Madagascar

	1993		1999			
	1993	t-stat	1999	t-stat	Diff	z-stat
Number of children 0-1	-0.249	-8.43 **	-0.206	-9.62 **	0.043	1.17
Number of children 1-5	-0.223	-7.81 **	-0.115	-2.87 **	0.107	2.18 *
Number of children 6-14	-0.182	-7.34 **	-0.189	-8.60 **	-0.007	-0.21
Number of female adults	-0.162	-5.48 **	-0.174	-7.96 **	-0.013	-0.34
Number of male adults	-0.148	-4.39 **	-0.172	-6.96 **	-0.024	-0.56
Number of seniors	-0.093	-2.35 *	-0.159	-4.18 **	-0.066	-1.20
Squared number of household members	0.008	4.16 **	0.007	5.56 **	0.000	-0.04
Number of adults with primary education	0.018	1.31	0.039	3.01 **	0.021	1.09
Number of adults with secondary education	0.073	3.77 **	0.083	4.42 **	0.011	0.39
Number of adults with tertiary education	0.188	2.78 **	0.387	3.66 **	0.199	1.58
1 if at least one HH member was sick	-0.015	-0.58	-0.028	-1.21	-0.013	-0.37
Age of hhhead	0.010	1.79 +	0.004	0.76	-0.006	-0.88
Age of hhhead squared	-0.0001	-1.97 *	0.0000	-0.63	0.0001	1.12
1 if female hh head	-0.112	-1.91 +	-0.109	-2.03 *	0.003	0.04
Head separated/divorced	-0.124	-2.13 *	-0.087	-1.48	0.037	0.44
Head single	-0.039	-0.45	0.042	0.48	0.081	0.65
Head widowed	-0.066	-1.10	0.019	0.21	0.085	0.78
1 if involved in ent. non-agric	0.028	0.59	0.099	3.46 **	0.072	1.30
1 if family has live stock	0.174	4.69 **	0.058	1.61	-0.116	-2.25 *
Produce only agric staple & have 1 income source	-0.082	-2.18 *	-0.015	-0.42	0.067	1.30
Industry	0.090	1.16	0.161	2.19 *	0.071	0.66
Services	0.167	3.17 **	0.166	3.55 **	-0.002	-0.02
Not working	-0.317	-1.26	-0.098	-0.59	0.219	0.73
Number of unemployed in the hh	-0.065	-1.81 +	-0.024	-1.56	0.041	1.05
Number of income sources	-0.009	-0.23	0.031	1.10	0.040	0.84
Land (0.0001 - 0.09 ha/capita)	-0.073	-0.92	-0.201	-2.19 *	-0.127	-1.05
Land (0.1 - 0.19 ha/capita)	0.043	0.51	0.005	0.05	-0.038	-0.30
Land (0.2 - 0.39 ha/capita)	0.195	2.32 *	0.186	1.94 +	-0.009	-0.07
Land (0.4 - 0.79 ha/capita)	0.296	3.41 **	0.418	4.26 **	0.122	0.93
Land (0.8 or more ha/capita)	0.439	4.60 **	0.589	6.04 **	0.150	1.10
Distance from health center, in km	-0.003	-3.47 **	-0.010	-3.29 **	-0.007	-2.21 *
1 if dist from health missing & imputed	-1.011	-5.05 **	-0.051	-0.98	0.960	4.64 **
Fianarantsoa	1.202	7.47 **	-0.302	-6.31 **	-1.505	-8.96 **
Toamasina	0.186	1.12	-0.337	-3.83 **	-0.523	-2.77 **
Mahajanga	0.884	5.27 **	-0.180	-2.62 **	-1.065	-5.87 **
Toilara	0.143	0.94	0.361	5.99 **	0.218	1.34
Antsiranana	0.823	4.80 **	-0.689	-5.69 **	-1.512	-7.20 **
Cyclones (in prev 2 seasons, nov-oct)	-0.252	-6.58 **	0.350	5.55 **	0.602	8.16 **
Drought prev 2 years (dekads < 75% normal prec)	-0.060	-1.91 +	-0.134	12.01 **	-0.074	-2.22 *
Constant	12.209	68.18 **	12.713	99.00 **	0.505	2.29 *
Observations	2652		2880			
R-squared	0.488		0.469			

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data

Note: Cyclone & drought data were provided by CNS (CARE SIRCat Project)

+, * and ** significant at 10%, 5% and 1% levels, respectively

Table 23: Urban Models of Per Capita Household Consumption in Madagascar

	1993		1999			
	1993	t-stat	1999	t-stat	Diff	z-stat
Number of children 0-1	-0.287	-6.16 **	-0.286	-10.65 **	0.002	0.03
Number of children 1-5	-0.288	-10.91 **	-0.334	-8.24 **	-0.046	-0.95
Number of children 6-14	-0.210	-9.39 **	-0.264	-12.82 **	-0.053	-1.75 +
number of female adults	-0.254	-7.20 **	-0.296	-8.92 **	-0.042	-0.86
number of male adults	-0.204	-6.38 **	-0.317	-10.19 **	-0.113	-2.52 *
Number of seniors	-0.124	-2.57 **	-0.252	-5.17 **	-0.128	-1.87 +
Squared number of household members	0.008	5.70 **	0.011	7.88 **	0.003	1.55
Number of adults with primary education	-0.003	-0.15	0.036	1.66 +	0.039	1.33
Number of adults with secondary education	0.133	6.62 **	0.141	6.74 **	0.009	0.30
Number of adults with tertiary education	0.353	11.00 **	0.373	11.19 **	0.020	0.43
1 if at least one HH member was sick	0.016	0.59	0.075	2.17 *	0.059	1.33
Age of hhhead	0.032	4.61 **	0.022	3.10 **	-0.011	-1.07
Age of hhhead squared	-0.0004	-5.18 **	-0.0002	-3.03 **	0.0002	1.68 +
1 if female hh head	-0.010	-0.15	-0.207	-3.29 **	-0.197	-2.14 *
Head separated/divorced	-0.279	-4.04 **	-0.047	-0.69	0.231	2.38 *
Head single	-0.216	-2.53 *	0.071	0.92	0.287	2.49 *
Head widowed	-0.171	-2.00 *	0.026	0.37	0.197	1.78 +
1 if involved in ent. non-agric	0.134	4.37 **	0.104	2.83 **	-0.031	-0.64
1 if family has live stock	0.098	2.75 **	0.030	0.88	-0.068	-1.38
Industry	-0.017	-0.33	0.084	1.46	0.101	1.31
Services	0.002	0.04	0.056	1.16	0.054	0.85
Not working	0.294	2.83 **	0.144	1.38	-0.150	-1.02
Civil Service	0.126	2.67 **	0.009	0.17	-0.117	-1.62
Number of unemployed in the hh	-0.078	-3.70 **	-0.071	-3.22 **	0.006	0.21
Number of income sources	0.007	0.30	-0.013	-0.56	-0.020	-0.61
Land (0.0001 - 0.09 ha/capita)	-0.045	-0.92	0.040	0.72	0.084	1.15
Land (0.1 - 0.19 ha/capita)	-0.007	-0.10	0.280	4.01 **	0.287	2.90 **
Land (0.2 - 0.39 ha/capita)	0.093	1.33	0.355	4.78 **	0.262	2.57 *
Land (0.4 - 0.79 ha/capita)	0.295	2.92 **	0.607	5.89 **	0.311	2.16 *
Land (0.8 or more ha/capita)	0.359	2.71 **	0.745	8.83 **	0.387	2.46 *
Fianarantsoa	-0.414	-7.36 **	-0.052	-0.69	0.362	3.84 **
Toamasina	-0.710	-11.37 **	-0.900	-9.31 **	-0.191	-1.66 +
Mahajanga	0.458	10.15 **	-0.585	-7.90 **	-1.044	-12.03 **
Toilara	-0.101	-1.58	-0.102	-1.80 +	-0.001	-0.01
Antsiranana	-0.131	-2.66 **	0.051	0.97	0.182	2.52 *
Constant	12.919	80.57 **	13.181	69.69 **	0.262	1.06
Observations	1852		2240			
R-squared	0.488		0.558			

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data

+ significant at 10% level; * significant at 5% level; ** significant at 1% level

Table 24: Select Returns and Endowment Effects from Rural Models of Consumption

Changes in poverty due to changes in returns and endowments

	Returns Effect			Endowment Effect		
	Po	P1	P2	Po	P1	P2
Number of adults with primary education	-1.49	-1.43	-1.04			
Number of adults with secondary education	-0.31	-0.21	-0.14	-0.44	-0.68	-0.54
Number of adults with tertiary education	-0.12	-0.07	-0.04			
1 if involved in non-agric enterprise	-0.64	-0.72	-0.53	-0.17	-0.24	-0.17
Produce only agric staple & have 1 income source	-0.74	-0.74	-0.54			
Industry	-0.07	-0.08	-0.05	..	-0.13	-0.13
Services	0.00	0.01	0.00			
Not working	-0.04	-0.03	-0.02			
Land (0.0001 - 0.09 ha/capita)	0.41	0.94	0.78			
Land (0.1 - 0.19 ha/capita)	0.27	0.31	0.25			
Land (0.2 - 0.39 ha/capita)	0.14	0.12	0.09	..	..	..
Land (0.4 - 0.79 ha/capita)	-1.36	-0.88	-0.55			
Land (0.8 or more ha/capita)	-0.67	-0.37	-0.22			
Fianarantsoa	10.31	8.94	7.54			
Toamasina	3.25	3.40	2.66			
Mahajanga	6.29	5.13	3.76			
Toilara	-1.19	-1.24	-1.00			
Antsiranana	4.79	3.58	2.78			

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data

Note: ".." indicates that the effect is not robust to the choice of reference period

Table 25: Select Returns and Endowment Effects from Urban Models of Consumption

Changes in poverty due to changes in returns and endowments

	Returns Effect			Endowment Effect		
	Po	P1	P2	Po	P1	P2
Number of adults with primary education	-3.64	-1.87	-1.25			
Number of adults with secondary education	-1.34	-0.37	-0.20	-0.46	-0.13	-0.05
Number of adults with tertiary education	-0.08	-0.04	-0.01			
1 if involved in non-agric enterprise	0.54	0.39	0.24	-0.43	-0.23	-0.13
Industry	-0.66	-0.37	-0.22			
Services	-1.67	-0.71	-0.42	..	..	..
Not working	0.22	0.09	0.04			
Civil Service	0.33	0.18	0.10			
Land (0.0001 - 0.09 ha/capita)	-0.94	-0.37	-0.24			
Land (0.1 - 0.19 ha/capita)	-0.99	-0.70	-0.50			
Land (0.2 - 0.39 ha/capita)	-1.72	-0.98	-0.56	..	-2.24	-1.36
Land (0.4 - 0.79 ha/capita)	-1.28	-0.43	-0.23			
Land (0.8 or more ha/capita)	-0.63	-0.17	-0.08			
Fianarantsoa	-4.74	-2.52	-1.63			
Taomasina	1.74	1.17	0.71			
Mahajanga	6.81	4.01	2.53			
Toliara	1.07	0.89	0.59			
Antsiranana	-1.16	-0.48	-0.20			

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data

Note: ".." indicates that the effect is not robust to the choice of reference period

Appendix Table 1: Average Per Capita Consumption Levels in Madagascar

Real November 1993 Urban Antananarivo Prices

	1993		1997		1999	
Quintile	Urban	Rural	Urban	Rural	Urban	Rural
Poorest	96,440	91,234	76,802	84,639	87,673	87,156
2nd	165,219	161,816	145,078	145,597	145,154	147,045
3rd	231,031	225,598	211,859	209,252	211,850	211,166
4th	323,278	319,373	300,786	298,534	314,402	308,513
Richest	788,899	878,291	645,867	610,460	660,042	577,906
All	441,202	304,086	321,627	258,007	379,518	243,013
National	329,338		271,726		273,370	

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data

Appendix Table 2: Numbers of Poor in Madagascar

	Total			Urban			Rural		
	1993	1997	1999	1993	1997	1999	1993	1997	1999
Total Population	12,275,671	13,566,630	14,630,627	2,264,375	2,925,176	3,253,644	10,011,296	10,641,454	11,376,983
Extreme Poor	7,256,137	8,558,461	9,023,306	850,611	1,580,596	1,404,373	6,405,526	6,977,865	7,618,933
Poor	8,592,885	9,939,221	10,424,413	1,133,609	1,848,195	1,695,280	7,459,276	8,091,026	8,729,133
Non-Poor	3,682,786	3,627,409	4,206,214	1,130,766	1,076,981	1,558,364	2,552,020	2,550,428	2,647,850
Antananarivo	3,700,449	3,826,522	4,083,773	899,541	1,098,514	1,190,016	2,800,908	2,728,008	2,893,757
Extreme Poor	2,118,495	2,130,091	2,093,475	298,185	470,582	413,303	1,820,310	1,659,509	1,680,172
Poor	2,514,669	2,539,598	2,521,442	381,227	571,160	515,131	2,133,442	1,968,438	2,006,311
Non-Poor	1,185,780	1,286,924	1,562,331	518,314	527,354	674,885	667,466	759,570	887,446
Fianarantsoa	2,367,922	2,744,589	2,732,978	290,384	450,177	438,970	2,077,538	2,294,412	2,294,008
Extreme Poor	1,510,186	1,748,291	1,946,220	143,725	324,109	208,030	1,366,461	1,424,182	1,738,190
Poor	1,753,359	2,062,101	2,215,289	188,464	374,020	244,961	1,564,895	1,688,081	1,970,328
Non-Poor	614,563	682,488	517,689	101,920	76,157	194,009	512,643	606,331	323,680
Taomasina	1,980,514	2,232,752	2,266,064	255,743	488,250	486,964	1,724,771	1,744,502	1,779,100
Extreme Poor	1,335,910	1,592,515	1,390,979	100,824	342,390	209,590	1,235,086	1,250,125	1,181,389
Poor	1,541,994	1,782,220	1,615,149	142,801	372,732	256,366	1,399,193	1,409,488	1,358,783
Non-Poor	438,520	450,532	650,915	112,942	115,518	230,598	325,578	335,014	420,317
Mahajanga	1,584,457	1,524,058	2,004,445	285,336	305,406	412,631	1,299,121	1,218,652	1,591,814
Extreme Poor	611,163	925,094	1,351,179	72,310	163,733	222,701	538,853	761,361	1,128,478
Poor	844,121	1,124,010	1,522,975	106,499	208,291	269,196	737,622	915,719	1,253,779
Non-Poor	740,336	400,048	481,470	178,837	97,115	143,435	561,499	302,933	338,035
Toliara	1,660,570	2,102,382	2,288,103	291,422	391,236	519,790	1,369,148	1,711,146	1,768,313
Extreme Poor	1,226,689	1,588,331	1,455,469	148,111	248,040	304,805	1,078,578	1,340,291	1,150,664
Poor	1,347,809	1,723,423	1,638,648	194,954	270,328	345,468	1,152,855	1,453,095	1,293,180
Non-Poor	312,761	378,959	649,455	96,468	120,908	174,322	216,293	258,051	475,133
Antsiranana	981,759	1,136,327	1,255,264	241,949	191,593	205,273	739,810	944,734	1,049,991
Extreme Poor	453,694	574,139	785,984	87,456	31,742	45,944	366,238	542,397	740,040
Poor	590,933	707,869	910,910	119,664	51,664	64,158	471,269	656,205	846,752
Non-Poor	390,826	428,458	344,354	122,285	139,929	141,115	268,541	288,529	203,239

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data

Appendix Table 3: Percentages of Poor in Madagascar

	Total			Urban			Rural		
	1993	1997	1999	1993	1997	1999	1993	1997	1999
Total Population	100.0	100.0	100.0	18.4	21.6	22.2	81.6	78.4	77.8
Extreme Poor	59.1	63.1	61.7	37.6	54.0	43.2	64.0	65.6	67.0
Poor	70.0	73.3	71.3	50.1	63.2	52.1	74.5	76.0	76.7
Non-Poor	30.0	26.7	28.7	49.9	36.8	47.9	25.5	24.0	23.3
Antananarivo	30.1	28.2	27.9	7.3	8.1	8.1	22.8	20.1	19.8
Extreme Poor	57.2	55.7	51.3	33.1	42.8	34.7	65.0	60.8	58.1
Poor	68.0	66.4	61.7	42.4	52.0	43.3	76.2	72.2	69.3
Non-Poor	32.0	33.6	38.3	57.6	48.0	56.7	23.8	27.8	30.7
Fianarantsoa	19.3	20.2	18.7	2.4	3.3	3.0	16.9	16.9	15.7
Extreme Poor	63.8	63.7	71.2	49.5	72.0	47.4	65.8	62.1	75.8
Poor	74.0	75.1	81.1	64.9	83.1	55.8	75.3	73.6	85.9
Non-Poor	26.0	24.9	18.9	35.1	16.9	44.2	24.7	26.4	14.1
Taomasina	16.1	16.5	15.5	2.1	3.6	3.3	14.1	12.9	12.2
Extreme Poor	67.5	71.3	61.4	39.4	70.1	43.0	71.6	71.7	66.4
Poor	77.9	79.8	71.3	55.8	76.3	52.6	81.1	80.8	76.4
Non-Poor	22.1	20.2	28.7	44.2	23.7	47.4	18.9	19.2	23.6
Mahajanga	12.9	11.2	13.7	2.3	2.3	2.8	10.6	9.0	10.9
Extreme Poor	38.6	60.7	67.4	25.3	53.6	54.0	41.5	62.5	70.9
Poor	53.3	73.8	76.0	37.3	68.2	65.2	56.8	75.1	78.8
Non-Poor	46.7	26.2	24.0	62.7	31.8	34.8	43.2	24.9	21.2
Toliara	13.5	15.5	15.6	2.4	2.9	3.6	11.2	12.6	12.1
Extreme Poor	73.9	75.5	63.6	50.8	63.4	58.6	78.8	78.3	65.1
Poor	81.2	82.0	71.6	66.9	69.1	66.5	84.2	84.9	73.1
Non-Poor	18.8	18.0	28.4	33.1	30.9	33.5	15.8	15.1	26.9
Antsiranana	8.0	8.4	8.6	2.0	1.4	1.4	6.0	7.0	7.2
Extreme Poor	46.2	50.5	62.6	36.1	16.6	22.4	49.5	57.4	70.5
Poor	60.2	62.3	72.6	49.5	27.0	31.3	63.7	69.5	80.6
Non-Poor	39.8	37.7	27.4	50.5	73.0	68.7	36.3	30.5	19.4

Source: INSTAT, Cornell University and World Bank staff estimates from EPM data