The rural non-farm economy, livelihood strategies and household welfare

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Abstract

This paper examines the relationship between rural non-farm employment and household welfare using nationally representative data from Madagascar. It focuses on labor outcomes in the context of household livelihood strategies that include farm and non-farm income earning opportunities. It identifies distinct household livelihood strategies that can be ordered in welfare terms, and estimates multinomial logit models to assess the extent of the barriers to choosing dominant strategies. It finds that high-return non-farm activities provide an important pathway out of poverty, but that barriers such as lack of (a) education, (b) formal credit and (c) access to telecommunications restrict participation in such activities. Individual employment choice models and estimates of earnings functions provide supporting evidence of these barriers. Although the poverty reduction effects may be limited, low-return non-farm activities also play an important role as safety nets by providing opportunities for ex ante risk reduction and ex post coping with shocks.

Keywords: non-farm; livelihood strategy; diversification; labor; welfare; Madagascar

Cet article examine la relation entre l'emploi du secteur non agricole et le bien-être des ménages dans les zones rurales grâce aux données représentatives, à l'échelle nationale, de Madagascar. Il cible les revenus générés par le travail dans le cadre des stratégies de subsistance des ménages qui incluent les possibilités de gagner de l'argent des secteurs agricole et non agricole. Il identifie différentes stratégies de subsistance des ménages que l'on peut classer en termes de bien-être et examine des modèles logit multinomiaux pour évaluer l'étendue des barrières dans le choix des stratégies dominantes. L'étude montre que les activités du secteur non agricole générant des revenus élevés permettent de manière significative de se sortir de la pauvreté, mais que les barrières comme le manque d'éducation (a), de crédit officiel (b), et d'accès aux télécommunications (c) réduisent la participation à de telles activités. Les modèles de choix en matière d'emploi pour les personnes individuelles et les évaluations des fonctions génération de revenu mettent en lumière ces barrières. Bien que les effets réduction de pauvreté soient limités, les activités du secteur non agricole générant peu de revenus jouent également un rôle important, en tant que filets de sécurité, en permettant la réduction de risque ex-ante et l'absorption des chocs ex-post.

Mots-clés : *non agricole ; stratégie de subsistance ; diversification ; main-d'oeuvre ; bien-être ; Madagascar*

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1. Introduction

The rural non-farm sector is often seen an important pathway out of poverty (Lanjouw, 2001). Indeed, an empirical regularity emerging from studies of the non-farm economy in developing countries is that there exists a positive relationship between non-farm activity and welfare on average (Barrett et al., 2001). In addition, non-farm employment has the potential to reduce inequality, absorb a growing rural labor force, slow rural-urban migration and contribute to the growth of national income (Lanjouw & Feder, 2001).

The supply of labor to the non-farm sector in rural areas, however, is perhaps best understood in the context of households' decision making based on livelihood strategies (Reardon, 1997). After all, 'diversification is the norm' (Barrett et al., 2001), especially among agricultural households, whose livelihoods are vulnerable to climatic uncertainties. For households facing substantial crop and price risks, and consequently agricultural income risks, there is a strong incentive to diversify their income sources. In principle, such diversification could be accomplished through land and financial asset diversification. But the absence of well-functioning land and capital markets in developing countries often means that these diversification strategies are not feasible. Consequently, many rural households find themselves pursuing second-best diversification strategies through the allocation of household labor (Bhaumik et al., 2006). In this setting, household labor supply and allocation decisions are not made simply on the basis of productivity calculations; rather, they involve weighing both productivity and risk factors (Barrett et al., 2008).

Given the multitude of constraints faced by households and the heterogeneity of non-farm employment opportunities available to them, livelihood diversification strategies vary widely (Barrett et al., 2005). This heterogeneity can make generalizations problematic and is a reason for our general lack of knowledge about the rural non-farm economy (Haggblade et al., 2007). Nonetheless, some broad characterizations are helpful.

One such characterization is based on the existence of both *push* and *pull* factors that influence the choices households make when it comes to non-farm employment. First, there is an incentive, or *push*, for households with weak non-labor asset endowments and who live in risky agricultural zones to allocate household labor to non-farm activities. Although households frequently do turn to the non-farm sector as an ex ante risk reduction strategy, distress diversification into low-return non-farm activities is also observed as an ex post reaction to low farm income (Von Braun, 1989; Haggblade, 2007). In this way, there are benefits to low-return non-farm activities that serve as a type of safety net that 'helps to prevent poor [households] from falling into even greater destitution' (Lanjouw, 2001). Second, such factors as earnings premia from high productivity or high income activities may attract, or *pull*, some household labor into non-farm employment (Dercon & Krishnan, 1996; Barrett et al., 2001; Lanjouw & Feder, 2001; Reardon et al., 2001; Haggblade, 2007). These high-return non-farm jobs may serve as a genuine source of upward mobility (Lanjouw, 2001).

Another characterization is based on the type of livelihood strategies adopted. Identifying distinct livelihood strategies built on labor allocations can be informative, especially if certain strategies are found to offer higher returns than others. For example, the co-existence of high- and low-return strategies is an indication that there are barriers to adopting the former. As Brown et al. (2006:23) explain,

> a simple revealed preference argument suggests that, where different asset allocation strategies yield different income distributions that can be ordered in welfare terms…, any household observed to have adopted a lower return strategy must have faced a constraint that limited its choice set relative to those of its neighbors.

Indeed, the positive correlation commonly found between household income and non-farm participation is consistent with access to these high-return strategies being limited to a subpopulation of well-endowed households.[1] After all, it is those who begin poor who typically face difficulties raising the funds required for investment and overcoming other entry barriers to participating in the type of non-farm activities that might raise their standards of living (Dercon & Krishnan, 1996; Barrett et al., 2005; Bhaumik et al., 2006).

In this paper, we examine the relationship between rural non-farm employment and household welfare using nationally representative data from Madagascar. In doing so, we focus attention on labor outcomes in the context of household livelihood strategies that include farm and non-farm income earning opportunities. We identify distinct household livelihood strategies that can be ordered in welfare terms and estimate multinomial logit models to assess the extent to which there exist barriers to choosing dominant strategies. Individual employment choice models, as well as estimates of earnings functions, provide supporting evidence of these barriers.

A weakness in the extensive and growing literature on household income diversification strategies is that the empirical analyses have generally been confined to limited geographical areas (Dercon & Krishnan, 1996; Ellis, 1998; Barrett et al., 2001; Little et al., 2001; Brück, 2004; Bhaumik et al., 2006; Barrett et al., 2005; Brown et al., 2006). This paper aims to fill this gap and to complement the existing literature by using nationally representative household survey data to generalize the results more broadly.

In the next section we describe the main data source and define basic terms used in the paper. Section 3 provides an overview of individual labor market outcomes in Madagascar and identifies household livelihood strategies. In Section 4 we estimate the determinants of the livelihood strategies identified in the previous section to test for the existence of barriers that may prevent households from adopting high-return strategies associated with non-farm employment. In Section 5, given that household strategy choices are limited by the characteristics of their members, we estimate the determinants of individual employment choice and individual earnings. Section 6 concludes with remarks and observations.

2. Data and definitions

This section describes the main data source and defines the terms ‘employment’, ‘rural’ and ‘non-farm’ as used in this paper.

[1] The effect of non-farm participation is thus ambiguous. On the one hand, entry barriers that limit the accessibility of those with limited asset endowments to high-return non-farm activities tend to result in more inequality. On the other hand, the ‘safety-net’ role of the non-farm sector tends to buoy these same households and consequently have an equalizing effect (Lanjouw, 2001; Haggblade et al., 2007).

Data

Our main source of information in this analysis is the 2005 Madagascar *Enquête Prioritaire auprès des Ménages* (EPM), a nationally representative integrated household survey of 11,781 households, 5,922 of which are in rural areas. The data were collected by the *Institut National de la Statistique* (INSTAT) between September and December, 2005. The sample was selected through a multi-stage sampling technique in which the strata were defined by the region and milieu (rural, secondary urban centers and primary urban centers), and the primary sampling units were *fokontany*.[2] Each of the *fokontany* was selected systematically, with probability proportional to size and sampling weights defined by the inverse probability of selection to obtain accurate population estimates.

The multi-purpose questionnaires included sections on education, health, housing, agriculture, household expenditure, assets, non-farm enterprises and employment. Employment and earnings information are available in the employment, non-farm enterprise and agriculture sections. For a measure of household well-being, in this analysis we use the estimated household-level consumption aggregate constructed by INSTAT.

Definitions: Employment, rural and farm vs non-farm

Although workforce participation is high in Madagascar, formal labor markets are thin in rural areas. Fewer than 6% of those involved in income generating activities are compensated in the form of wages or salaries (Stifel et al., 2007). Given the agricultural orientation of the economy and the importance of family-level production units, most rural workers in this country are self-employed. We therefore adopt for this analysis a broad definition of labor markets that includes self-employment. If a labor market is a place where labor services are bought and sold, then self-employed individuals are seen as simultaneously buying and selling their own labor services.

Two concepts related to the term 'rural non-farm' need clarification. First, when we refer to 'rural' income (or employment), we mean income earned by rural households. This definition allows for income to be earned anywhere, including urban areas (Barrett et al., 2001).[3] Second, we follow Reardon et al. (2001) and Haggblade et al. (2007) in defining 'non-farm' activities as any activities outside agriculture (own-farming and wage employment in agriculture). This definition requires further clarification of what is meant by 'agriculture'. As described by Reardon et al. (2001:396),

> …agriculture produces raw agrifood products with one of the production factors being natural resources (land, rivers/lakes/ocean, air); the process can involve 'growing' (cropping, aquaculture, livestock husbandry, woodlot production) or 'gathering' (hunting, fishing, forestry).

Thus, in addition to cropping, agriculture includes livestock husbandry, fishing and forestry. Non-farm production therefore includes industry (e.g. mining, wood products, energy, food and beverages, textiles and leather and construction materials) and services (e.g. commerce, handicrafts, hotels and restaurants, transport, public works and private health). Note that

[2] There are 17,433 *fokontany* (village-level administrative divisions) in Madagascar.

[3] The data do not provide enough information to distinguish whether employment is in urban areas, but questions are asked about distance to the place of work. In 2005, for example, only 18% of wage workers employed in industrial and service jobs traveled more than 5 km to their place of work.

although agro-processing is closely linked to agriculture (e.g. by transforming raw agricultural products) it is classified as non-farm (Haggblade et al., 2007).

Finally, wage earnings were measured in the survey by asking wage-employed individuals how much they earned in terms of cash and in-kind payments. Non-wage (family) farm earnings were measured by estimating household agricultural earnings as a residual (total household consumption less all non-agricultural earnings and transfers). Household agricultural earnings were then divided by the number of household members working on the family farm and deflated regionally to approximate individual non-wage agricultural earnings. We caution that an implicit assumption underlying the use of this approximation of agricultural earnings is that household net savings are zero.[4]

3. Characteristics of rural labor markets and household livelihood strategies

In this section we examine the characteristics of rural labor markets in Madagascar from the perspective of individuals and then analyze these individual outcomes in the context of household livelihood strategies.

Individual outcomes

Rural labor markets in Madagascar are characterized predominantly by agricultural activities. Some 93% of economically active adults (aged 15 to 64) are employed in agriculture in one form or another, whether it is their primary or secondary job. Among primary jobs, 89% are agricultural (see Table 1), nearly all involving non-wage work on the family farm. Only 4% are wage positions.[5] Further, 71% of second jobs (held by 32% of all employed adults) are in agriculture. Unlike primary jobs, however, secondary jobs in agriculture are more likely to be wage positions (64%).

Table 1: Employment among economically active adults (15–64) in rural Madagascar (2005)

		Percent employed in…					
	Percent with	Farm			Non-farm		
	1st or 2nd job	Non-wage	Wage	**Total**	Non-wage	Wage	**Total**
1st job	*100*	85	4	**89**	5	6	**11**
Expenditure quintile							
Poorest	*100*	90	4	**95**	3	3	**5**
Q2	*100*	87	5	**91**	5	4	**9**
Q3	*100*	89	4	**93**	4	4	**7**
Q4	*100*	85	3	**88**	6	7	**12**
Richest	*100*	75	3	**77**	10	12	**23**

[4] Another approach, to value agricultural production, was also taken but the unit prices used to value unsold production proved to be problematic.

[5] Employment in the questionnaire was defined as activities for which the individual received remuneration. This may explain the low percentage of agricultural wage labor, as reciprocal agricultural labor was not included. In the comprehensive agricultural module of the 2001 EPM survey, we find that reciprocal labor was used on 44% of the plots.

Education level							
None	*100*	90	4	**94**	4	2	**6**
Primary	*100*	86	3	**89**	6	5	**11**
LowSecondary	*100*	71	4	**75**	11	14	**25**
UpperSecondary	*100*	53	3	**56**	11	34	**44**
PostSecondary	*100*	25	3	**28**	10	62	**73**
2nd job	*32*	26	46	**71**	24	4	**29**
Expenditure quintile							
Poorest	*29*	18	61	**78**	17	4	**22**
Q2	*35*	21	53	**74**	22	4	**26**
Q3	*33*	25	47	**73**	23	4	**27**
Q4	*33*	25	42	**67**	28	5	**33**
Richest	*28*	43	21	**65**	30	5	**35**
Education Level							
None	*32*	21	51	**73**	24	3	**27**
Primary	*32*	28	43	**71**	25	5	**29**
LowSecondary	*29*	37	30	**67**	24	9	**33**
UpperSecondary	*36*	50	17	**67**	23	9	**33**
PostSecondary	*27*	63	4	**67**	26	7	**33**

Source: Author's calculations from EPM 2005

Nearly 20% of active adults are employed in some form of non-farm activity. Only 11% of first jobs are in the non-farm sector, whereas 29% of second jobs are non-agricultural (Table 1). This finding is consistent with the notion that individuals are drawn to non-farm employment for their second jobs during periods of slack demand for agricultural labor. Unfortunately, this cannot be verified with the data at hand.

As is commonly found in other African countries (Barrett et al., 2001), there is a positive relationship between rural non-farm employment and welfare as measured by per capita household expenditure.[6] The percentage of workers with non-farm employment rises by expenditure quintile, with 11% employed in the poorest quintile in this sector and 31% in the richest. Among primary employment activities, only 5% were non-farm for those in the poorest quintile, while nearly a quarter were non-farm for those in the richest (Table 1).

As noted earlier, there may be substantial barriers to entry to high-return non-farm activities (Barrett et al., 2001). One such barrier may be lack of skills and education among the poor. As shown in Table 1, there is a strikingly strong positive relationship between educational attainment and non-farm activities among first jobs. For example, only 6% of those with no education are employed in the non-farm sector, compared to 44% of those with upper secondary education and 73% of those with post-secondary. The biggest differences are for wage activities, where 2% of those with no education had non-farm wage employment, compared to 34% of those with upper secondary education and 62% of those with post-

[6] Household expenditures are more accurately defined as consumption as they include not only expenditure items but also own-consumption of household agricultural and non-agricultural production as well as the imputed stream of benefits from durable goods and housing. The consumption aggregate for the EPM 2005 was constructed by INSTAT (2006).

secondary. The education–non-farm employment gradient is not as steep for secondary employment, probably because most non-farm employment among second jobs is in the form of non-wage (85%) rather than wage activities.

The general attraction of non-farm wage employment suggested in Table 1 is further illustrated by the relatively high earnings in this sector (Table 2). With a median of Ar 78,000 per month (approximately US$37),[7] earnings for non-farm wage workers are more than double not only those in the farm sector (Ar 31,000 for non-wage and Ar 38,000 for wage), but also those in the non-farm non-wage sector (Ar 37,000). Interestingly, on the basis of earnings alone, non-farm non-wage employment is not unambiguously preferred to farm activities since there is no clear pattern showing which sector has the higher earnings. As is characteristic of non-farm sectors throughout the developing world, and as will become clearer in this paper, non-farm employment activities in Madagascar are highly heterogeneous (Haggblade et al., 2007).

Table 2: Median monthly earnings of adults (15–64) in rural Madagascar (2005)

Thousands of ariary	Farm			Non-farm		
	Non-wage	Wage	**Total**	Non-wage	Wage	**Total**
1st job	31	38	**31**	37	78	**67**
Expenditure quintile						
Poorest	17	36	**18**	25	48	**28**
Q2	26	38	**27**	21	66	**41**
Q3	31	38	**32**	32	69	**47**
Q4	39	42	**39**	37	78	**63**
Richest	58	44	**58**	67	100	**89**
Education level						
None	29	37	**30**	28	49	**36**
Primary	33	42	**33**	26	72	**48**
LowSecondary	41	37	**40**	70	89	**84**
UpperSecondary	45	29	**45**	75	100	**91**
PostSecondary	38	*173	**45**	195	150	**151**
2nd job	24	20	**21**	22	39	**24**
Expenditure quintile						
Poorest	12	17	**17**	16	29	**18**
Q2	17	22	**20**	20	39	**21**
Q3	23	22	**22**	23	39	**24**
Q4	29	18	**20**	21	37	**22**
Richest	37	30	**35**	32	57	**35**
Education level						
None	23	19	**20**	21	30	**21**
Primary	22	22	**22**	22	35	**24**
LowSecondary	27	25	**26**	31	58	**37**
UpperSecondary	29	*30	**30**	24	*57	**37**
PostSecondary	*28	*40	***28**	*73	*57	**60**

Source: Author's calculations from EPM 2005
Note: 1 USD = approx. 2,100 MGA in 2005.
* Fewer than 20 observations

[7] At the time of the 2005 survey, the exchange rate was approximately Ar 2,100 per US dollar.

The evidence in Table 2 suggests that, in general, individuals may be pressed into non-farm non-wage employment as part of household income diversification strategies designed to reduce risk. Since it is not clear that earnings alone are enough to attract individuals to this sector, *push* factors such as land constraints, risky farming and weak or incomplete financial systems may instead be the forces compelling households to diversify their income sources by allocating household labor to non-farm non-wage employment. Conversely, *pull* factors such as higher earnings appear to be attracting labor to the non-farm wage.

Push factors may also motivate individuals to take on second jobs, particularly those in farming and in non-farm non-wage activities where median earnings are roughly two thirds those of first jobs. Although earnings for second jobs in the non-farm wage sector are approximately half those for first jobs (Ar 39,000 compared to Ar 78,000), they remain attractive relative to all other earnings, whether for first or second jobs.

Monthly farm wage earnings for first jobs are surprisingly high compared to family farm earnings (a median of Ar 38,000 compared to Ar 31,000). There are two possible reasons for this. One may be measurement issues because of the small size of the sample (only 4% of economically active adults) or differences in the definitions of wage and non-wage earnings, and the other may be the seasonal nature of agricultural wage employment. Indeed, median monthly earnings for seasonally wage employed individuals in agriculture are higher than for those with permanent employment (Ar 42,000 compared to Ar 31,000), and among wage employed individuals with permanent jobs, median earnings are similar to those of family farm workers.

Household outcomes

As noted above, in the presence of weak land and financial markets, household non-farm labor supply decisions are made by weighing both productivity and risk factors in the context of household livelihood strategies. Nonetheless, not all activities are available to all households. Diversification strategies may be affected by the constraints that exist for many activities. As Dercon and Krishnan (1996) note, ‘the ability to take up particular activities will distinguish the better off household from the household that is merely getting by’. In this section we therefore explore household patterns of labor diversification and identify strategies that can be ordered in welfare terms.

Given that households typically have more than one economically active member, we find that household income sources are more diversified than individual income sources (Table 3). While the percentage of households with at least one member employed in agriculture is the same as the percentage of individuals employed in agriculture (93%), households are more likely than individuals to also derive labor income from non-farm sources. For example, whereas 20% of economically active individuals in rural areas have some sort of non-farm employment, 31% of households in rural areas have at least one member in non-farm employment.

Table 3: Household employment activities* in rural Madagascar (2005)

Percent	Farm			Non-farm		
	Non-wage	Wage	**Total**	Non-wage	Wage	**Total**
Total	92	24	**93**	22	13	**31**
Expenditure quintile						
Poorest	94	28	**96**	15	8	**22**
Q2	94	29	**95**	22	10	**29**
Q3	96	26	**97**	23	10	**31**
Q4	92	21	**93**	25	16	**37**
Richest	81	12	**82**	26	21	**41**

Source: Author's calculations from EPM 2005

* Percent of households with at least one member employed in the various categories

This pattern is seen consistently across the household expenditure distribution. While only 11% of individuals in the poorest quintile have non-farm employment, 22% of households have non-farm employment. Similarly, 31% of economically active individuals in the richest quintile have non-farm jobs compared to 41% of households.

The rural non-farm economy is also a relatively important source of household income (Table 4). On average, households derive 22% of their income from non-farm jobs, whereas for individuals it is 20%. Conversely, although 93% of economically active adults derive at least some of their income from agriculture, only 78% of household income comes from this source.

Table 4: Sources of income by sector of activity in rural Madagascar (2005)

Share of total labor income

		Non-farm			
	Farm	*Total*	*Industry*	*Services*	*Total*
2005	78	22	*3*	*19*	100
Poorest	85	15	*3*	*12*	100
Q2	82	18	*2*	*16*	100
Q3	82	18	*4*	*15*	100
Q4	79	21	*2*	*19*	100
Richest	68	32	*4*	*28*	100

Source: Author's calculations from EPM 2005

As with employment, there is a strong positive relationship between non-farm income shares and welfare. Those in the poorest quintile derive 15% of their income from non-farm employment, whereas households in the richest quintile derive more than twice this much (32%). A consequence of this may be that, with non-farm incomes accruing largely to the

richer sector, the non-farm economy may lead to greater income inequality (Lanjouw & Feder, 2001).

Livelihood strategies

Is there a way that we can broadly define households in rural Madagascar so as to distinguish them by their livelihood strategies and provide insights into the choices available to them? If so, what distinct livelihood strategies do households adopt and can they be ordered in welfare terms? Identifying livelihood strategies in an informative manner is not straightforward, since a precise operational definition of 'livelihood' remains elusive. Consequently, methods of identifying livelihoods have been varied (Brown et al., 2006).[8] The approach adopted here is a simple one, but it effectively delineates households into categories that facilitate welfare orderings.

To determine these strategies, we begin by categorizing households according to permutations of choices among farm and non-farm and wage and non-wage activities. As Table 5 shows, there are three broad categories – farm activities only, non-farm activities only and combinations of farm and non-farm activities. The distribution of these strategies among the rural population is as follows: 67% live in households that allocate all their labor to agricultural activities, 27% have some members who work in agriculture and some who work off-farm,[9] and only 5% rely solely on non-farm activities for income.[10]

[8] A common method is to group households by income shares (e.g. Dercon & Krishnan, 1996; Barrett et al., 2005). Brown et al. (2006) used cluster analysis to identify livelihood strategies in the rural Kenyan highlands, but while this approach is intuitively appealing, a similar exercise carried out with the EPM data resulted in strategies for which no stochastic dominance orderings could be established.

[9] This is consistent with Haggblade's (2007) observation that 'most rural non-farm activities are undertaken by diversified households that operate farm and non-farm enterprises simultaneously'.

[10] We ignore those households whose sole source of income is non-labor income since these are made up mostly of the elderly, who do not actively participate in the labor market.

Table 5: Household livelihood strategies in rural Madagascar (2005)

	Percent pursuing each strategy							
	Expenditure quintile						Poverty	
	Poorest	Q2	Q3	Q4	Richest	Total	Headcount	Depth
Livelihood strategies								
Only farm	**77**	**71**	**66**	**64**	**55**	**67**	**78**	**31**
Family & wage farm	22	25	19	19	9	19	85	34
Wage farm only	1	1	1	0	0	1	83	42
Family farm only	53	45	47	46	46	47	75	30
Farm & non-farm	**20**	**25**	**30**	**30**	**29**	**27**	**70**	**25**
Family & wage farm and non-farm	3	4	5	3	3	4	79	30
Wage farm and non-farm	1	1	0	1	1	1	71	30
Family farm and non-farm	16	19	25	26	25	22	69	25
- Non-wage non-farm	*11*	*14*	*16*	*16*	*15*	*14*	*71*	*26*
- Non-wage & wage non-farm	*1*	*2*	*1*	*2*	*1*	*1*	*69*	*23*
- Wage non-farm	*4*	*4*	*8*	*8*	*8*	*6*	*63*	*22*
Only non-farm	**2**	**3**	**2**	**4**	**13**	**5**	**39**	**15**
Non-wage & wage non-farm	0	1	1	1	3	1	38	12
Non-wage non-farm	1	1	1	1	3	1	46	18
Wage non-farm	1	1	1	2	6	2	37	14
Non-labor income	**2**	**2**	**1**	**1**	**3**	**2**	**57**	**24**
Total	***100***	***100***	***100***	***100***	***100***	***100***	***73***	***29***

Source: Author's calculations from EPM 2005

Although there is some overlap within these three categories, there is also a clear overall welfare ordering. Poverty rates are highest among households that rely exclusively on farming (78%) and lowest among those that rely solely on non-farm activities (39%). Although the poverty rate for households that adopt both farm and non-farm activities is lower than the rural poverty rate, it is still high at 70%.

What is most striking is that despite seemingly high agricultural wage earnings (Table 2), households with members involved in agricultural wage activities tend to be the among the poorest. For example, households that combine family farming with wage farming have the highest poverty rates (85%) and are concentrated at the lower end of the income distribution (e.g. 22% of the poorest expenditure quintile compared to 9% of the richest quintile). Further, of the 1% living in households that rely solely on agricultural wage labor, 83% are poor. Indeed these households are poorer than any other group as measured by the depth of poverty.[11] This suggests that households may be resorting to agricultural wage activities as an ex post reaction to low farm income or because of various ex ante push factors. For this analysis we therefore define a distinct livelihood strategy in which households resort to

[11] This is the P_1 measure in the Foster et al. (1984) class of poverty measures.

agricultural wage activities ('any agricultural wage' or AW). This category of households includes those with family farm or non-farm activities, or both, as long as at least one member of the household worked for a wage in agriculture. Nearly a quarter of the rural population lives in a household in this category, and 83% of them are poor.

The other three distinct strategies follow naturally from Table 6 and are illustrated along with AW in this table. The first identifies households that rely solely on family farming (FF). These account for 47% of the rural population, 75% of whom are poor. The second identifies the 22% of the rural population who live in households with members involved in both family farm and non-farm activities (FFNF). As Table 5 shows, these households' non-farm activities are primarily non-wage family enterprises (72%). The poverty rate for this group is even lower at 69%. Finally, the third identifies 5% of the rural population, 39% of whom are poor and live in households whose income is solely from non-farm activities (NF). Unlike the FFNF households, those living in NF households are predominantly in wage employment (73%).

Table 6: Aggregated household livelihood strategies in rural Madagascar (2005)

	Percent pursuing each strategy							
	Expenditure quintile						Poverty	
	Poorest	Q2	Q3	Q4	Richest	Total	Headcount	Depth
Livelihood strategies								
Any farm wage	27	31	24	23	13	24	83	33
Family farm only	53	45	47	46	46	47	75	30
Family farm & non-farm	16	19	25	26	25	22	69	25
Non-farm only	2	3	2	4	13	5	39	15
Non-labor income	2	2	1	1	3	2	57	24
Total	*100*	*100*	*100*	*100*	*100*	*100*	*73*	*29*

Source: Author's calculations from EPM 2005

Besides being chosen by differing poverty levels, these strategies also differ in the returns they offer across nearly the entire distribution of income. This suggests a clear welfare ordering in that some strategies are superior to others because they bring in more income. Appealing to dominance analysis as a way of testing for the existence of such superior strategies (Brown et al., 2006), in Figure 1 we plot the cumulative frequencies of per capita household consumption for each of the four household types. The idea is that dominance tests permit us to make ordinal judgments about livelihood strategies on the basis of the entire distribution of household well-being, not just particular points (such as the poverty line). Specifically, pairs of livelihood-specific distributions are compared over a range of consumption values. One distribution is said to first-order 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 of this lower distribution is that there is a greater likelihood that households adopting this strategy will have higher consumption levels.

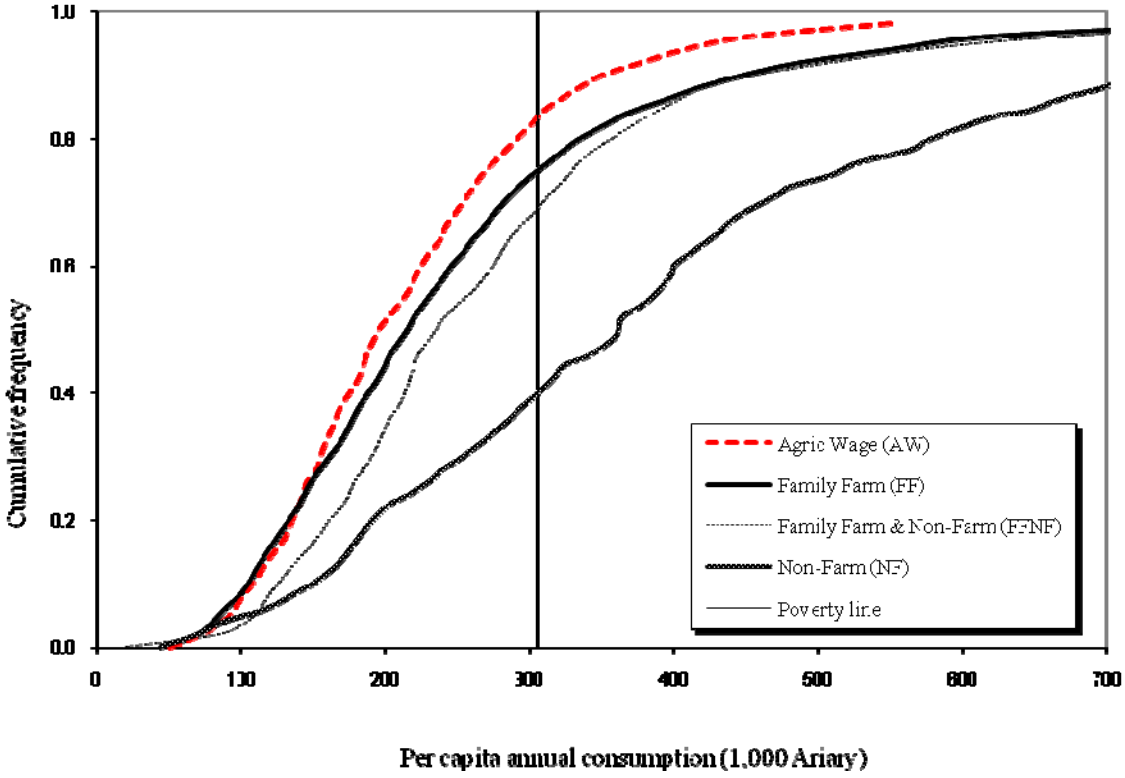

Figure 1: Cumulative frequency of household consumption by livelihood strategy

Figure 1 shows that at very low levels of consumption there is no clear ordering of strategies.[12] However, for the 91% of households with per capita consumption levels of Ar 120,000 and above, NF first-order dominates the other three strategies.[13] In other words, on the basis of this criterion, NF is a superior strategy. Similarly, the FFNF strategy dominates FF up to a value of Ar 375,000. Further, since FF dominates AW for all consumption values above Ar 150,000 (these two distributions are indistinguishable for values below this), AW is inferior to the other three strategies. Thus, strategies that include some non-farm employment are superior to those that rely solely on farming or some form of farm wage employment.

4. Analysis of rural household livelihood strategies

Barrett et al. (2001:316) observe that 'The positive wealth-non-farm correlation may also suggest that those who begin poor in land and capital face an uphill battle to overcome entry

[12] This follows partly because there are so few households at the lower tails. Note further that because the distributions cross multiple times at the lower tails, tests of second and third order dominance also prove inconclusive in terms of ordering the distributions. These tests place more weight on differences at the lower end of the distribution than the test of first order dominance does.

[13] We also statistically test the vertical difference between the NF distribution and each of the other distributions (Davidson & Duclos, 2000; Sahn & Stifel, 2002). For 100 test points between Ar 120,000 and Ar 400,000, the null hypothesis that the difference in the cumulative frequencies is zero was rejected. We thus conclude that the frequency distributions are different over this range.

barriers and steep investment requirements to participation in non-farm activities capable of lifting them from poverty'.

The evidence from Section 3 above indicates that there are superior household livelihood strategies associated with non-farm employment. This naturally makes us ask why so few rural households choose the dominant strategies (5% for NF and 22% for FFNF). The next question is whether there are barriers that prevent households from adopting these strategies.

To address this, we analyze rural household livelihood strategy choice using multinomial logit models. The choices, ordered from inferior to superior, are those described above: (a) any agricultural wage (AW), (b) family farming only (FF), (c) family farm and non-farm activities (FFNF) and (d) non-farm activities only (NF). The estimated effects in these models should not be interpreted literally as *determinants* of choices for two reasons. First, unobserved household characteristics such as motivation and entrepreneurship may be correlated with both the observed characteristics (access to credit, ownership of durable goods, etc.) and the chosen livelihood strategy. In such cases, the endogeneity bias of the parameter estimates cannot be ruled out. Second, since not all the choices will necessarily be available to each household, the parameters should be interpreted as reduced form estimates of how household and community characteristics affect the probabilities that households are *able* to choose one of the four livelihood strategies. The household and community covariates used in the estimates are summarized in Table 7.

Table 7: Summary statistics for models of household livelihood strategy choice in rural areas

Sample: ***All households with labor income in rural areas***	Any agric. wage		Family farm only		Family farm and non-farm		Non-farm only	
	mean	std dev	mean	std dev	mean	std dev	mean	std dev
Age of household head	41.6	12.0	43.5	13.0	43.3	11.2	40.9	11.7
Female household head (dummy)	0.136	0.343	0.125	0.331	0.129	0.335	0.230	0.421
Migrant (dummy)	0.084	0.278	0.067	0.250	0.092	0.289	0.195	0.397
Household structure								
Household size (number of members)	6.289	2.476	6.014	2.499	6.423	2.536	4.806	1.813
Share of children < 5	0.166	0.152	0.135	0.150	0.157	0.152	0.118	0.145
Share of children 5–14	0.327	0.194	0.332	0.201	0.323	0.192	0.306	0.216
Share of men 15–64[†]	0.239	0.151	0.255	0.157	0.243	0.152	0.260	0.194
Share of women 15–64	0.252	0.129	0.257	0.137	0.268	0.139	0.306	0.172
Share of members 65+	0.015	0.061	0.020	0.075	0.010	0.045	0.010	0.058
Education dummies – most educated member								
Primary	0.558	0.497	0.498	0.500	0.459	0.499	0.272	0.445
Lower secondary	0.075	0.263	0.106	0.308	0.180	0.384	0.249	0.433
Upper secondary	0.032	0.176	0.040	0.196	0.089	0.284	0.189	0.392
Post secondary	0.007	0.081	0.008	0.086	0.037	0.189	0.170	0.376
Radio (dummy – HH owns one)	0.479	0.500	0.509	0.500	0.663	0.473	0.664	0.473
Non-labor income (log)	2.64	4.47	2.02	4.23	2.53	4.50	3.37	5.19
Value of agricultural assets (log)	2.14	1.40	2.53	1.80	2.52	1.57	0.57	1.16
Land holding dummies								
None	0.046	0.210	0.016	0.124	0.031	0.173	0.828	0.377
< 1 hectare[†]	0.530	0.499	0.238	0.426	0.350	0.477	0.069	0.254
1–3 hectares	0.318	0.466	0.502	0.500	0.441	0.497	0.081	0.273
3–5 hectares	0.072	0.259	0.140	0.347	0.095	0.294	0.007	0.083

5–10 hectares	0.021	0.142	0.057	0.231	0.045	0.208	0.008	0.091
10+ hectares	0.012	0.110	0.048	0.214	0.037	0.190	0.006	0.080
Difficult access to formal credit (dummy)	0.54	0.50	0.52	0.50	0.46	0.50	0.50	0.50
Community characteristics								
MFI available in community	0.518	0.500	0.424	0.494	0.431	0.495	0.468	0.500
Phone (dummy at least one HH owns)	0.018	0.132	0.031	0.172	0.082	0.275	0.440	0.497
Electricity access (dummy)	0.072	0.258	0.083	0.275	0.076	0.266	0.541	0.499
Piped water access (dummy)	0.508	0.500	0.406	0.491	0.473	0.499	0.615	0.487
Distance to nearest city (dummies)								
<2 hours	0.051	0.220	0.053	0.224	0.091	0.287	0.351	0.478
2–5 hours	0.226	0.419	0.214	0.410	0.225	0.418	0.228	0.420
5–10 hours†	0.355	0.479	0.174	0.379	0.174	0.379	0.097	0.296
10–15 hours	0.095	0.293	0.104	0.306	0.099	0.299	0.082	0.274
15–24 hours	0.101	0.301	0.074	0.262	0.088	0.283	0.051	0.220
24+ hours	0.173	0.378	0.380	0.486	0.323	0.468	0.192	0.394
Percent with labor income in each category	24		48		23		5	
Sample size	1,085		3,065		1,143		366	

Source: Data from EPM 2005

† Left out category in the estimates

The estimated marginal effects that appear in Table 8 are interpreted as the average change in the probability of a household selecting a particular livelihood strategy corresponding to a one unit change in the independent variables. Because the average marginal effects are shown instead of the estimated coefficients, all four livelihood strategies (including the left-out category) can be shown. The marginal effects sum to zero across the categories.[14]

Table 8: Regression analysis of household livelihood strategy choice in rural areas

Multinomial logit *Sample:* ***All households with labor income in rural areas***	Any agric. wage			Family farm only			Family farm and non-farm			Non-farm only		
	Marg effect	t-val		Marg effect	t-val		Marg effect	t-val		Marg effect	t-val	
Age of household head	-0.001	-3.06	***	0.000	0.79		0.001	1.52		0.000	0.93	
Female household head (dummy)	0.01	0.40		-0.04	-2.32	**	0.02	1.28		0.01	2.10	**
Migrant (dummy)	0.02	1.16		-0.06	-3.17	***	0.04	2.03	**	0.01	1.18	
Household structure†												
Household size (number of members)	0.012	4.67	***	-0.013	-4.08	***	0.006	2.02	**	-0.005	-3.30	***
Share of children < 5	0.00	-0.03		0.00	-0.06		0.00	0.10		0.00	0.00	
Share of children 5–14	0.00	-0.02		0.00	0.00		0.00	0.01		0.00	0.04	
Share of women 15–64	0.00	-0.05		0.00	-0.05		0.00	0.10		0.00	-0.01	
Share of members 65+	0.01	0.08		0.01	0.10		-0.02	-0.16		0.00	0.05	
Education dummies - most educated member												
Primary	0.01	0.57		-0.04	-3.33	***	0.03	2.63	***	0.00	0.77	
Lower secondary	-0.07	-4.77	***	-0.12	-5.71	***	0.14	6.03	***	0.05	4.58	***
Upper secondary	-0.06	-2.96	***	-0.21	-7.33	***	0.20	6.17	***	0.07	4.19	***
Post secondary	-0.10	-3.89	***	-0.33	-7.71	***	0.34	6.58	***	0.09	3.64	***

[14] The left-out category in the estimation is FF. Note that the sample does not include those households without any labor income.

Radio (dummy - HH owns one)	-0.03	-3.14	***	-0.04	-3.41	***	0.06	5.25	***	0.01	1.70	*
Non-labor income (log)	0.00	0.03		0.00	-0.02		0.00	-0.01		0.00	0.03	
Value of agricultural assets (log)	0.00	0.09		0.00	0.43		0.00	0.32		0.00	-1.96	**
Land holding dummies[††]												
None	0.07	2.75	***	-0.29	-9.63	***	-0.12	-6.49	***	0.33	7.32	***
1–3 hectares	-0.06	-6.60	***	0.08	5.79	***	-0.02	-1.53		0.00	0.08	
3–5 hectares	-0.07	-5.28	***	0.14	6.79	***	-0.05	-3.22	***	-0.01	-0.91	
5–10 hectares	-0.09	-4.50	***	0.13	4.64	***	-0.06	-2.64	***	0.01	0.91	
10+ hectares	-0.07	-3.32	***	0.07	2.45	**	0.00	-0.16		0.01	0.33	
Difficult access to formal credit (dummy)	0.04	3.72	***	-0.01	-1.11		-0.02	-1.99	**	0.00	-0.82	
Community characteristics												
MFI available in community	-0.03	-2.42	**	0.06	3.73	***	-0.02	-1.19		-0.01	-2.75	***
Phone (dummy at least one HH owns)	0.00	-0.11		-0.11	-3.91	***	0.09	3.17	***	0.03	2.62	***
Electricity access (dummy)	-0.02	-1.23		0.06	2.84	***	-0.06	-3.21	***	0.01	1.70	*
Piped water access (dummy)	0.01	1.39		-0.03	-2.60	***	0.01	0.87		0.01	1.82	*
Distance to nearest city (dummies)[†††]												
< 2 hours	0.02	0.69		-0.05	-1.74	*	0.04	1.41		0.00	-0.42	
2–5 hours	-0.01	-1.00		0.05	2.63	***	-0.04	-2.36	**	0.00	0.26	
10–15 hours	0.01	0.70		-0.06	-2.64	***	0.05	2.16	**	0.00	0.00	
15–24 hours	0.07	2.80	***	-0.10	-3.82	***	0.05	1.82	*	-0.01	-1.62	
24+ hours	-0.03	-1.88	*	0.00	-0.24		0.05	2.49	**	-0.01	-2.10	**
Percent with labor income in each category	24			48			23			5		
Percent correctly predicted										63		
Number of observations										5,659		
Pseudo R-squared										0.31		

Source: Data from EPM 2005

Note: Region dummies included but not shown. Left out strategy in estimation is 'Family farm only'.
Note: Marginal effects show the average change in the probability of chosen strategy resulting from a unit change in the independent variable. Consequently the marginal effects sum to zero across the categories.
[†] Left out category is share of men 15-64; [††] Left out category is < 1 hectare; [†††] Left out category is 5–10 hours.

Three potential barriers to participation in high-return non-farm activities by households are highlighted in the model estimates. First, households with higher levels of educational attainment tend to be those who choose the dominant NF and FFNF strategies. The measure of household education used here is the education level of the most educated member of the household.[15] Households in which the most educated member attained a lower (upper) secondary level of education are 14% (20%) more likely to adopt a FFNF strategy than those with no education at all. Households with less education are most likely to adopt the least remunerative AW and FF strategies. Given the positive relationship between household welfare and education in Madagascar (Amendola & Vecchi, 2007), poor households with

[15] In doing so, we assume 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 aspect of education (See also Valenti, 2001; Basu et al., 2002). Sarr (2004) finds evidence from Senegal that illiterate members of households benefit from the earnings of literate members. Almeyda-Duran (2005) also finds that in some situations there are child health benefits to village level proximity to literate females.

low levels of education generally face greater barriers than the non-poor in their choices of high-return livelihood strategies.

Second, households without access to formal credit[16] tend to adopt inferior AW strategies and are less likely to combine family farming with non-farm activities. For those households adopting AW strategies, credit market failures may be a barrier to adopting any of the higher-return livelihood strategies. For the FFNF, some households may indeed engage in non-farm activities because they have access to credit, as the model estimates suggest. But given the measure of credit access used in this model, the result is also consistent with the notion that farm households may engage in non-farm activities as a means of generating cash to substitute for the absence or high cost of credit. The idea is that they do this in order to purchase agricultural inputs or to make farm investments (Ellis, 1998). In the measure of access used here, households that are not classified as 'having difficulty accessing formal credit' in the EPM data include those that report not seeking credit because they either (a) did not need it (9%) or (b) did not want to have any debt (33%). Indeed, the source of start-up financing for household non-farm enterprises is predominantly household saving (78%). It may be households such as these that rely on non-farm activities to accumulate cash savings as a substitute for the absence of credit markets.[17]

In an effort to address the potential endogeneity of the household-specific credit access measure and to measure an independent effect of credit availability, a community-level variable is included in the model to indicate the presence of a microfinance institution (MFI).[18] As expected, the presence of an MFI is associated with lower probabilities of households adopting AW strategies. However, it is also associated with a 1% decrease in the probability of adopting the preferred NF strategy. Indeed, households living in communities with MFIs present are 6% more likely to adopt FF strategies. This result is consistent with non-farm activities substituting for the absence of credit markets. However, it may also be because MFIs target poorer communities (Zeller et al., 2003). Such targeting can lead to biased estimates of the effect of MFI availability on livelihood choice (Pitt et al., 1993).

Third, households with access to forms of outside communication have a greater likelihood of choosing the dominant livelihood strategies. For example, households owning a radio are 6% more likely to have members undertaking a preferred strategy of participating in both family farming and non-farm activities. Similarly, those that live in villages in which at least one household has a phone are 11% more likely to have members involved in non-farm activities. Admittedly, owning a radio could be a consequence of higher earnings associated with the dominant strategy.[19] We therefore proceed with caution with regard to radio access, and emphasize the effect of village access to telecommunications as measured by at least one household owning a phone.[20] This form of communication represents access to information

[16] Households are categorized as such when they have sought loans from formal institutions (banks or microfinance institutions) and were turned down, or if they report not applying for loans because (a) procedures are too complicated, (b) interest rates are too high, (c) they do not know the procedures, (d) they do not have collateral, or (e) they do not know of a lending institution.

[17] Although their livelihood strategies differ slightly from those identified here, Brown et al. (2006) similarly found that liquidity constraints appear to hamper the ability of households in the rural Kenyan highlands to diversify into high-return activities.

[18] The presence of a formal sector bank has no effect.

[19] Radio ownership has been used as a proxy for household welfare either as an asset (Sahn & Stifel, 2000) or as a predictor of household consumption (Stifel & Christiaensen, 2007).

[20] The model was also estimated using various measures of community radio access in an effort to address the endogeneity issue. One variant included a dummy variable for villages with at least one radio. Since over 98%

about price and market conditions outside the community. Households living in communities without such access are more likely to allocate labor to farming activities geared toward home consumption and the local market – i.e. those activities that are likely to have lower remunerative rewards.[21]

Turning to other correlates of household livelihood strategy choice, it is interesting to note that although households living in rural communities with electrification are slightly more likely to adopt the dominant NF strategies (1%) they are even more likely to concentrate solely on family farming (6%). Households living in such communities are *less* likely to adopt the second best strategy of mixed family farming and non-farm activities (6%). Despite the mixed results, one lesson to be learned from the data is that although households adopting NF strategies tend to be situated in communities with electricity access (e.g. 54% of NF households have electricity compared to 9% for all other households; see Table 7), such access is not a sufficient condition for participation in non-farm employment activities. This may be due to endogenous placement of electrification or the bundling of electrification with other infrastructure variables, or both.

Remoteness may affect the choice set of livelihood strategies available to households by affecting transaction costs and by determining the degree of access to markets and to market information. This is consistent with the multinomial logit model estimates where travel time to the nearest city serves as a proxy for remoteness and transaction costs. With increased travel times, households are less likely to rely on family farming alone and more likely to combine family farming activities with non-farm activities. For example, households that live 15 to 24 hours away from a major city are 10% less likely to adopt FF strategies and 5% more likely to adopt FFNF strategies. This is consistent with the notion that agricultural surplus can more easily be marketed to urban areas in less remote areas, while competition in the non-farm sector is greater in the vicinity of urban areas (Lanjouw & Feder, 2001). Finally, households living more than 15 hours away from the nearest city are 1 to 2% less likely to undertake wage-dominated NF strategies.

Access to land has differential effects on household strategy choice. This being the case, these estimates neither confirm nor refute the claim that those poor in land holdings face entry barriers. For example, while households with more land are less likely to adopt AW strategies, they are more likely to concentrate their household labor solely in family farming. This is not surprising since land is an important agricultural input for farming households.[22]

Not only are landless households 7% more likely to adopt AW strategies that are inferior to those of smallholder households (less than one hectare), they are also 33% more likely than any landed households to adopt superior NF strategies. Whether inferior AW strategies or superior NF strategies are chosen by landless households probably depends on other characteristics that enable them to overcome the barriers to participation in non-farm activities.[23]

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of villages fall into this category, little effect was found. Similarly, no effect was found when using a variable indicating the share of households in the community with radios.

[21] This is consistent with Randrianarisoa et al.'s (2009) finding using 2001 data, that demand for hired non-farm labor in rural Madagascar is stimulated by similar access to information.

[22] Similarly, households with more non-land agricultural assets are also less likely to concentrate all of their labor efforts in non-farm activities.

[23] These estimates may also suffer from endogeneity bias as lack of land ownership may be correlated with unobserved household characteristics that are themselves correlated with advantages available to those working in non-farm wage employment.

The relationship between land holdings and the choice of the FFNF strategy is nonlinear. Households that are more likely to adopt this strategy are either those with small land holdings (less than three hectares) or large land holdings (ten or more hectares). Those with medium-sized land holdings (three to five hectares) are 5 to 6% less likely to combine family farming with non-farm employment. This may follow from household labor constraints on the farm, since more land requires more household labor input. Although large holders are also affected by these constraints, they are also more likely to be wealthier and more capable of hiring labor. Such households are in a better position to invest in the human capital of their family members and to diversify into non-farm activities.

5. Analysis of rural employment and labor earnings

Since the ability of households to diversify their income sources depends to a large extent on the characteristics of their economically active members, we now use regression analysis to address rural employment patterns and earnings. This permits us to tackle the question of how barriers to participation in non-farm activities are associated with individual as well as household characteristics. We also assess the characteristics associated with earnings, once employment choices are made, by estimating earnings functions. In this context, we are able to further disaggregate the non-farm sector further into non-wage and wage activities (Malchow-Møller & Svarer, 2005).

Rural employment

We start with multinomial logit choice models similar to those in the previous section. In this case, however, instead of households the sample is made up of all 13,339 economically active individuals living in rural areas. Their employment is characterized as (a) agricultural wage, (b) family farming, (c) non-farm non-wage or (d) non-farm wage. Although there is considerable overlap in the distribution of earnings among these four employment types, they are roughly ordered in welfare terms (lowest annual earnings to highest on average). Separate models are estimated for primary and secondary employment, though only the former are presented here (Table 9).[24]

Table 9: Regression analysis of primary employment in rural areas

Multinomial logit

Sample: ***First jobs held by adults (15+) in rural areas***	Agric. wage			Family farm			Nonfarm non-wage			Nonfarm wage		
	Marg effect	t-val		Marg effect	t-val		Marg effect	t-val		Marg effect	t-val	
Individual characteristics												
Female (dummy)	-0.01	-1.23		-0.01	-1.54		0.03	4.15	***	-0.01	-2.50	**
Age	0.000	1.68	*	-0.001	-2.86	***	0.001	2.64	***	0.000	0.13	
Household head (dummy)	-0.02	-4.94	***	0.02	1.43		-0.01	-1.74	*	0.02	1.95	*
Spouse of household head (dummy)	-0.02	-5.59	***	0.02	2.17	**	0.00	-0.21		0.00	0.10	
Migrant (dummy)	0.00	-0.28		-0.04	-3.68	***	0.01	1.94	*	0.02	3.77	***
Education dummies†												
Primary	-0.01	-3.85	***	-0.02	-3.16	***	0.02	3.06	***	0.02	3.12	***
Lower secondary	-0.01	-3.67	***	-0.09	-7.20	***	0.04	4.06	***	0.07	6.75	***

[24] The secondary employment estimates are available on request from the author.

Upper secondary	-0.02	-2.29	**	-0.22	-8.24	***	0.05	2.88	***	0.19	8.06	***
Post secondary	0.00	-0.22		-0.39	-8.18	***	0.04	1.53		0.36	8.33	***
Household characteristics												
Female household head (dummy)	0.01	1.70	*	-0.06	-4.77	***	0.04	4.03	***	0.01	0.69	
Age of household head	0.00	-2.76	***	0.00	2.89	***	0.00	-2.13	**	0.00	0.20	
Household Structure												
Household size (no. of members)	0.001	0.84		-0.002	-1.68	*	0.000	-0.31		0.002	2.10	**
Share of children < 5[††]	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	
Share of children 5–14	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	
Share of women 15–64	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	
Share of members 65+	0.00	0.00		0.00	0.01		0.00	0.01		0.00	-0.02	
Radio (dummy - HH owns one)	0.00	-1.10		-0.03	-5.42	***	0.03	5.43	***	0.01	2.45	**
Non-labor income (log)	0.00	0.00		0.00	-0.01		0.00	0.00		0.00	0.02	
Value of agricultural assets (log)	0.00	-0.03		0.00	0.24		0.00	-0.13		0.00	-0.19	
Land holding dummies[†††]												
None	0.12	6.81	***	-0.45	-19.15	***	0.18	9.13	***	0.15	8.30	***
1–3 hectares	-0.01	-4.05	***	0.04	7.13	***	-0.01	-3.03	***	-0.01	-3.37	***
3–5 hectares	-0.01	-3.18	***	0.05	7.45	***	-0.02	-2.72	***	-0.02	-4.64	***
5–10 hectares	-0.01	-2.49	**	0.04	3.95	***	-0.01	-0.93		-0.02	-2.51	**
10+ hectares	-0.01	-1.28		0.01	0.43		0.00	-0.13		0.01	0.62	
Difficult access to formal credit (dummy)	0.01	3.67	***	-0.02	-3.23	***	0.00	0.27		0.00	0.90	
Community characteristics												
MFI available in community	0.01	1.34		0.01	2.06	**	-0.01	-1.51		-0.01	-3.20	***
Phone (dummy at least one HH owns)	0.01	0.82		-0.10	-5.60	***	0.06	4.81	***	0.02	2.96	***
Electricity access (dummy)	-0.01	-2.41	**	-0.01	-0.72		-0.02	-2.70	***	0.03	4.14	***
Piped water access (dummy)	0.00	1.00		-0.03	-4.52	***	0.02	3.26	***	0.01	2.17	**
Distance to nearest city (dummies)[††††]												
< 2 hours	0.01	1.17		-0.05	-3.24	***	0.04	2.83	***	0.01	0.63	
2–5 hours	0.00	0.54		0.00	-0.31		-0.01	-0.91		0.01	0.98	
10–15 hours	-0.01	-1.62		-0.02	-1.55		0.02	1.77	*	0.01	1.22	
15–24 hours	0.01	1.78	*	-0.02	-1.78	*	0.00	-0.42		0.01	1.32	
24+ hours	0.00	-0.81		0.00	0.36		0.00	-0.35		0.00	0.55	
Percent in each category	4			85			5			6		
Number of observations										13,339		
Pseudo R-squared										0.30		

Source: Data from EPM 2005

Note: Region dummies included but not shown. Left out category is 'agricultural non-wage'.

Note: Marginal effects show the average change in the probability of 'sector' of employment resulting from a unit change in the independent variable. Consequently the marginal effects sum to zero across the categories.

[†] Left out category is no education; [††] Left out category is men 15–64; [†††] Left out category is < 1 hectare; †††† Left out category is 5–10 hours

As with the household livelihood choice models, education is associated with higher probabilities of non-farm employment. Individuals with a lower (upper) secondary education are 7% (19%) more likely to work in non-farm wage activities than those with no education. Such individuals are particularly less likely to work on the family farm for their primary employment. In the context of household livelihood strategies, this suggests that in households adopting FFNF strategies members with less education are more likely to remain

on the farm, while those with more education perform higher-paying non-farm wage activities. Interestingly, members with higher levels of education are also more likely to help out on the family farm for their second jobs – perhaps contributing their labor during peak agricultural demand periods (e.g. field preparation, planting, transplanting and harvest).

Although statistically significant, the relationship between credit and individual employment is small. Those living in households without access to credit are 1% more likely to be involved in agricultural wage employment and 2% less likely to work on the family farm (non-farm non-wage). These small individual effects nonetheless do add up for the household unit as a whole, given that this is a household-level constraint. The finding that individuals in credit constrained households are those who are more likely to resort to agricultural wage labor (associated with low-return household livelihood strategies) is consistent with the household choice models in Section 4 and with previous research on the importance of credit to household livelihood choice and welfare (Dercon & Krishnan, 1996; Ellis, 1998; Brown et al., 2006).

Access to communication devices (radio and phone) has relationships with individual employment similar to those it has with household livelihood strategies. Those with such access are more likely to engage in higher-return non-farm activities and are less likely to work on the family farm as their primary form of employment.

The individual choice models shed additional light on the relationship between rural electrification and employment opportunities. Electricity access in the community is associated with more non-farm wage employment, but not with non-farm non-wage activities. This is consistent with the household livelihood models in which a positive relationship was found between electricity access and NF strategies where the bulk of non-farm jobs undertaken by these households are wage activities (73%). It is also consistent with the negative relationship found between electricity access and FFNF strategies, given that the non-farm activities for these households are predominantly non-wage (72%).

For the 90% of the rural population living in villages without electricity, high-return non-farm employment opportunities are more limited. Of those with higher paying non-farm wage jobs, 36% live in communities with electricity access, compared to less than 10% of those with lower-return non-farm wage employment. Nonetheless, because electrification in communities is most certainly not randomly placed, it is difficult to establish the causal relationship. For example, while access to electricity may create more non-farm employment opportunities, dynamic communities with more non-farm employment may be better positioned to establish electricity connections in the first place.

Interestingly, although we find no clear pattern with regard to remoteness (travel time to city) and first jobs, there appears to be a more systematic relationship with second jobs. In the most remote areas, secondary employment tends to be concentrated in non-farm non-wage activities that involve providing services in the local market. These non-farm activities may fill a gap created by the high transaction costs associated with remoteness and the consequent restricted access to major markets. Further, this pattern of diversification may also be driven by the seasonal nature of agricultural calendar as individuals seek out employment opportunities during the periods of slack demand for agricultural labor (Ellis, 1998).

Because households in the less remote areas (two to five hours) are more likely to specialize in family farming, individuals in these areas are 10% more likely to only have one job (i.e.

on the family farm) than those who live five to ten hours away from major cities. This may follow from higher returns to agriculture in less remote areas (Stifel & Minten, 2008), inducing households to concentrate their household labor in family farming.

Except for those individuals who live in households with large land holdings (ten hectares or more), there is a positive association between land holdings and family farming. For example, those with between one and ten hectares of land are 4 to 5% more likely to work on the family farm than are small holders (with under one hectare), while those who are landless are 45% less likely to do so. With landless individuals 18% and 15% more likely to work off-farm in non-wage and wage activities, respectively, non-farm employment for these individuals appears to be a result of 'push' factors. However, landless individuals are 25% *more* likely than small holders to only have one job. This suggests that the relative returns to employment for the landless (e.g. non-farm activities) are higher than for small holders who are most likely to be family farmers. These individuals may in fact be landless because they are unable to find high-return employment.

Turning to other individual correlates, we find that women are significantly more likely to be employed as non-wage workers in the non-farm sector (3% more than for men), but are less likely to undertake non-farm wage work.[25] As individuals get older, they are less likely to work on the family farm and more likely to undertake non-wage employment off the farm. While household heads and their spouses are less likely to work as agricultural wage laborers, household heads are more likely to find non-farm wage work, while their spouses are more likely to remain on the family farm. Those who migrated to their current location within the past five years are more likely to be involved in non-farm activities and less likely to work on a family farm.

Rural labor earnings

We now turn to econometric estimates of earnings and, by extension, the correlates of employment quality once an individual has 'chosen' a sector. In particular, earnings functions are estimated separately for those who are employed in (a) agricultural wage, (b) family farming, (c) non-farm non-wage or (d) non-farm wage activities (Table 10). The dependent variable in each of these models is the log of real daily earnings.[26] The explanatory variables are typical of those found in standard Mincerian earnings functions and include experience,[27] levels of education, hours worked, a dummy variable that takes on a value of one if the individual is female, and controls for location (not shown). We also control for selection bias by using a correction method proposed by Bourguignon et al. (2002). This is an extension of Lee's (1983) method in which the selectivity is modeled as a multinomial logit, rather than as a probit (Heckman, 1979). The multinomial logit selection models are based on those that appear in the previous section.

[25] Lanjouw (2001) had a similar finding based on probit models for El Salvador where women were more likely than men to be employed in low-productivity non-farm activities. He did not find a significant difference, however, for high productivity jobs.

[26] Since we use the log of earnings, the estimated coefficients represent a percentage change in earnings for a one unit change in the independent variable.

[27] Experience is difficult to measure because we do not know when individuals began working. Here we use the difference between individual's age and the number of years of schooling plus five years. It is important to account for experience because experience and educational attainment are negatively correlated. Since experience is likely to contribute positively to earnings (up to a point), the error terms in the estimated models are likely to be negatively correlated with educational attainment if experience is not included as an explanatory variable. The result is likely to be a downward bias in the estimates of returns to schooling.

Table 10: Regression analysis of daily labor earnings in rural Madagascar (2005)

Dependent variable = log(daily earnings)												
Sample: ***Primary jobs of all rural***	Agric. wage			Family farm			Non-farm non-wage			Non-farm wage		
adults (15-64)	Coef.	t-value		Coef.	t-value		Coef.	t-value		Coef.	t-value	
Farm												
Hours worked per day	0.03	1.92	*	0.00	0.13		0.07	3.63	***	0.04	3.12	***
Experience	0.02	0.93		-0.01	-2.22	**	-0.03	-1.37		0.01	0.69	
Experience-squared	-0.0002	-0.66		0.0002	1.95	*	0.0005	1.13		0.0000	0.10	
Education†												
Primary education dummy	0.14	1.83	*	-0.02	-0.91		-0.09	-0.79		0.36	2.87	***
Lower secondary education dummy	0.22	1.32		0.10	2.92	***	0.48	2.51	**	0.71	2.93	***
Upper secondary education dummy	0.47	1.33		0.14	2.28	**	0.55	2.18	**	1.09	2.92	***
Post secondary education dummy	0.65	1.12		-0.06	-0.51		0.75	1.87	*	1.63	3.38	***
Female dummy	-0.12	-2.25	**	0.00	0.07		-0.20	-2.05	**	-0.42	-6.22	***
Constant	7.44	8.70	***	7.40	79.22	***	8.47	6.54	***	6.29	8.28	***
Number of observations	455			10,409			666			692		
R-squared	0.20			0.04			0.10			0.31		

Data: EPM 2005

Note: Region dummies included but not shown

Note: Estimates corrected for selection (Bourguignon et al., 2002)

† Level of education for non-wage models is the highest level of education attained by a household member working in the farm (or in the rural non-farm economy).

We find positive and significant estimates of schooling that are substantial, but that are varied across employment types. We caution that these returns are likely to be overestimated because the correlation between education and earnings does not necessarily represent causation. For example, because adolescents living in households with more education are more likely to attend school (Stifel et al., 2007), schooling is not randomly distributed among the individuals in the sample, and the parameter estimates are probably biased.[28] Thus we proceed with caution.

Returns to schooling are largest among those in the non-farm sector in general and among the wage employed in particular. They are significant for secondary education in family farming, though not for primary education. For agricultural wage workers, the positive returns to education are only significant for those with primary education. This is probably because the sample of agricultural wage workers is small and very few have secondary education or higher. As expected, returns to schooling for non-farm employment are considerably larger than in farming. For example, while the returns to lower secondary education are 71% (higher earnings than those without schooling), the returns are 48% and 10% for non-farm non-wage and family farming, respectively.[29]

In short, education is an important factor associated not only with non-farm employment opportunities for the rural population in Madagascar but also with higher earnings for those employed in the non-farm sector. It appears that those individuals and households with little or no education face barriers not only to acquiring non-farm jobs, but also to reaping the full benefits of the potentially high-return non-farm sector.

Controlling for education, experience and other factors associated with employment selection, we find that women's non-agricultural wage and non-wage earnings are 42% and 20% lower than those of men, respectively. Although we do not find a significant difference between the earnings of men and women in agriculture, this does not imply that the earnings are necessarily equal, since our measure of agricultural earnings is based on equal sharing of total household agricultural earnings.[30]

6. Concluding remarks

In this paper we examine the relationship between rural non-farm employment and household welfare using nationally representative data from Madagascar. In doing so, we focus our attention on labor outcomes in the context of household livelihood strategies that

[28] As Behrman (1999) notes, 'individuals with higher investments in schooling are likely to be individuals with more ability and more motivation who come from family and community backgrounds that provide more reinforcement for such investments and who have lower marginal private costs for such investments and lower discount rates for the returns to those investments and who are likely to have access to higher quality schools'.

[29] The level of education used in the non-wage models is the highest level of education attained by a household member working in the family farm/non-farm enterprise. The rationale for this measure is that non-wage earnings are measured by total farm/enterprise earnings and then are distributed equally among those working on the farm/enterprise. Given intra-household (in this case intra-farm or intra-enterprise) education externalities, the most appropriate measure of education is that of the member with the highest level of education.

[30] There are two sources of error implicit in this measure of agricultural labor earnings. The first assumption is that all household agricultural labor is equally productive, and the second is that resources are shared equally within the household, which is not necessarily the case (Quisumbing & Maluccio, 2000; Sahn & Stifel, 2002).

include farm and non-farm income earning opportunities. We identify distinct household livelihood strategies that can be ordered in welfare terms, and estimate multinomial logit models to assess the extent to which there are barriers to choosing dominant strategies. Individual employment choice models, as well as estimates of earnings functions, provide supporting evidence of these barriers.

We find that the non-farm sector may indeed provide an important pathway out of poverty. As is commonly found in other African countries (Barrett et al., 2001), there is a positive relationship between rural non-farm employment and welfare as measured by per capita household expenditure. The percentage of workers with non-farm employment rises by expenditure quintile, with 11% in this sector employed in the poorest quintile and 31% in the richest.

It is perhaps best, however, to understand rural non-farm employment in the context of household livelihood strategies. After all, 'diversification is the norm' (Barrett et al., 2001), especially among agricultural households whose livelihoods are vulnerable to climatic uncertainties. In principle, diversification could be accomplished through land and financial asset diversification. But the absence of well-functioning land and capital markets often means that these diversification strategies are not feasible. Consequently, many rural households find themselves pursuing second-best diversification strategies through the allocation of household labor (Bhaumik et al., 2006). Household labor supply and allocation decisions among farm and non-farm activities are thus made by weighing both productivity and risk factors.

The four distinct household livelihood strategies identified for rural Madagascar, ordered from inferior to superior, are (a) any agricultural wage (AW), (b) family farming only (FF), (c) family farm and non-farm activities (FFNF) and (d) non-farm activities only (NF). Multinomial logit model estimates of household strategy choice indicate that there may be barriers to participation in high-return non-farm activities (FFNF and NF). First, households with higher levels of educational attainment tend to be those that choose the dominant strategies. It appears that poor households with low levels of education generally face greater barriers than the non-poor in their choices of high-return livelihood strategies. Second, households without access to formal credit tend to adopt inferior strategies and are less likely to combine family farming with non-farm activities. Third, households with access to telecommunication – and by extension information on price and market conditions outside of the community – are more likely to choose the dominant livelihood strategies. Households living in communities without such access are more likely to allocate labor to farming activities that are geared to home consumption and the local market – i.e. those activities that are likely to have lower remunerative rewards.

Nonetheless, although these potential barriers may mean that high-return strategies are limited to a subpopulation of well-endowed households, the non-farm sector can still benefit the poor. On the one hand, for those with limited asset endowments entry barriers limit access to high-return non-farm activities (e.g. the wage sector). On the other hand, low-return non-farm activities tend to provide opportunities for ex ante risk reduction, as well as for ex post coping with shocks. The non-farm non-wage sector tends to play this safety net role in Madagascar. In addition, non-farm activities may also have an indirect effect on poverty by affecting agricultural wages. Increased non-farm employment may tighten the

agricultural wage market, leading to higher wages that are an important source of income for the poorest households.[31]

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