

## The Evolution of Groupwise Poverty in Madagascar, 1999-2005

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Comments greatly appreciated

**Abstract:** This paper explores whether there exist differences in groupwise poverty in Madagascar; that is, whether there is a pattern over time of consistently poorer performance among subpopulations readily identifiable by one or more identity markers. Three key messages come out of this analysis. First, there exists a core type of household that remained persistently poor over the 1999-2005 period. These households were largely not members of the dominant ethnic group, land poor, lived in remote areas, and were headed by uneducated individuals, most commonly women. Second, in addition to establishing the existence of persistent differences in poverty across groups, relative differences in returns to education, land and remoteness underscore the existence of differences within groups, as one characteristic affects the returns to another. Third, persistent differences in groupwise poverty is associated with multiple different identities, some of which are offsetting and some of which are reinforcing. For example, women's higher education tends to offset the disadvantages associated with being a head of household, while remoteness compounds the disadvantages associated with living in female-headed households.

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### I. Introduction

Madagascar is one of the world's poorest nations, consistently ranking in the bottom quintile of most global rankings by per capita income, the UNDP's Human Development Index, and similar tables of average well-being. After a sluggish decade since the enactment in the mid-1980s of market-oriented reforms aimed at igniting economic growth and reducing poverty in this formerly socialist state, the economy finally began experiencing solid, sustained growth by the latter part of the 1990s. Then a hotly contested presidential election nearly sent the country into civil war and seriously disrupted the economy from December 2001 through the second half of 2002. The economy bounced back handsomely in the ensuing several years, restoring many observers' hopes that Madagascar was finally on the move from the bottom of the world's well-being rankings.

In spite of this generally favorable experience of macroeconomic growth over the past decade, poverty measures have remained stubbornly high in Madagascar. Not everyone seems to be enjoying the fruits of the aggregate progress enjoyed in the country. This underscores how easy it is to lose track of the experience of large groups of individuals amid the macroeconomic data. Madagascar's experience of solid growth with minimal poverty reduction raises important questions about structural impediments to progress for identifiable subpopulations. Partly, this raises questions about the possible existence of poverty traps that might impede some people's or groups of people's exit from chronic poverty, on which there is a bit of suggestive evidence from Madagascar (Barrett et al. 2006).

This paper focuses on the evolution of groupwise poverty in Madagascar. That is, we explore whether there is a pattern over time of consistently poorer performance among subpopulations readily identifiable by one or more identity markers. The groups analyzed here are defined over multiple dimensions since individuals possess multiple identities, defining themselves – and being defined externally – by race, gender, and ethnicity among other cultural, political, and socio-economic dimensions. Where group identities have reasonably clear, recognizable boundaries and where membership is stable over time – as is typically the case for race, gender or ethnicity, for example – the confluence of economic disparities with tangible group boundaries can result in differing group welfare outcomes. The potential for political and social conflict to follow from these disparities highlights the value in associating relatively immutable group identities with a set of acquired characteristics and asset endowments, such as educational attainment, wealth, and geographic location.<sup>1</sup> If some of these attributes affect the incentives or constraints that individuals face, they will affect behaviors and outcomes such as economic measures of well-being (Barrett 2005). If the behavioral effects are self-reinforcing or the

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<sup>1</sup> Race, gender, ethnicity, educational attainment are effectively unchangeable for adults. Wealth and geographic location, by contrast, can obviously change due to accumulation or migration, respectively. But mobility is commonly limited at intragenerational time scales and the experience of an economic class or geographic community may transcend the experience of the few individuals who manage to escape. Further, wealth (especially in the form of readily-observed physical holdings of land or livestock, the main forms of wealth in rural areas of the low-income world) and geographic location are among the easier attributes to identify and target for those wishing to assist poor households.

incentives and constraints continue for extended periods, the resulting outcomes can appear a lot like poverty traps. The mechanism that initially caused disparity in asset holdings, physical remoteness or low educational attainment – among other potentially changeable household and individual attributes – may no longer be at play but the consequence of those disparities among immutable cultural groups persists because household endowments still matter to well-being.

Of course, if the attributes associated with limited asset accumulation or low productivity can be identified, they can also be targeted for interventions aimed at helping to liberate those who belong to persistently poor groups. So the first question one must explore – and the topic of this paper – is whether there indeed exist persistent disparities among subpopulations. We focus on this, using nationally representative, repeated cross-sectional household surveys to investigate how different features of households' identity affect well-being in Madagascar and the persistence of apparent inequalities associated with attributes such as ethnicity, gender educational attainment, geographic remoteness, and land holdings.

## II. Data

Our main source of information in this analysis is the 1999, 2001, and 2005 Madagascar *Enquête Périodique Auprès des Ménages* (EPM), nationally representative integrated household surveys of 5,120, 5,080, and 11,781 households, respectively. The data were collected by the Institut National de la Statistique (INSTAT) between the months of September and December for each of the three surveys. The samples were selected through a multi-stage sampling technique in which the strata were defined by the province<sup>2</sup> and *milieu* (rural, secondary urban centers, and primary urban centers), and the primary sampling units (PSU) were *fokontany*.<sup>3</sup> Each of the *fokontany* was selected systematically with probability proportional to size (PPS), and sampling weights defined by the inverse probability of selection to obtain accurate population estimates.

The multi-purpose questionnaires include sections on education, health, housing, agriculture, household expenditures, assets, non-farm enterprises and employment. Employment and earnings information are available in the employment, non-farm enterprise and agriculture sections. The measure of household well-being used in this analysis is the estimated household-level annual consumption aggregate constructed by Razafindravonona et al. (2001), Rakotomahefa, Razakamanantsoa and Romani (2002), and INSTAT (2006) for the three respective years.<sup>4</sup> We normalize household expenditures by the number of members to derive per capita expenditure measures of household well-being.<sup>5</sup>

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<sup>2</sup> The strata were the 22 regions in 2005, compared to the six provinces in 1999 and 2001.

<sup>3</sup> There are 17,433 *fokontany* in Madagascar.

<sup>4</sup> The consumption aggregate is made up of three components. First, money values for a detailed list of daily, monthly and annual expenditures were recorded. To account for seasonal variation in expenditures, respondents were instructed to estimate the expenditure for each item in a typical month (see Deaton and Grosh, 2000, for a discussion of appropriate recall periods). Because this is not likely to fully account for seasonal variation, efforts were made to assure that data collection in each year took place during the same month so that seasonal biases are the same across surveys. Second, the quantities of own-produced goods that were consumed by the household in the previous year were valued at farmgate prices. Finally, the stream of benefits derived from all durable goods owned by the household (including housing) were imputed.

<sup>5</sup> This necessarily ignores intra-household inequality questions because the data do not permit reliable disaggregation to individual level. This finer grained question merits separate investigation.

Our other source of data is a commune census that was conducted at the same time that the 2001 national household survey was in the field, in a collaborative effort between the *Ilo* program of Cornell University<sup>6</sup>, the national Malagasy agricultural research institute (FOFIFA), and INSTAT. We use these data to measure remoteness in our analysis. The survey, which was conducted at the commune's administrative center, gathered information on access to markets, health centers, educational enrollments, commune budgets, and crime figures from the relevant government offices in the commune. A total of 1,385 out of 1,392 communes were visited. Finally, commune-level information from this census was merged with the rural communities that appear in each of the EPM datasets.

Rural isolation can be defined in many ways. Distance to urban centers or markets is one commonly used measure (McCabe, 1977; Ahmed and Hossain, 1990; Minten and Kyle, 1999; Jacoby, 2000; and Fafchamps and Moser, 2003). In this paper we attempt to capture isolation in Madagascar through the cost of transporting a 50 kg sack of rice to the market in the nearest primary urban center to capture the transaction cost component of isolation. The cost of transporting a 50 kg sack of rice collected in the commune census is the cost of dry season transport between the commune center and the market in the nearest primary urban center to which residents travel on a regular basis. The nice feature of this measure is that unlike distance, which is inherently unchangeable, transport costs can be improved (reduced) through policy or project interventions, so it is possible to change a household's remoteness without it having to physically migrate (Stifel and Minten, 2008). Table 1 illustrates the magnitude of the geographical differences in transaction costs using the 2001 commune census. When applied to the 2005 survey, for example, the median cost of transporting rice from the most remote regions was some 1400 percent greater than from the least remote regions. This translates to 60 percent of the value of the rice in the most remote areas, compared to 4 percent in the least remote areas.

### III. Economic Context

During the 1999-2005 period considered in this analysis, the Madagascar economy was in flux as a result of several large-scale shocks. In addition to chronic weather problems associated with recurring seasonal cyclones, droughts and flooding, these shocks include the 2001-2 political crisis which resulted in a major disruption of economic activity due to general strikes, roadblocks on major national roads, destruction of some key infrastructure (e.g., bridges leading to the main central highlands cities), along with the strong depreciation of the currency, the rise in international oil and rice prices that occurred in 2004 and 2005, and the final phase-out of the Multi-Fibre Arrangement.<sup>7</sup> While the political crisis appears to have had a widespread impact,

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<sup>6</sup> The *Ilo* program (<http://www.ilo.cornell.edu/>) was a USAID-funded program for "Improved Policy Analysis for Economic Decision-Making and Improved Public Information and Dialog." *Ilo* (pronounced "ee-lew") is a Malagasy word that translates roughly as (a) to enlighten and (b) to facilitate the joining of pieces together through lubrication.

<sup>7</sup> Cling et al. (2007) find that the burgeoning export processing zone (*Zones Franche*) firms were adversely affected by the phase-out. Prior to the phase-out, Madagascar had become the second largest exporter of clothing in Sub-Saharan Africa thanks to the *Zones Franche*. The 2004 phase-out resulted in a halt to export and employment growth as well as a fall in averages wages in the *Zones Franche*.

the latter shocks may have affected the richer segments of society more adversely due to the negative impact they had on manufacturing.<sup>8</sup>

Between 2001 and 2005 poverty declined more rapidly in rural areas than in urban areas, in marked contrast to 1999–2001, when the small decline in poverty was largely the result of declining urban poverty (Rakotomahefa et al., 2002; Amendola and Vecchi, 2007). Growth in 1999–2001 was driven largely by the export processing zone sector, based in the central highlands metropolitan areas of Antananarivo and Antsirabe, which improved job opportunities and reduced poverty in urban areas. The decline in poverty in rural areas between 2001 and 2005 is linked to greater emphasis on rural development, accelerated implementation of the roads program, and higher rice prices, which improved incentives for rural producers, even though it reduced many farmers' welfare as a majority of Malagasy rice producers are net rice buyers (Minten and Barrett 2008).<sup>9</sup>

After the 2002 crisis the annual GDP growth rate rebounded to 9.8 percent in 2003 from a 12.7 percent plunge a year before, and continued to grow at an average rate of about 5 percent per year thereafter. Growth came largely through higher tourism receipts (tourism arrivals in 2005 were 21 percent higher than in 2004), improved performance in agriculture, especially higher rice production (rice productivity increased from 2.3 tons per hectare in 2003 to 2.6 in 2005), and continued public investments. In 2005 the economy grew at 4.6 percent despite a sharp increase in world petroleum prices, and a financial crisis at the state-owned electricity provider, JIRAMA, that disrupted economic activity through power cuts and tariff increases.

The upturn in the late 1990s and the rapid turn around since 2002 offer encouraging signs. Private investment increased, leading to higher and more diversified production, which was absorbed by increased exports and domestic demand. New activities around the export processing zone attracted substantial foreign direct investment to textiles and clothing. Shrimp and more recently tourism and mining also grew impressively. Contract farming arrangements for high-value specialty crops for export to European markets have likewise taken off and appear to have advanced the prospects of participating farmers (Minten et al. forthcoming). These activities will continue to generate opportunities and employment, but they are not likely to provide enough jobs for the country's growing labor force and they have to date been highly circumscribed geographically to a few geographic pockets in the country.

Achieving high rates of employment and income generating growth will also depend on improving performance elsewhere in the economy. Despite strong potential in agriculture, the sector's contribution to GDP is low relative to the rural share of population, at only 14.8 percent in 2005 and declining. Between 1997 and 2005 the sector grew 2 percent a year, well below the population growth rate of about 2.8 percent and slightly below the rural population growth rate of 2.2 percent. Improvements in agricultural productivity are therefore essential to poverty reduction in Madagascar (Minten and Barrett 2008). However, recent performance improvements in agriculture, in part in response to public investments, offer hopeful signs but call for a more concerted effort building on the current momentum.

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<sup>8</sup> Employment in manufacturing (especially textiles) fell substantially between 2001 and 2005 (Nordman et al., 2007; and Stifel et al., 2007).

<sup>9</sup> Rice is Madagascar's main crop, accounting for more than half of all cultivated area nationwide.

#### **IV. Differences in Groupwise Poverty and their Persistence**

So who has been participating in Madagascar's recent economic growth and who is being left behind? One way to explore this question is to identify the relationship between household well-being – here represented by per capita expenditures – and different household attributes to establish whether there exist significant differences in well-being among distinct groups and whether such differences persist over time. In a cross-section, this reflects differences in productivity, which could arise through any of a host of mechanisms: differential access to public goods; differential or discriminatory treatment in labor, financial or other markets; differential transactions costs associated with market participation or contracting; prevailing production technologies that are not scale-neutral; physical geographical disadvantages; etc. In these data, we cannot parse out the mechanisms that generate apparent differences in well-being across groups; but we can identify the existence of such differences. And by comparing estimates across repeated cross-sections we can establish the persistence, if any, of differential groupwise poverty over the 1999-2005 period in Madagascar.

As a first cut in exploring the welfare ordering of groups defined by different characteristics, we plot the cumulative frequencies of per capita household consumption for households from the household surveys. In particular, we do this separately for each year for mutually exclusive categories of households characterized by the socio-cultural dimensions (a) ethnicity and (b) gender of the household head, and by the asset endowments (c) education of the household head, (d) degree of geographic remoteness, and (e) land holdings. The idea here is that ordinal judgments can be made about differences in groupwise welfare based on the entire distribution of household well-being, rather than just on particular summary statistics (e.g., headcount poverty rates or mean per capita consumption). By looking not only at immutable cultural characteristics of groups, such as ethnicity and gender, but also at changeable, acquired characteristics (such as land holdings, remoteness, or educational attainment) that can also define group identities and are sometimes more salient, we begin to see which elements of individuals' multidimensional identities seem the relevant boundaries for understanding poverty in Madagascar.

Specifically, pairs of group distributions are compared over a range of consumption values. One distribution is said to first-order (stochastically) dominate the other if and only if the cumulative frequency is lower than the other for every possible consumption level in the range (Ravallion, 1994). The implication is that households of the lower distribution's type enjoy a greater likelihood of having higher consumption levels. If group membership is immutable (e.g., adults cannot change their gender or ethnicity), stochastic dominance implies structural barriers to equalization of opportunities and well-being across distinct groups (Barrett et al. 2005).

Before proceeding, however, we plot the national distributions of household consumption in an effort to understand how the overall conditions described in the previous section translate into changes in these aggregate well-being distributions. We will then unpack these by distinct groups in order to investigate groupwise poverty during a turbulent economic period in Madagascar. As illustrated in Figure 1, between 1999 and 2001, poverty reduction and growth were primarily found in at the upper end of the distribution. The 2001 to 2005 period, however, was characterized by rural and agricultural development as seen by the rightward shift of the

lower portion of the distribution, and by the adverse effects of multiple exogenous shocks on those in the commercial sector (i.e. those with consumption levels above the poverty line). Overall, there was a compression of the distribution of household per capita consumption (also reported by Amendola and Vecchi 2007). Interestingly, the two distributions cross almost exactly at the poverty line (Figure 1), indicating that the poor on average fared better in the more recent period than did the non-poor.

We now turn to welfare ordering based on group characteristics. Keep in mind that so long as one cannot voluntarily leave one group for another, first-order stochastic dominance orderings imply unambiguously lower welfare for the dominated group; under the most basic assumptions about preferences, households would prefer not to be in the dominated group. The unconditional analyses in the remainder of this subsection are strongly suggestive of key differences in poverty based on group membership. But because individuals possess multiple identities and these comparisons of cumulative frequency distributions necessarily ignore all other household attributes, one needs to treat these dominance tests with caution. The multivariate econometric analyses in the next section provide a more nuanced treatment of these questions. In most cases, we find this reinforces the clearer, albeit less rigorous, messages suggested by the unconditional welfare orderings that follow. However, in one important area, ethnicity, the unconditional analysis differs sharply from the conditional analysis, which underscores the complexity and potential history dependence of processes that generate persistent differential groupwise poverty.

### *Ethnicity*

Ethnicity is often an important dimension of differences in groupwise poverty and one might reasonably expect this to be true in Madagascar as well. As illustrated in Figure 2, the Merina ethnic group has persistently had higher levels of per capita consumption than all other ethnic groups.<sup>10</sup> This is not surprising given that the Merina have dominated economic and political affairs in Madagascar since the early 19<sup>th</sup> century, before the French colonized the island nation. The current President, Marc Ravalomanana, hails from the Merina breadbasket region around Antsirabe. Merina dominance is reflected in much higher levels of educational attainment and relatively little gender discrimination.<sup>11</sup> It is also associated with lower remoteness measures, reflecting not just that the capital city of Antananarivo and the nation's main agribusiness hub, Antsirabe, are Merina strongholds, but also that infrastructure is far better in the central highlands of Antananarivo Province than elsewhere on the island. Land holdings among the Merina are no greater on average than among other ethnic groups, largely due to the greater population density in the central highlands; but the land distribution is more bimodal than among other groups, with a nontrivial subpopulation of landless or near-landless workers and a number of very large farms, reflecting greater specialization and capitalization of more successful agricultural enterprises in the Merina highlands.

The Merina's first order dominance over Madagascar's other ethnic groups in 2001 and 2005 indicates the existence of differential groupwise poverty for these two years. Considering the

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<sup>10</sup> The 1999 data did not include ethnic identifiers for individual respondent households. So the comparisons based on ethnicity can only be performed using the 2001 and 2005 data.

<sup>11</sup> The pre-colonial Merina empire was ruled for a longer period by queens than by kings, reflecting the longstanding relative acceptance of female authority and ability in Merina society.

Merina's long dominance in Malagasy politics, as well as in the economic sphere, as manifest in greater average asset endowments, it would seem that these differences have persisted over an extended period of time. These simple univariate comparisons cannot tell us, however, whether this is attributable to contemporary discrimination in favor of the Merina (or against other groups) or whether it is rather the cumulative by-product of many generations' inequitable treatment. The multivariate regression analysis in the next section sheds some light on this important question.

### *Gender*

In Figure 3, we plot the distributions for households defined by gender of the household head. Interestingly, there is virtually no difference in the distributions of consumption for female-headed households and male-headed households in each of the years. Overall, and perhaps surprisingly, gender does not appear a key dimension of consumption differences. But *ceteris* are not *paribus* in these figures. Simple reduced form econometric models indicate that female-headed households appear to suffer persistent disadvantages once one controls for the separate effects associated with household demographics and assets. We explore this further in the more detailed econometric estimation in the next section.

### *Education*

In Figure 4, the distributions of household consumption are plotted for households whose household head has no education (48 percent of households), primary education (30 percent) and more than primary education (23 percent), respectively. Similar analysis was done using the highest education level in the household as a measure of household education.<sup>12</sup> The results are qualitatively similar, so we proceed with the education of the household head.

For all three years, we find that higher levels of education first order dominate lower levels of education. The education premia appeared to grow with the urban and commercial development observed in the 1999-2001 period. Conversely, the premia shrunk during the 2001-2005 period because of lower returns to primary and to higher levels of education, not just because of improvements in the livelihoods of those households whose heads do not have formal schooling.

Although there has been a weakening of the education premia, household education levels continue to play an important role in stratifying household groups in welfare terms. Moreover, that ordering has been remarkably persistent, with the main break associated with attaining greater than primary education.

### *Remoteness*

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<sup>12</sup> The assumption behind using this measure is that there are household public good characteristics to education. Basu and Foster (1998) suggest that literacy may have public good characteristics in the household and formalize an "effective" literacy rate based on this public good aspect of education (see also Valenti (2001) and Basu et Al. (2002)). Sarr (2004) finds evidence from Senegal that illiterate members of households benefit from literate household members in terms of their earnings. Almeyda-Duran (2005) also finds that in some situations there are child health benefits to village level proximity to literate females.

Figure 5 shows clearly how much better off urban households are than rural households in Madagascar. Although there was a deterioration in urban consumption levels between 2001 and 2005, the urban distribution continues to first order dominate the rural distributions by a large margin. Within rural areas an additional remoteness penalty for the most remote 40 percent of households began to emerge in 2001 but disappeared in 2005. Geography plainly matters fundamentally to patterns of well-being.

### *Land Holdings*

During the 1999 and 2001 periods, households with large land holdings (more than five hectares) were clearly better off than those with very small (less than one hectare) and small (one to five hectares) holdings (Figure 6). In 2005, however, the gap narrowed substantially as a result of both an improvement in smallholders' well-being and a worsening for large land holders. Indeed, the deterioration in consumption levels for large holders in 2005 left them with consumption levels lower than those observed in 1999.

It is worth commenting here that there may be considerable measurement error in the self-reported area of plots owned by households. For this reason we opt for a broad categorical variable to describe land holdings. A continuous variable based on holding sizes as reported by the survey respondent will be more prone to more reordering of households from the true land distribution than is likely due to misclassification of households among ordinal groupings, most likely due to measurement errors near a cutoff point for the categorical variable.

## **V. Econometric Estimates**

The analysis in the previous section is strongly suggestive of key differences in groupwise poverty. Given that individuals possess multiple identities, however, and because the unconditional analysis ignores all other household attributes, we now turn to a multivariate econometric approach to addressing the question of whether differences in groupwise wellbeing exist and persist in Madagascar.

We begin with an overview of the three key messages coming out of this analysis, before describing the details of the model estimation procedure and results. First, we find a core type of household that remains persistently poor. These households are land poor, live in remote areas and are headed by uneducated individuals, most commonly women. Second, in addition to welfare differences between groups, there exist significant differences within groups. For instance, land rich households in remote areas do relatively well. Not only does a positive premium to land holdings exist in remote areas, but this premium is even larger than what is observed in better-off urban areas. Third, and building on the previous two core points, persistent groupwise differences in wellbeing are associated with multiple different identities, some of which are offsetting and some of which are reinforcing. For example, women's higher education tends to offset the disadvantages associated with being a head of household, while remoteness compounds the disadvantages associated with living in a female-headed household. The (dis)advantages associated with specific identity attributes interact in important ways that

should matter for agencies aiming to target groups that suffer from persistent poverty. In particular, unidimensional, unconditional targeting will commonly lead to serious errors of both exclusion and inclusion where it neglects these reinforcing and offsetting effects.

We illustrate this point in Table 2 where we show the average per capita consumption and poverty rates for three stylized households in the 1999, 2001 and 2005 samples. These households include (i) households headed by uneducated females that are land poor (less than 1 hectare) and live in relatively remote areas (fourth and fifth quintiles), (ii) educated, female-headed urban household with some land (1-5 hectares), and (iii) households that are headed by males with secondary education and large land holdings (5+ hectares) in the most remote areas (first and second quintiles). The contrast between type (i) and type (ii) households draws out the danger of targeting just on gender. Although both of these household types are female-headed and would both be included in gender-based targeting, the type (i) households are considerably poorer (over 80 percent compared to under 44 percent in 1999) given that they are uneducated, land poor and somewhat remote. Similarly, the contrast between type (i) and type (iii) households underscores the risk of relying solely on geographic targeting. In this case, although type (i) households are less remote and more likely to be excluded from a geographically targeted program, they are substantially poorer than type (iii) households in part because they are female-headed, uneducated and land poor. This suggests that targeting based on multiple household identity attributes can increase the likelihood that more resources are directed at households that are more prone to suffer persistent inequalities (e.g. type (i)) rather than those that are not so (e.g. type (ii) and (iii)).

### *Estimation Procedure*

To control for several household attributes in our analysis simultaneously, we estimate multivariate econometric models of the determinants of log per capita household consumption. Separate models are estimated for each of the survey years, controlling for the effect of asset endowments on per capita household consumption.

We first estimate an ultra-reduced form model, controlling only for immutable cultural characteristics, gender of household head and an indicator of Merina ethnicity, as well as controls for household demographics. The household demographic variables include the age of the household head, entered in quadratic form to allow for life cycle effects, and the number of household members for given age and gender categories. The latter capture both household labor supply as well as household composition, which help to address the issue of equivalence scales given that the model explains per capita consumption, which clearly varies somewhat according to household composition due to physiological and cultural differences among ages and between genders.

We label this the parsimonious model in Table 3. In this model for 2001 and 2005, there is a very large positive welfare premium associated with being Merina, from 23 to 42 percent. This reinforces the message of Figure 2, which showed that the Merina consumption distribution first-order dominates that for non-Merina households.

But when we add controls for quasi-fixed assets (e.g. education, land holdings, and geographic remoteness) in the full model in Table 3, the apparent effect of Merina identity disappears completely. There is no evidence of ethnic discrimination among those with identical endowments and non-ethnic characteristics. This strongly suggests that the current superior welfare status of the Merina ethnic group is explained by hysteresis. It is the result of the numerous years for which they had superior access to education, land holdings, and urban markets, not by some residual, current discrimination. Thus while ethnic groupings may provide convenient – and sometimes incendiary – axes for political allegiance because of the obvious unconditional difference between the groups, one needs to be careful about inferring contemporary discrimination from such differences. They are far more historically embedded and nuanced and thus require different instruments than, for example, group-based hiring or contracting preferences or anti-discrimination laws, which may have apparent merit yet prove ineffective in addressing the persistence of ethnicity-based differences in groupwise wellbeing in Madagascar. Rather, one needs to make concerted efforts to redress the inter-ethnic disparity in access to private and public assets that clearly matter to household well-being.

Given this result, and given that the 1999 household survey data do not have information on ethnicity, the remainder of this paper concentrates on the remaining non-ethnic dimensions of groupwise differences in wellbeing. This not only permits us to work with the full three-year sample, it also focuses attention on the most currently relevant dimensions of groups experiencing persistent differences in poverty.

As a point of clarification, we note that in addition to the household characteristics of interest (education of household head, gender of household head, remoteness and land holdings), and the household demographic controls, we include additional controls for geographical regions in the full model in Table 3. The inclusion of provincial dummies (with Antananarivo serving as the omitted province) captures the many agroecological, infrastructural and cultural differences that exist across geographical regions in any given period.<sup>13</sup> Given all of these control variables, the representative household in these regressions is headed by an uneducated male who is land poor and lives in urban Antananarivo province.

In order to estimate differences in returns to education and to remoteness for various household identities based on gender and land holdings in the full model for the three sample years, we also include interactions between education and remoteness, on the one hand, and gender and land holdings, on the other.<sup>14</sup> The main parameter estimates for these models appear in Table 4. To facilitate the interpretation of the interaction estimates, we report the marginal effects of education (Table 5a) and remoteness (Table 5b) for each year instead of the interaction parameter estimates themselves (which we report in Appendix Table 1). In addition, we report the marginal effects of land holdings by remoteness quintile in Table 5c. To be clear about the interpretation of these marginal effects, consider the marginal effects of primary education in

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<sup>13</sup> Note that we include provincial dummies in part because we want to understand the effect of geographic remoteness. In order to compare people who differ only by their access to urban services and markets, holding constant their agroecological zone of residence, culture, the market center toward which they are oriented, etc., we need to include the provincial controls.

<sup>14</sup> Models with ethnicity interactions were also estimated, but as consistent with the full models in Table 3, these interactions were not statistically significant.

2001 for distinct households defined by the gender of the household head (i.e. the first column of Table 5a). The 18.1 percent return to primary education for male-headed households, which is the same effect that is reported in Table 4, is the difference in log per capita consumption for male-headed households with primary education relative to male-headed households with no education (the omitted category). Now consider the 35.5 percent return to primary education for female-headed households. This is the difference in log per capita consumption for female-headed households with primary education relative to female-headed households with no education.<sup>15</sup> Note that the latter is not the left-out category. This is the appropriate reference in order to interpret the marginal effects as returns to education for a given, distinct household group.

### *Results*

The main model estimates that appear in Table 4 reinforce the messages for assets suggested by the unconditional welfare orderings in the previous section. For example, for all three years, returns to education are statistically and economically significant. Individuals living in households in which the head has some primary education have on average 11-18 percent higher consumption levels than those with no education. Secondary education has an even higher average return of 40-70 percent. Similarly, returns to land holdings are positive and statistically significant, though they become both smaller in estimated magnitude and less precisely estimated in 2005, after the national crisis that drove many people back into farming.

The somewhat ambiguous unconditional analysis in the previous section with respect to remoteness becomes far more definitive in the multivariate regression model. In addition to confirming that rural areas are strictly worse off than urban areas in terms of per capita consumption, the econometric estimates suggest that in 2001 and 2005 more remote rural areas were poorer than less remote rural areas. In 2005, for example, while the least remote quintile of rural households had consumption levels 17 percent lower than urban households, an otherwise identical household in the most remote quintile had a consumption level that was 40 percent lower, with a statistically significant difference between the most and least remote rural areas ( $t = 2.45$ ). This difference within rural areas is not obvious from Figure 4.

The multivariate regression results illustrate a subtlety with respect to gender of the household head that is not apparent in Figure 3's apparent lack of significant group differences based on gender discrimination. In the models that appear in Table 3, female-headed households clearly have persistently lower levels of household consumption than male-headed households. Not controlling for household asset holdings or provincial location in the parsimonious model in Table 3, we found that female-headed households suffered 6-14 percent lower consumption. Those magnitudes declined somewhat when controls for assets and provincial location were added (full model, Table 3), but remained statistically significant. Once we employ a full set of interactions in the models (Table 4), however, the point estimate of gender-based consumption

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<sup>15</sup> In particular, this marginal effect is the sum of the coefficients for primary education and the interaction between primary education and female-headed households, less the coefficient for female-headed households. Note that if the latter (the returns for female-headed households without any education) is not netted out, the marginal effect then explains the differences in returns to primary education between female-headed households with primary education and male-headed households without any education. This is not the desired comparison.

disparities fall to 2.5 percent or less in each year and are not statistically significantly different from zero. As illustrated in Table 5b, this follows from larger negative effects of remoteness for female-headed households than male-headed households.

The upshot of these estimates is that we find persistent welfare differences between groups that can be identified largely by gender of the household head, household asset endowments and location. There exists a core type of persistently poorer households that is distinguished by four key characteristics: they (a) are land poor, (b) live in more remote rural areas, (c) are headed by uneducated individuals, and (d) are commonly headed by women. This is not merely a description at one point in time. These differences persist across each of the three years for which we have nationally representative survey data. Education, land endowments, and geographic location all seem to convey long-term well-being (dis)advantages in Madagascar. These differences are strongly statistically associated with ethnicity, but this characteristic no longer explains persistent consumption differences among households.

Two further general stories related to groupwise wellbeing emerge from the differential returns illustrated by the marginal effects in Tables 5a, 5b and 5c. First, in addition to establishing the existence of differential welfare across groups, relative differences in returns to land holdings within groups underscore the existence of differences within groups. For example, the land-rich in remote rural areas do well relative to the land-poor in those areas. Returns to land in remote areas are not only positive, they are generally larger than in the least remote and urban areas, except in 1999 (Table 5c). This not only underscores the existence of within group differences in more remote areas (see Table 6 for the distribution of land holdings within remoteness quintile), but it also is consistent with evidence from China, India and Uganda that returns to investment in marginal (or less-favored) areas may be higher than in more-favored (i.e., less remote) areas (Fan and Hazell, 1999; and Fan and Chan-Kang, 2004). Given that poverty is highest in these more remote areas (Stifel and Minten, 2008), the poverty reduction impact from investments there may be larger than from similar investments in favored, urban and peri-urban (i.e., least remote rural) areas.

Second, persistent groupwise welfare differences are associated with more than one identity attribute, and depending on the composite identity of a given household, some attributes can be *reinforcing* and some *offsetting* of group poverty. For example, living in a female-headed household can compound the disadvantages associated with remoteness, thereby *reinforcing* group differences in welfare. Although the differences are only statistically significant for 2005, the negative marginal effect of remoteness is always greater for female-headed households than male-headed households (Table 5b),<sup>16</sup> thus *reinforcing* the gender-based welfare differences observed in Table 3. Further, as indicated by the panels at the bottom of Table 5b, there is no pattern of statistically significant change in these interaction terms from 1999 to 2001 to 2005. This further supports the general finding of the persistence of groupwise poverty in Madagascar. Since most of the key covariates – location, land holdings, educational attainment of adults – change little, if at all, over time, it is perhaps unsurprising that these effects persist and that the marginal returns to specific household assets and attributes do not change much over time.

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<sup>16</sup> Except for the fourth remoteness quintile in the 2001 sample.

Conversely, women's higher educational attainment tends to *offset* the disadvantages associated with living in a female-headed household. To illustrate this, consider female-headed households in the 2001 sample. Individuals living in uneducated female-headed households in the most remote quintile have levels of consumption that are on average 14 percent lower than for uneducated male-headed households (Table 5c). This disadvantage is ameliorated by marginal returns to primary and higher levels of education of 36 percent and 78 percent, respectively (Table 5a). The disadvantage for these households relative to similarly educated male-headed households is *offset* when the returns to education for female-headed households are greater than the returns for male-headed households. Further, it is *overcome* when the differences in returns are greater than the initial penalty of 14 percent. For 2001, therefore, we find that education *offsets* the disadvantages to living in a permanently female-headed household because the returns to primary and higher levels of education are 17 and 8 percentage points greater than for male-headed households. Although it appears to be *overcoming* in the case of primary education by 3 percentage points, it is not significant ( $t = 0.20$ ), as is the case for higher levels of education. In 1999 and 2001, we also find that higher levels of education offset the disadvantages of gender in rural areas, but do not overcome them entirely.

Education also tends to *offset*, if not *overcome*, inequalities arising from meager land holdings. As illustrated in Table 5a, there is a consistent pattern of higher returns to education for the land poor relative to those with holdings of one hectare or more. Again consider the 2001 sample. Returns to primary and higher levels of education for the land poor are 18 percent and 70 percent, respectively. While these returns to primary education for the land poor are *offsetting* in that they are 28 percentage points higher than those of small holders, they are not enough to overcome the 29 percent premium small holders over the land poor (Table 4). Higher levels of education, however, are more than enough to *offset* the penalty to being land poor. The 67 percent greater return to higher levels of education *overcomes* the penalty by 38 percent ( $t = 3.20$ ) relative to small holders and by 35 percent ( $t = 4.1$ ) relative to large holders.

## Conclusions and Policy Implications

This study explores the hypothesis that there exist differences in poverty in Madagascar among groups defined by distinct and largely immutable characteristics, and that such differences persist over time. Using nationally representative survey data from 1999, 2001 and 2005, we indeed find clear evidence of economically and statistically significant and persistent welfare differences between groups defined by ethnicity and the gender of the household head. While important inter-ethnic differences exist, this appears to signal past discrimination manifest in patterns of private investment in education and land as well as in public goods provision (e.g., remoteness and the provincial dummies), not in current discrimination based on ethnicity. Hence, we find that persistently low per capita consumption levels amongst non-Merina households are now largely due to meager land endowments, geographic remoteness, and low educational attainment, which are in turn associated with ethnicity.

So how can such findings inform the design of policy or project interventions? Since apparent disparities associated with ethnicity and gender arise today due to intergroup differences in asset holdings, targeted interventions to build up the educational attainment of non-Merina and women, and to reduce the geographic remoteness of predominantly non-Merina communities

may have merit. Land redistribution to address unequal household endowments is probably not politically feasible in Madagascar, so that will likely remain a source of disparity for some time. So while we can clearly identify persistent poverty differences associated with household characteristics such as ethnicity, gender or land holdings, it is less clear what practical measures can be undertaken to address those penalties.

By contrast, remoteness and education both have demonstrably high returns and are amenable to interventions that address these disadvantages, through improvements to infrastructure and services delivery in rural areas and measures to keep children enrolled in and progressing through school, respectively. The large share of the Malagasy population that is uneducated (51 percent), lives in remote rural areas (73 percent<sup>17</sup>), or both (42 percent), suggests a large population whose persistent disadvantage could be addressed through interventions aimed at reducing remoteness and facilitating completion of primary – or, better yet, secondary – schooling for the children of poor households.

A more nuanced story also emerges that can be particularly useful for targeting interventions. Where estimated returns are significantly and persistently higher for specific subpopulations who otherwise suffer disadvantage, interventions would appear especially promising as efficiency and equity arguments are then mutually reinforcing. For example, educational attainment has generally had higher marginal benefits to the well-being of female-headed households than male-headed ones. Education of girls can help offset, perhaps even overcome, the disadvantages otherwise suffered by adult women who find themselves heading households. The returns to education are likewise persistently and significantly highest for households with the smallest land holdings, although this could signal endogenous land accumulation patterns wherein the well-educated reduce land holdings in order to specialize in non-farm employment. Education that is truly universal, in both gender and geographic terms, can thereby be equalizing in per capita consumption terms. The existence of apparently persistent differences in groupwise poverty in Madagascar does not imply that structural disadvantages must be permanent; identifiable disparities can rather become a targeting criterion for agents committed to redressing them.

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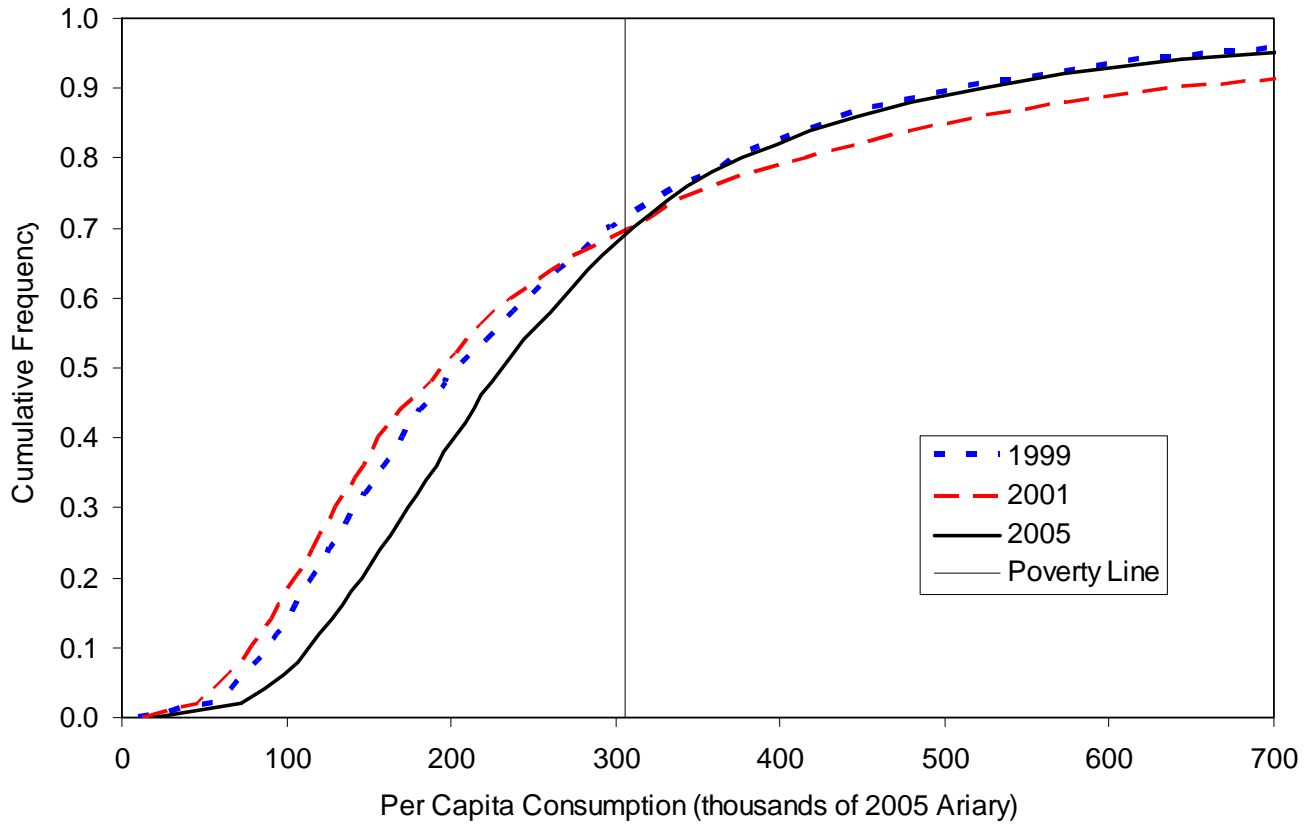
<sup>17</sup> As defined by the first four remoteness quintiles. Note that for households in the fourth remoteness quintile, the cost of transporting a 50 kg sack of rice to the urban center was Ar 5,000, or roughly 10 percent of the value of the rice. The median travel time to the nearest urban center was 4.5 hours.

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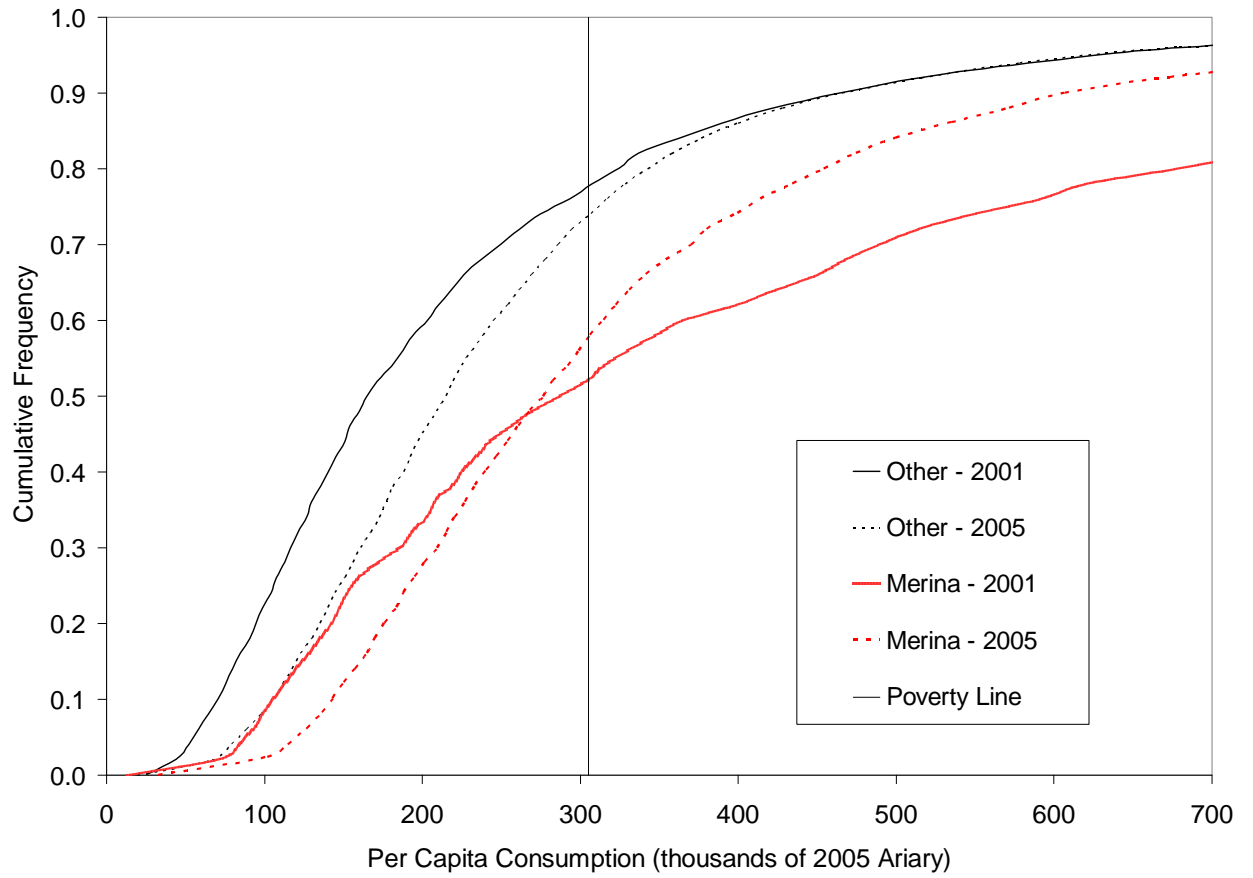
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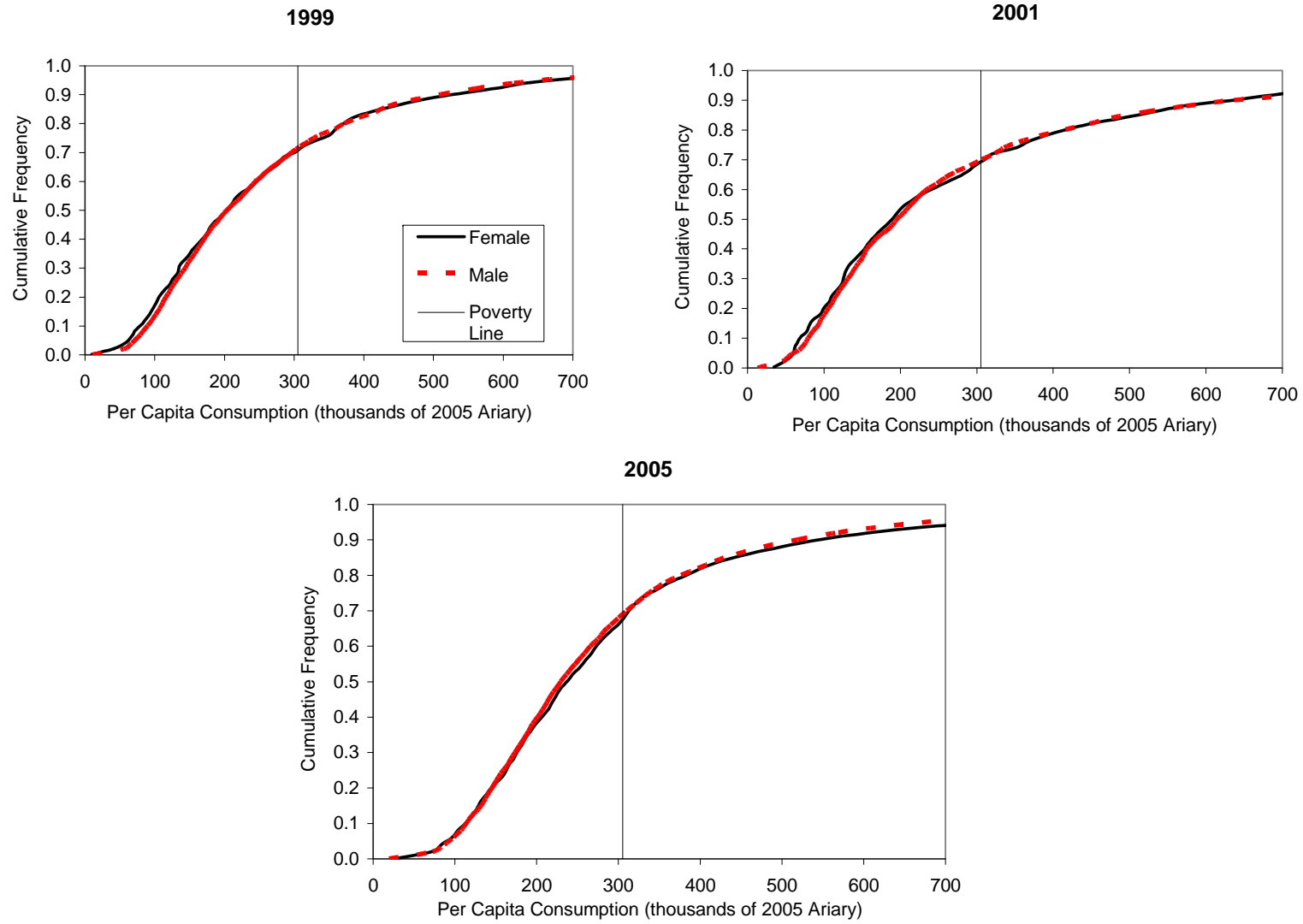
**Figure 1: Distributions of National Per Capita Consumption in Madagascar, 1999-2005**



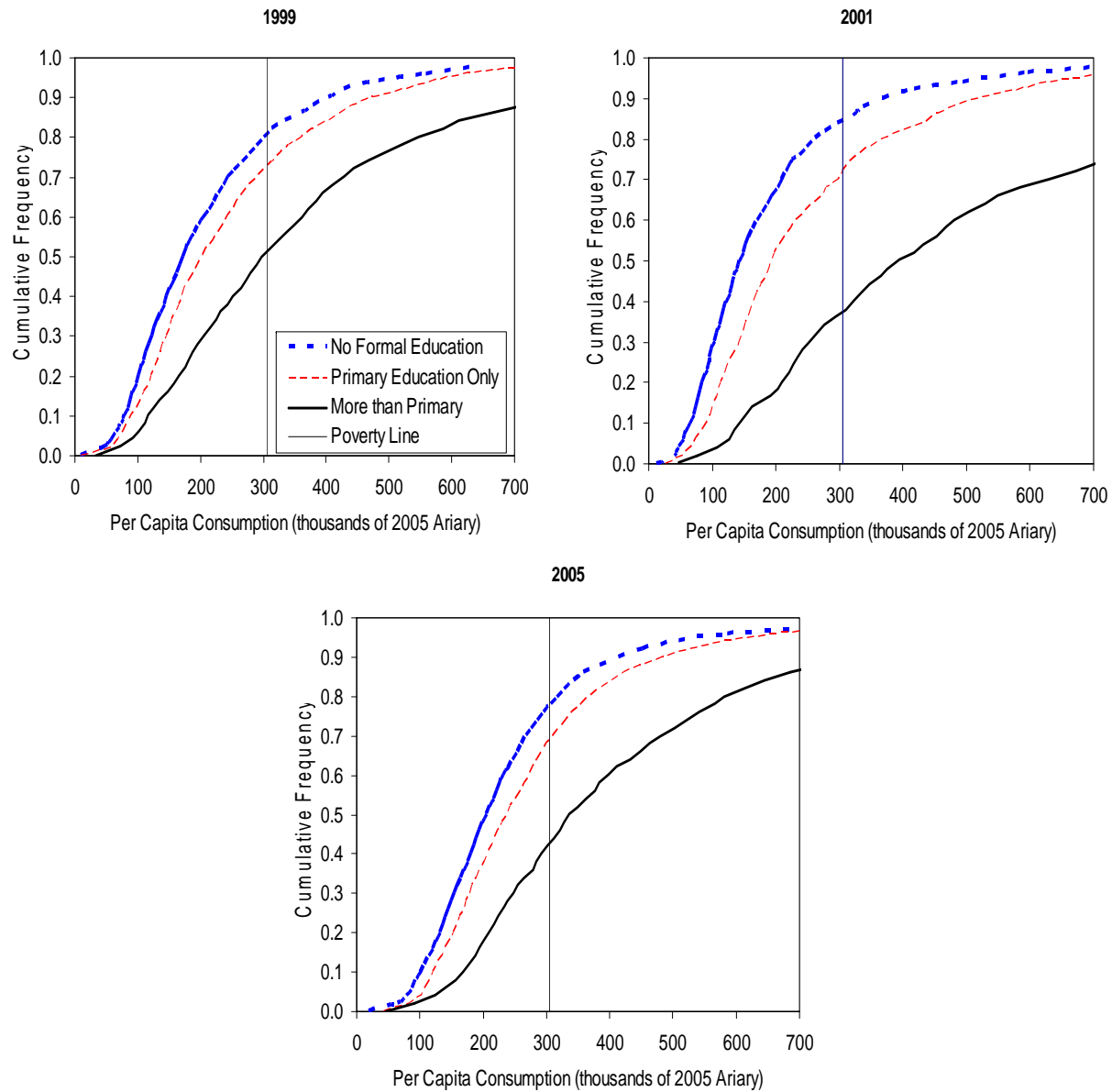
**Figure 2: Distributions of Per Capita Consumption by Ethnic Group**



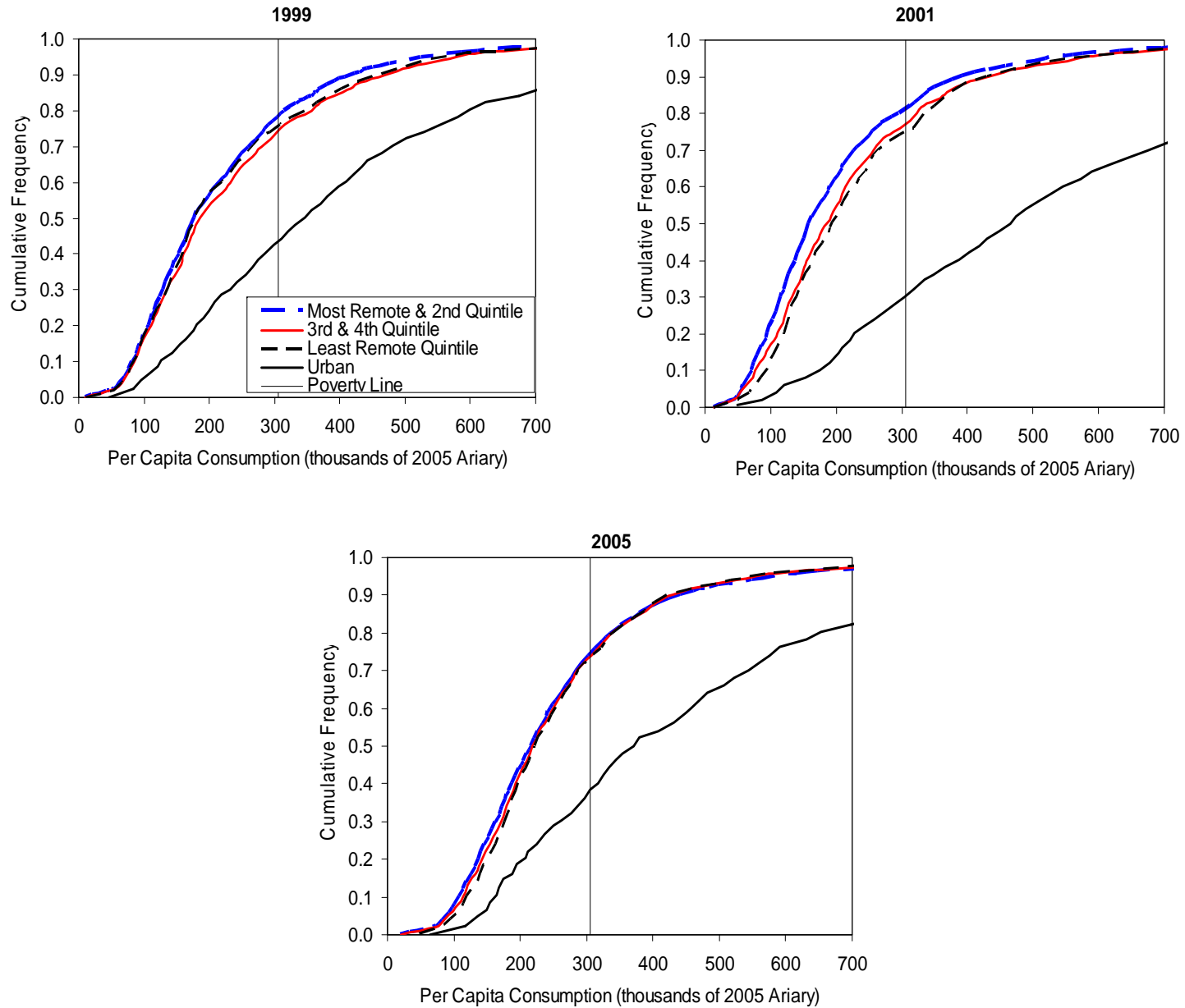
**Figure 3: Distribution of Household Expenditure by Gender of Household Head**



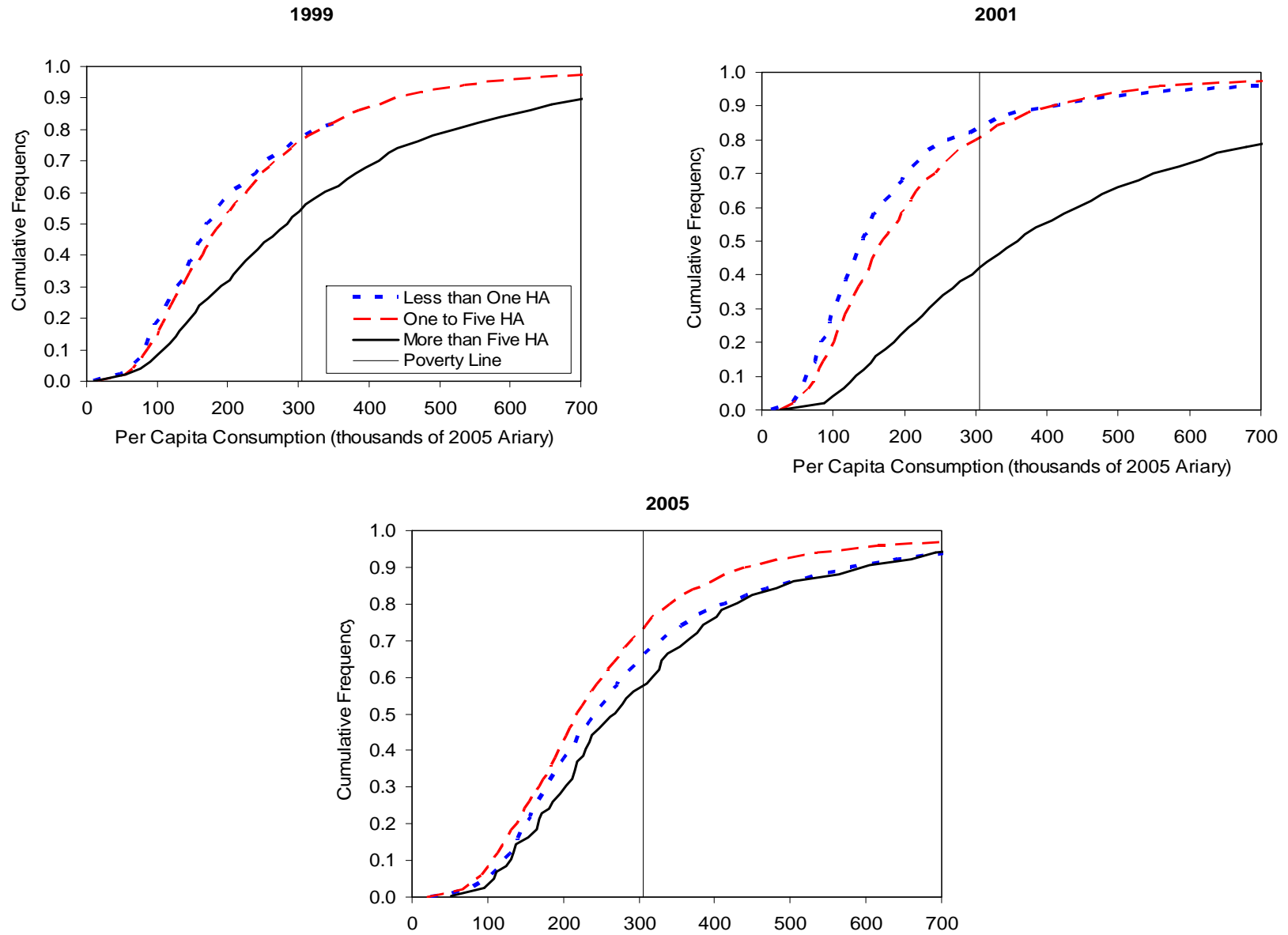
**Figure 4: Distribution of Per Capita Consumption by Education of Household Head**



**Figure 5: Distribution of HH Expenditure by Remoteness (by Year)**



**Figure 6: Distribution of HH Expenditure by Land Holdings**



**Table 1: Transaction Cost by Remoteness Quintile**

	Median Cost of Transporting 50 kg Sack of Rice		
	Cost	Percent of Rice Value	Percent of Urban Cost
<b>1999</b>			
Most remote	30,000	60.0	900.0
Q2	15,000	30.0	400.0
Q3	10,000	20.0	233.3
Q4	5,000	10.0	66.7
Least remote	1,000	2.0	-66.7
Urban center	3,000	6.0	-
<b>2001</b>			
Most remote	26,000	52.0	766.7
Q2	15,000	30.0	400.0
Q3	10,000	20.0	233.3
Q4	5,000	10.0	66.7
Least remote	1,000	2.0	-66.7
Urban center	3,000	6.0	-
<b>2005</b>			
Most remote	30,000	60.0	1400.0
Q2	15,000	30.0	650.0
Q3	10,000	20.0	400.0
Q4	5,000	10.0	150.0
Least remote	2,000	4.0	0.0
Urban center	2,000	4.0	-

Note: Transaction costs is measured as the cost (in 2005 Ariary) of transporting a 50 kg sack of rice to the market.

Note: A 50 kg sack of rice has estimated value 1000 Ar/kg \*50 kg = 50 000 Ar.

Note: Percentage change of transaction cost is measured from any one to the next, more remote quintile.

Table 2: Well-Being of Households by Type

	Average per capita consumption*			Percent poor		
	1999	2001	2005	1999	2001	2005
<i>Type i</i>	195.2	162.0	248.9	81.6	88.9	79.7
Female head						
Uneducated						
Land poor						
Less remote (Q4 & Q5)						
<i>Type ii</i>	472.7	779.7	461.3	44.6	15.6	40.6
Female head						
Educated						
Some land						
Urban						
<i>Type iii</i>	399.4	646.2	435.8	50.4	26.4	39.2
Male headed						
Secondary+ education						
Large land holdings						
Most remote (Q1 & Q2)						

\* Thousands of 2005 Ariary

**Table 3: Reduced Form Models of Per Capita Household Consumption, Madagascar 2001 & 2005**

	2001				2005			
	Parsimonius		Full		Parsimonius		Full	
	Model		Model <sup>†</sup>		Model		Model <sup>†</sup>	
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
<b>Ethnicity - Merina dummy</b>	<b>0.423</b>	<b>19.47 ***</b>	<b>-0.001</b>	<b>-0.03</b>	<b>0.234</b>	<b>19.46 ***</b>	<b>0.009</b>	<b>0.48</b>
HH Head is female	-0.139	-4.66 ***	-0.059	-2.58 ***	-0.060	-3.68 ***	-0.053	-3.40 ***
Number of HH members								
Under age 5	-0.301	-24.46 ***	-0.231	-23.59 ***	-0.210	-30.07 ***	-0.189	-27.47 ***
Age 5-14	-0.204	-24.65 ***	-0.170	-24.96 ***	-0.150	-36.46 ***	-0.139	-34.48 ***
Female 15-50	0.016	1.14	-0.044	-4.01 ***	-0.076	-9.28 ***	-0.085	-11.23 ***
Male 15-50	-0.102	-8.07 ***	-0.088	-9.01 ***	-0.055	-7.57 ***	-0.059	-8.48 ***
Female 50+	0.058	1.13	-0.054	-1.37	-0.026	-0.93	-0.040	-1.54
Male 50+	-0.169	-2.88 ***	-0.167	-3.53 ***	-0.028	-0.90	-0.058	-1.94 *
Head Age	0.028	6.11 ***	0.015	3.97 ***	0.020	8.07 ***	0.017	6.73 ***
Head Age - squared	-0.0003	-6.08 ***	-0.0001	-2.96 ***	-0.0002	-7.68 ***	-0.0002	-5.73 ***
Constant	12.540	134.33 ***	12.630	152.96 ***	12.605	242.27 ***	12.788	214.89 ***
Head Age - turning point	44.9		60.4		47.3		53.5	
R-squared	0.291		0.568		0.234		0.324	
No. of observations	5,070		5,070		11,751		11,751	

Note: Representative household is male-headed, without education, land poor, living in urban Antananarivo Province.

Note: \*, \*\* and \*\*\* indicate significance at the 90, 95 and 99 percent level of confidence, respectively.

<sup>†</sup> The full model includes the following explanatory variables, not shown here: land holdings, education of household head, remoteness, and province dummies.

**Table 4: Determinants of Per Capita Household Consumption, Madagascar 1999, 2001 & 2005**

Main Model	1999		2001		2005		<i>Differences</i>			
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	1999 to 2001		2001 to 2005	
							Coeff	t-stat	Coeff	t-stat
HH Head is female	-0.004	-0.04	-0.025	-0.40	0.091	1.59	-0.021	-0.20	0.115	1.38
Land Holdings (left out = < 1)										
Small (1 - 5 hectares)	0.420	3.67 ***	0.286	2.67 ***	0.180	1.87 *	-0.134	-0.86	-0.105	-0.73
Large (5+ hectares)	0.297	3.76 ***	0.424	7.06 ***	0.048	0.99	0.127	1.28	-0.376	-4.85 ***
Head Educ (left out = none)										
Head Educ - Primary	0.154	3.17 ***	0.181	4.60 ***	0.107	4.95 ***	0.027	0.43	-0.073	-1.64
Head Educ - At least Secondary	0.469	8.53 ***	0.704	13.06 ***	0.397	15.64 ***	0.235	3.05 ***	-0.307	-5.16 ***
Remoteness (left out = urban)										
Most remote	-0.126	-1.42	-0.372	-5.81 ***	-0.398	-10.05 ***	-0.245	-2.24 **	-0.027	-0.36
Q2	-0.186	-1.99 **	-0.407	-6.66 ***	-0.282	-6.52 ***	-0.222	-1.99 **	0.125	1.67 *
Q3	-0.153	-1.96 **	-0.321	-4.81 ***	-0.325	-8.37 ***	-0.168	-1.63	-0.004	-0.05
Q4	-0.081	-1.12	-0.283	-4.63 ***	-0.311	-8.68 ***	-0.202	-2.13 **	-0.027	-0.38
Least remote	-0.101	-1.40	-0.234	-3.92 ***	-0.172	-4.63 ***	-0.133	-1.43	0.062	0.88
Number of HH members										
Under age 5	-0.138	-11.39 ***	-0.230	-23.42 ***	-0.184	-27.73 ***	-0.092	-5.91 ***	0.046	3.89 ***
Age 5-14	-0.076	-7.97 ***	-0.171	-24.97 ***	-0.141	-36.86 ***	-0.095	-8.06 ***	0.030	3.82 ***
Female 15-50	-0.064	-7.81 ***	-0.043	-3.99 ***	-0.087	-11.70 ***	0.020	1.49	-0.044	-3.31 ***
Male 15-50	-0.060	-7.40 ***	-0.090	-9.19 ***	-0.060	-8.85 ***	-0.031	-2.41 **	0.030	2.53 **
Female 50+	-0.129	-3.35 ***	-0.054	-1.38	-0.034	-1.31	0.075	1.37	0.020	0.43
Male 50+	-0.004	-0.11	-0.171	-3.66 ***	-0.063	-2.16 **	-0.167	-2.68 ***	0.108	1.96 **
Head Age	0.003	0.67	0.015	4.00 ***	0.018	7.32 ***	0.012	2.26 **	0.003	0.68
Head Age - squared	0.0000	0.19	-0.0001	-2.97 ***	-0.0002	-6.16 ***	-0.0001	-2.21 **	0.0000	-0.90
Province (left out = Antananarivo)										
Fianarantsoa	-0.202	-7.43 ***	-0.260	-9.19 ***	-0.184	-11.70 ***	-0.058	-1.47	0.077	2.37 **
Toamasina	-0.051	-1.86 *	-0.285	-10.03 ***	-0.176	-9.11 ***	-0.234	-5.93 ***	0.109	3.17 ***
Mahajanga	-0.095	-3.16 ***	-0.086	-3.00 ***	-0.023	-1.40	0.008	0.20	0.064	1.93 *
Toliara	-0.039	-1.36	-0.114	-3.60 ***	-0.100	-5.88 ***	-0.076	-1.79 *	0.014	0.39
Antsiranana	0.087	2.83 ***	0.036	1.24	0.029	1.35	-0.051	-1.22	-0.007	-0.19
Interactions appear in Appendix Table 1										
Constant	12.709	113.62 ***	12.633	138.85 ***	12.859	211.40 ***	-0.076	-0.53	0.226	2.06 **
									12.635	139.99
Head Age - turning point	NA		60.9		53.8		NA		-7.1	
R-squared	0.374		0.575		0.346					
No. of observations	5,100		5,070		11,751					

Note: Representative household is male-headed, without education, without land holdings, living in urban Antananarivo Province.

Note: \*, \*\* and \*\*\* indicate significance at the 90, 95 and 99 percent level of confidence, respectively.

**Table 5a: Differential Marginal Effects of Education on Per Capita Consumption**

*Marginal Effects*

	Marginal Effect				Difference Relative to Land Poor/Male-Headed HH			
	Primary		Secondary +		Primary		Secondary +	
	Coeff.	t-stat	Coeff.	t-stat	Difference	t-stat	Difference	t-stat
<b>1999</b>								
<i>Gender of Household Head</i>								
Female	0.182	1.15	0.523	3.60 ***	0.028	0.17	0.054	0.35
Male	0.154	3.17 ***	0.469	8.53 ***	..	..	..	..
<i>Land Holdings</i>								
< 1 HA	0.154	3.17 ***	0.469	8.53 ***	..	..	..	..
1 - 5 HA	-0.284	2.51 **	-0.056	0.58	-0.438	-3.55 ***	-0.525	-4.71 ***
5+ HA	-0.149	1.19	0.192	2.11	-0.303	-2.26 **	-0.278	-2.62 ***
<b>2001</b>								
<i>Gender of Household Head</i>								
Female	0.355	4.58 ***	0.780	8.50 ***	0.174	2.01 **	0.076	0.72
Male	0.181	4.60 ***	0.704	13.06 ***	..	..	..	..
<i>Land Holdings</i>								
< 1 HA	0.181	4.60 ***	0.704	13.06 ***	..	..	..	..
1 - 5 HA	-0.095	0.62	0.032	2.00 **	-0.276	-1.74 *	-0.672	-11.97 ***
5+ HA	-0.309	3.25 ***	-0.072	2.60 ***	-0.490	-4.76 ***	-0.776	-12.81 ***
<b>2005</b>								
<i>Gender of Household Head</i>								
Female	0.059	1.50	0.419	5.54 ***	-0.048	-1.06	0.022	0.27
Male	0.107	4.95 ***	0.397	15.64 ***	..	..	..	..
<i>Land Holdings</i>								
< 1 HA	0.107	4.95 ***	0.397	15.64 ***	..	..	..	..
1 - 5 HA	-0.018	0.73	0.232	1.59	-0.126	-3.80 ***	-0.165	-1.12
5+ HA	0.158	2.25 **	0.383	5.30 ***	0.051	0.69	-0.014	-0.19
<i>Differences</i>								
<i>1999 to 2001</i>								
<i>Gender of Household Head</i>								
Female	0.173	0.98	0.257	1.49	0.146	0.78	0.022	0.12
Male	0.027	0.43	0.235	3.05 ***	..	..	..	..
<i>Land Holdings</i>								
< 1 HA	0.027	0.43	0.235	3.05 ***	..	..	..	..
1 - 5 HA	0.189	0.99	0.088	0.89	0.162	0.81	-0.147	-1.18
5+ HA	-0.160	-1.02	-0.263	-2.78 ***	-0.187	-1.11	-0.498	-4.08 ***
<i>2001 to 2005</i>								
<i>Gender of Household Head</i>								
Female	-0.296	-3.40 ***	-0.362	-3.04 ***	-0.222	-2.27 **	-0.055	-0.41
Male	-0.073	-1.64	-0.307	-5.15 ***	..	..	..	..
<i>Land Holdings</i>								
< 1 HA	-0.073	-1.64	-0.307	-5.15 ***	..	..	..	..
1 - 5 HA	0.077	0.50	0.200	1.37	0.150	0.93	0.507	3.21 ***
5+ HA	0.468	3.96 ***	0.454	5.88 ***	0.541	4.28 ***	0.761	7.80 ***

Note: \*, \*\* and \*\*\* indicate significance at the 90, 95 and 99 percent level of confidence, respectively.

**Table 5b: Differential Marginal Effects of Remoteness on Per Capita Consumption**

Marginal Effects

	Marginal Effect										Difference Relative to Land Poor/Male-Headed HH										
	Most Remote		Q2		Q3		Q4		Least Remote		Most Remote		Q2		Q3		Q4		Least Remote		
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Diff	t-stat	Diff	t-stat	Diff	t-stat	Diff	t-stat	Diff	t-stat	
<b>1999</b>																					
<i>Gender of Household Head</i>																					
Female	-0.214	1.67 *	-0.388	2.63 ***	-0.282	2.05 **	-0.304	2.55 **	-0.223	1.82 *	-0.087	-0.56	-0.202	-1.16	-0.129	-0.81	-0.223	-1.59	-0.123	-0.86	
Male	-0.126	-1.42	-0.186	-1.99 **	-0.153	-1.96 **	-0.081	-1.12	-0.101	-1.40	..	..	..	..	..	..	..	..	..	..	
<i>Land Holdings</i>																					
< 1 HA	-0.126	-1.42	-0.186	-1.99 **	-0.153	-1.96 **	-0.081	-1.12	-0.101	-1.40	..	..	..	..	..	..	..	..	..	..	
1 - 5 HA	-0.876	4.60 ***	-0.734	3.84 ***	-0.732	3.83 ***	-0.790	4.15 ***	-0.793	4.15 ***	-0.750	-3.57 ***	-0.548	-2.58 ***	-0.579	-2.81 ***	-0.709	-3.48 ***	-0.692	-3.39 ***	
5+ HA	-0.531	5.14 ***	-0.647	5.37 ***	-0.550	5.44 ***	-0.542	5.27 ***	-0.517	5.44 ***	-0.405	-2.97 ***	-0.461	-3.02 ***	-0.397	-3.10 ***	-0.460	-3.66 ***	-0.416	-3.49 ***	
<b>2001</b>																					
<i>Gender of Household Head</i>																					
Female	-0.511	3.77 ***	-0.511	3.78 ***	-0.341	2.27 **	-0.281	1.64	-0.300	1.72 *	-0.139	-0.93	-0.104	-0.70	-0.020	-0.12	0.002	0.01	-0.066	-0.36	
Male	-0.372	-5.81 ***	-0.407	-6.66 ***	-0.321	-4.81 ***	-0.283	-4.63 ***	-0.234	-3.92 ***	..	..	..	..	..	..	..	..	..	..	
<i>Land Holdings</i>																					
< 1 HA	-0.372	-5.81 ***	-0.407	-6.66 ***	-0.321	-4.81 ***	-0.283	-4.63 ***	-0.234	-3.92 ***	..	..	..	..	..	..	..	..	..	..	
1 - 5 HA	-0.576	4.28 ***	-0.598	4.22 ***	-0.553	3.77 ***	-0.392	3.17 ***	-0.561	3.61 ***	-0.204	-1.37	-0.191	-1.24	-0.232	-1.44	-0.109	-0.79	-0.328	-1.97 **	
5+ HA	-0.517	9.24 ***	-0.684	10.10 ***	-0.520	9.01 ***	-0.598	10.17 ***	-0.357	6.59 ***	-0.146	-1.71 *	-0.277	-3.03 ***	-0.199	-2.25 **	-0.314	-3.70 ***	-0.123	-1.52	
<b>2005</b>																					
<i>Gender of Household Head</i>																					
Female	-0.658	5.31 ***	-0.591	4.68 ***	-0.518	3.97 ***	-0.613	5.11 ***	-0.421	3.23 ***	-0.260	-1.99 **	-0.308	-2.31 **	-0.193	-1.42	-0.303	-2.42 **	-0.250	-1.84 *	
Male	-0.398	#####	-0.282	-6.52 ***	-0.325	-8.37 ***	-0.311	-8.68 ***	-0.172	-4.63 ***	..	..	..	..	..	..	..	..	..	..	
<i>Land Holdings</i>																					
< 1 HA	-0.398	#####	-0.282	-6.52 ***	-0.325	-8.37 ***	-0.311	-8.68 ***	-0.172	-4.63 ***	..	..	..	..	..	..	..	..	..	..	
1 - 5 HA	-0.456	4.12 ***	-0.437	3.04 ***	-0.419	3.36 ***	-0.351	3.31 ***	-0.545	3.49 ***	-0.058	-0.49	-0.155	-1.03	-0.095	-0.72	-0.041	-0.36	-0.373	-2.33 **	
5+ HA	-0.052	3.76 ***	-0.148	2.71 ***	0.020	1.63	0.018	2.32 **	-0.032	0.99	0.346	8.25 ***	0.134	1.93 *	0.345	8.47 ***	0.328	8.97 ***	0.140	2.86 ***	
<i>Differences</i>																					
<i>1999 to 2001</i>																					
<i>Gender of Household Head</i>																					
Female	-0.297	-1.59	-0.123	-0.62	-0.059	-0.29	0.023	0.11	-0.076	-0.36	-0.052	-0.24	0.098	0.43	0.108	0.47	0.225	0.98	0.057	0.24	
Male	-0.245	-2.24 **	-0.222	-1.99 **	-0.168	-1.63	-0.202	-2.13 **	-0.133	-1.43	..	..	..	..	..	..	..	..	..	..	
<i>Land Holdings</i>																					
< 1 HA	-0.245	-2.24 **	-0.222	-1.99 **	-0.168	-1.63	-0.202	-2.13 **	-0.133	-1.43	..	..	..	..	..	..	..	..	..	..	
1 - 5 HA	0.301	1.29	0.136	0.57	0.179	0.74	0.397	1.75 *	0.232	0.94	0.546	2.12 **	0.358	1.36	0.346	1.32	0.600	2.44 **	0.365	1.39	
5+ HA	0.014	0.12	-0.038	-0.27	0.030	0.26	-0.056	-0.47	0.160	1.47	0.259	1.61	0.184	1.04	0.198	1.27	0.146	0.96	0.294	2.04 **	
<i>2001 to 2005</i>																					
<i>Gender of Household Head</i>																					
Female	-0.147	-0.80	-0.080	-0.43	-0.177	-0.89	-0.332	-1.59	-0.122	-0.56	-0.120	-0.61	-0.205	-1.03	-0.173	-0.81	-0.305	-1.38	-0.184	-0.81	
Male	-0.027	-0.36	0.125	1.67 *	-0.004	-0.05	-0.027	-0.38	0.062	0.88	..	..	..	..	..	..	..	..	..	..	
<i>Land Holdings</i>																					
< 1 HA	-0.027	-0.36	0.125	1.67 *	-0.004	-0.05	-0.027	-0.38	0.062	0.88	..	..	..	..	..	..	..	..	..	..	
1 - 5 HA	0.120	0.69	0.161	0.80	0.134	0.70	0.041	0.25	0.016	0.07	0.147	0.77	0.036	0.17	0.138	0.66	0.068	0.38	-0.046	-0.20	
5+ HA	0.465	8.06 ***	0.536	6.16 ***	0.540	9.15 ***	0.615	10.38 ***	0.325	5.16 ***	0.492	5.19 ***	0.411	3.58 ***	0.544	5.60 ***	0.643	6.95 ***	0.263	2.79 ***	

Note: \*, \*\* and \*\*\* indicate significance at the 90, 95 and 99 percent level of confidence, respectively.

**Table 5c: Differential Marginal Effects of Land Holdings on Per Capita Consumption**

*Marginal Effects*

	Marginal Effect				Difference Relative to Urban/Male-Headed HH			
	Small (1 - 5 HA)		Large (5+ HA)		Small (1 - 5 HA)		Large (5+ HA)	
	Coeff.	t-stat	Coeff.	t-stat	Difference	t-stat	Difference	t-stat
<b>1999</b>								
<i>Remoteness</i>								
Most Remote	0.216	0.91	0.316	1.79 *	-0.204	-0.77	0.018	0.10
Q2	0.477	2.55 **	0.319	1.60	0.057	0.26	0.022	0.10
Q3	0.415	3.30 ***	0.351	2.72 ***	-0.005	-0.03	0.053	0.35
Q4	0.213	1.56	0.215	1.64	-0.207	-1.16	-0.082	-0.53
Least Remote	0.248	1.94 *	0.279	2.27 **	-0.172	-1.00	-0.018	-0.13
Urban Center	0.420	3.67 ***	0.297	3.76 ***	..	..	..	..
<b>2001</b>								
<i>Remoteness</i>								
Most Remote	0.493	11.10 ***	0.829	8.33 ***	0.208	1.79 *	0.405	3.48 ***
Q2	0.566	8.37 ***	0.758	7.67 ***	0.280	2.22 **	0.333	2.88 ***
Q3	0.492	8.34 ***	0.803	7.25 ***	0.207	1.69 *	0.379	3.00 ***
Q4	0.544	9.39 ***	0.616	6.10 ***	0.258	2.12 **	0.192	1.63
Least Remote	0.344	10.19 ***	0.827	8.80 ***	0.059	0.52	0.402	3.61 ***
Urban Center	0.286	2.67 ***	0.424	7.06 ***	..	..	..	..
<b>2005</b>								
<i>Remoteness</i>								
Most Remote	0.430	6.60 ***	0.569	8.18 ***	0.249	2.14 **	0.521	6.13 ***
Q2	0.392	5.66 ***	0.417	5.85 ***	0.211	1.78 *	0.368	4.27 ***
Q3	0.420	6.05 ***	0.595	8.46 ***	0.239	2.01 **	0.547	6.38 ***
Q4	0.402	7.59 ***	0.506	8.08 ***	0.221	2.01 **	0.458	5.77 ***
Least Remote	0.088	2.46 **	0.337	5.56 ***	-0.092	-0.90	0.289	3.71 ***
Urban Center	0.180	1.87 *	0.048	0.99	..	..	..	..
<b>Differences</b>								
<i>1999 to 2001</i>								
<i>Remoteness</i>								
Most Remote	0.277	1.14	0.514	2.54 **	0.411	1.43	0.387	1.71 *
Q2	0.089	0.44	0.438	1.97 **	0.223	0.88	0.311	1.28
Q3	0.078	0.56	0.453	2.66 ***	0.212	1.01	0.325	1.65 *
Q4	0.331	2.23 **	0.401	2.42 **	0.465	2.16 **	0.273	1.42
Least Remote	0.096	0.72	0.548	3.55 ***	0.230	1.12	0.421	2.29 **
Urban Center	-0.134	-0.86	0.127	1.28	..	..	..	..
<b>2001 to 2005</b>								
<i>Remoteness</i>								
Most Remote	-0.064	-0.81	-0.260	-2.14 **	0.041	0.25	0.116	0.80
Q2	-0.174	-1.80 *	-0.341	-2.80 ***	-0.069	-0.40	0.035	0.24
Q3	-0.073	-0.80	-0.208	-1.59	0.033	0.19	0.168	1.10
Q4	-0.142	-1.81 *	-0.110	-0.92	-0.037	-0.22	0.266	1.88 *
Least Remote	-0.256	-5.19 ***	-0.489	-4.38 ***	-0.151	-0.99	-0.113	-0.83
Urban Center	-0.105	-0.73	-0.376	-4.86 ***	..	..	..	..

Note: \*, \*\* and \*\*\* indicate significance at the 90, 95 and 99 percent level of confidence, respectively.

**Table 6: Proportion of Households by Land Holding and Remoteness**

	Land Holdings		
	< 1 HA	1- 5 HA	5+ HA
<b>1999</b>			
<i>All Households</i>	0.17	0.59	0.24
<i>Remoteness</i>			
Most remote	0.06	0.79	0.15
Q2	0.14	0.68	0.18
Q3	0.18	0.61	0.21
Q4	0.22	0.67	0.11
Least remote	0.22	0.55	0.22
<hr/>			
<b>2001</b>			
<i>Total</i>	0.34	0.35	0.31
<i>Remoteness</i>			
Most remote	0.40	0.39	0.21
Q2	0.44	0.35	0.21
Q3	0.31	0.47	0.22
Q4	0.32	0.47	0.20
Least remote	0.36	0.30	0.34
<hr/>			
<b>2005</b>			
<i>Total</i>	0.35	0.50	0.15
<i>Remoteness</i>			
Most remote	0.29	0.62	0.09
Q2	0.29	0.54	0.17
Q3	0.29	0.60	0.11
Q4	0.42	0.50	0.08
Least remote	0.38	0.49	0.13

**Appendix Table 1: Determinants of Per Capita Household Consumption, Madagascar 1999, 2001 & 2005**

*Interaction Coefficient Estimates*

	Education of the Household Head <sup>†</sup>				Remoteness (left out = urban)									
	Primary		At least Secondary		Most Remote		Q2		Q3		Q4		Least Remote	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
<b>Interactions</b>														
<i>1999</i>														
HH Head is female	0.025	0.44	0.050	0.73	-0.091	-1.05	-0.206	-2.04 **	-0.132	-1.58	-0.226	-2.70 ***	-0.126	-1.66 *
Land Holdings (left out = < 1)														
Small (1 - 5 hectares)	-0.018	-0.32	-0.105	-1.58	-0.330	-2.57 ***	-0.128	-0.97	-0.159	-1.30	-0.288	-2.44 **	-0.272	-2.32 **
Large (5+ hectares)	-0.006	-0.09	0.019	0.28	-0.108	-1.06	-0.164	-1.33	-0.100	-1.07	-0.163	-1.79 *	-0.119	-1.42
<i>2001</i>														
HH Head is female	0.150	3.08 ***	0.051	0.94	-0.164	-2.37 **	-0.129	-1.71 *	-0.045	-0.70	-0.023	-0.33	-0.091	-1.32
Land Holdings (left out = < 1)														
Small (1 - 5 hectares)	0.037	0.68	-0.152	-1.99 **	-0.164	-1.42	-0.127	-1.05	-0.114	-0.98	-0.025	-0.23	-0.175	-1.54
Large (5+ hectares)	-0.039	-0.78	-0.117	-1.90 *	0.034	0.45	-0.074	-0.95	0.058	0.77	-0.092	-1.25	0.168	2.45 **
<i>2005</i>														
HH Head is female	0.043	1.42	0.112	3.01 ***	-0.169	-2.81 ***	-0.218	-3.52 ***	-0.103	-1.76 *	-0.212	-3.56 ***	-0.159	-2.71 ***
Land Holdings (left out = < 1)														
Small (1 - 5 hectares)	0.008	0.33	-0.057	-1.77 *	-0.149	-1.52	-0.071	-0.71	-0.086	-0.87	-0.089	-0.92	-0.264	-2.71 ***
Large (5+ hectares)	0.053	1.38	-0.038	-0.97	0.123	2.09 **	0.086	1.44	0.222	4.20 ***	0.147	2.62 ***	0.117	2.25 **
<b>Differences</b>														
<i>1999 to 2001</i>														
HH Head is female	0.125	1.68 *	0.001	0.01	-0.073	-0.66	0.077	0.61	0.087	0.82	0.204	1.88 *	0.036	0.35
Land Holdings (left out = < 1)														
Small (1 - 5 hectares)	0.054	0.70	-0.047	-0.46	0.166	0.96	0.002	0.01	0.044	0.26	0.263	1.63	0.097	0.59
Large (5+ hectares)	-0.033	-0.42	-0.136	-1.47	0.141	1.12	0.090	0.61	0.158	1.32	0.071	0.61	0.288	2.65
<i>2001 to 2005</i>														
HH Head is female	-0.107	-1.87 *	0.061	0.92	-0.005	-0.05	-0.089	-0.92	-0.058	-0.66	-0.189	-2.08 **	-0.068	-0.76
Land Holdings (left out = < 1)														
Small (1 - 5 hectares)	-0.028	-0.47	0.095	1.15	0.015	0.10	0.056	0.36	0.029	0.19	-0.064	-0.43	-0.089	-0.59
Large (5+ hectares)	0.091	1.46	0.078	1.07	0.089	0.94	0.160	1.63	0.164	1.79 *	0.239	2.59 ***	-0.051	-0.59

Note: \*, \*\* and \*\*\* indicate significance at the 90, 95 and 99 percent level of confidence, respectively.

<sup>†</sup> Left out categories are "no education" and "urban"