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ABSTRACT

We estimate a bivariate Tobit model to find the main determinants of time allocation to rural nonfarm employment (RNFE) among rural households in four Central American countries: El Salvador, Guatemala, Honduras, and Nicaragua. The main effects stem from gender and schooling of the household head, as well as access to infrastructure, with evidence of infrastructure complementarities, i.e. we identify increasing share of nonfarm activities when the household has simultaneously more than one infrastructure. Households from the poorest income quartile would allocate between 3 (Guatemala) to 8 (El Salvador) additional hours to nonfarm activities if they increase their access from 0 to 2 types of infrastructure. This apparently small change in time allocation (substituting time in farm by time out of the farm, leaving leisure intact) would have non-negligible impacts in income, which would increase by 6% in Guatemala and 11% in El Salvador. Moreover, infrastructure access variables are positive for all income quartiles, but the marginal effect is positively correlated with income, i.e. the poor would benefit less than the rich... Finally, the model also shows an inverted U-shape in the relationship between the expected number of hours in RNFE and income. The more the households specialize in agriculture the less time they allocate to RFN. The richest households (roughly the top 1%) specialize in agriculture and thus allocate less time (zero in the case of El Salvador and Guatemala) to RNFE.

Determinants of Time Allocation to Rural Non-Farm Activities in Central America: The Role of Infrastructure and Education

Manuel Barron and Máximo Torero[1]

1. Introduction

Though agriculture is still the main activity of rural workers, non-farm employment has been growing in importance. According to World Bank figures, retail trade and services represent 60% to 75% of non-farm wage employment worldwide. However, most rural enterprises are small and rely exclusively on family labor, therefore generating little wage employment. In addition to this, there exist significant constraints for investment in rural enterprises, like the availability and cost of credit or poor infrastructure, but in many cases the biggest constraint is the low local market demand for goods and services.

Even though rural non-farm wages are considerably higher than agricultural wages, it appears to be the case that the skill level of workers in both sectors can explain most of this difference. The evidence also shows that males' wages in the rural non-farm sector are higher than females'.

But what are the main determinants behind not farm activities and up to what point bilateral free trade agreements will help or hurt these activities. We work in this paper with four Central American countries to try to answer these questions.

Central America has undergone a process of market liberalization since the late 80s, resulting in a significant reduction of trade barriers. The five Central American countries were part of the so-called Caribbean Basin Initiative (CBI) proposed by President Ronald Reagan in February 1982 as part of a more comprehensive foreign policy program "to promote economic revitalization and facilitate expansion of economic opportunity in the Caribbean Basin region." The CBI trade preferences and other benefits were granted to the countries of the region by the Caribbean Basin Economic Recovery Act (CBERA) enacted in 1983 and put into effect beginning January 1, 1984. It is important to note that duty free entry into the US market was not granted permanently under the CBERA. As a result in the mid-90s, Central American countries started a negotiation process to establish CAFTA (Central American Free Trade Agreement), a free trade agreement with the USA. The negotiation process ended in January 2004, when each country started their own ratification process within their legislative bodies. Although the agreement took effect in 2006.

The consolidation of stronger commercial relations, the creation of a larger market, and the strengthening of norms and institutions had a positive effect on the investment flow to Central

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America and in achieving more dynamic economies and invigorating the demand for labor. However, some fears stem from the rural economy's capacity to seize the opportunities of market access in the short and middle run, especially in non-farm activities. Despite the existence of several studies on the probable effects of free trade on the rural sector of Central American countries, to date there is no impact analysis of the potential impact in terms of RNFE (Rural Non-Farm Employment). The empirical finding that CAFTA consolidates or improves the comparative advantages of several export products (agricultural or not) is important in this respect. For further details on the effects of CAFTA refer to.[2]This paper tries to understand, under an environment on four countries that have gone through a trade liberalization process since the 80's, if the belief that removing barriers to trade and investment is the surest way to raise income and enhance growth prospects in developing countries through RFNE. With this objective in mind we analyze what are the determinants behind RFNE by looking to the shares on time allocation among the rural economies of El Salvador, Guatemala, Nicaragua and Honduras. We found that the main effects stem from gender, schooling of the household head, and access to infrastructure. But the marginal effect of infrastructure is positively correlated with income, i.e. the poor would benefit less than the rich, and therefore the initial conditions of the households matter no matter the removal of major trade barriers. In addition, the more the specialization of the household in agriculture the lower the probability he will diversify its income with RNFE.

The paper is organized as follows; section 2 reviews recent literature on RNFE, section 3 lands RNFE into Central American countries. Section 4 presents a theoretical model to identify the determinants of RNFE and outlines the reduced form estimation. . Section 5 presents the main results and finally we present the conclusions.

2. Rural Non-Farm Employment (RNFE)

One of the earliest studies of RNFE is Guha (1974). Guha examines the role of RNFE in the promotion of employment in India, Iran and Syria. The first comprehensive review of RNFE is the study conducted by Lanjouw and Lanjouw (1995) and in which he defines the the non-farm "sector" as the one which includes all economic activities except agriculture, livestock, fishing and hunting. Since it is defined negatively, as non-agriculture, it is not in any sense a homogeneous sector. Recent studies usually find that Rural Non-Farm Employment (RNFE) generates 30 to 50 percent of rural households' income (Haggblade, Hazell and Reardon 2007, Carletto *et a*l 2007). This type of findings has originated increasing attention to RNFE as a means to defeat poverty in rural areas, ease the pressure of migration on cities and empower women.

In this paper we follow Lanjouw and Lanjouw (1995) RNFE definition. RFNE is defined as any labor activity (self-employment, wage employment or non-wage employment) in industry,

[2] For further details on the effects of CAFTA refer to Morley (2007), Morley et.al. (2007), and Jansen et.al (2007).

manufacture or services, performed by people who live in areas with a population density under certain threshold which defines the area as rural. This threshold will vary country by country. Thus, the definition excludes wage or self-employment in primary activities in farms, fishing and hunting.

It is important to highlight two issues concerning RNFE. In first place, "rural" should include rural centers. de Janvry and Sadoulet (2007) reviews experiences with territorial approaches to rural development and develops a series of recommendations for the implementation of a territorial approach to rural development in Latin America emphasizing the role that RNFE should play. According to Ravallion (2007), the national definitions of "rural" are likely to underestimate the true rural population. To account for the real share of manufacture as part of RNFE it is important to take into account mid-size towns that act as rural centers (de Janvry 2007). Therefore, the 30 to 50 percent figures are likely to be lower limits of the true contribution of nonfarm income to total household income in rural areas.

In second place, the development of RNFE is not equivalent to industrialization. RNFE includes service and trade, among other activities. This differentiation is especially important for regions whose industrial sectors perform poorly, as Bryceson (2007) shows for the case of Sub-Saharan Africa.

As to how to promote RNFE, Kristiansen (2003) based on a case study of Indonesia, suggests that policies towards rural employment creation should promote horizontal communication and economic transactions between regions and people. Dixon (1982) recommends the use of pre-existent institutions in agrarian communities as a guide to policymakers interested in promoting RNFE among women, especially for RNFE that require mutual trust and cooperation.

Finally, there are some studies that look into the effects of infrastructure and RNFE. For example, Escobal and Torero (2005) show the importance of complementarities in infrastructure and the impact on RNFE.

Main advantages of RNFE

One of the main advantages of nonfarm activities is that they play a role in income smoothing, because they can generate income during off-peak seasons and also allow the diversification of activities outside agriculture. In addition, some studies have shown that they help boost income and self-esteem of typically less favored groups as women. They usually provide higher income than agriculture and better prospects of escaping poverty, even when seasonal. In addition, policies favoring RNFE may help decelerate migration to cities, and may also attract "unsuccessful migrants" back from the cities.

On the other hand, Farm and non-farm activities are strongly linked (Anderson 1982). In fact, households that perform farm and non-farm activities simultaneously constitute the majority of rural households, although there are important sources of heterogeneity in the type of non-farm activities and the intensity of the resource allocation. Therefore, there is a necessity to take these links into account in the empirical models (see how these links are taken into account in our model in section 4.3.).

Main weaknesses of RNFE

RNFE is far from being a commonly agreed way out of poverty. In first place, its promotion may lead to increased income inequality in rural areas, because non-farm earnings in rural areas tend to be concentrated by the relatively richer households, owing to the existence of significant entry barriers and market segmentation (Reardon 1997). The most worrying finding of Reardon 1997, was the poor distribution of nonfarm earnings in rural areas, despite the importance of these earnings to food security and farm investments. This poor distribution implies significant entry barriers and market segmentation; it is probable that this will lead over time to an increasingly skewed distribution of land and other assets in rural Africa

In second place, a considerable share of the gains may be appropriated by urban workers as Levenson (2000) documents for the case of Taiwan. In third place, expansions in the RNFE are not irreversible. The Zairian economic crisis in the 1990s illustrates this point. The crisis not only led to a full stop of the de-agrarization process, but in addition non-agricultural employment opportunities diminished considerably, and an increasing proportion of the country's population was pushed back to subsistence agriculture (Shapiro and Shapiro 1994).

Other studies show that in some cases RNFE are not optimal, because they may be the result of disequilibria (Reardon 1997). In turn, other authors argue that non-farm activities should not be performed in rural areas because of the lack of economies of scale. And finally, the point has also been made that RNFE are not a way out of poverty (CITE).

3. Rural Non-Farm Activities in CAFTA Countries

Living Standard Measurement Surveys (LSMS) are used for all the countries under study. Specifically, the data for El Salvador comes from the 2004 EHPM (Encuesta de Hogares de Propósitos Múltiples from 2004), which includes 7842 rural households. The data for Guatemala comes from the 2000 Encovi (Encuesta de Condiciones de Vida). This dataset includes 3776 rural households. Honduras' 2002 MECOVI includes 2508 rural households. Finally, the data for Nicaragua comes from 2000 Enig (Encuesta de Ingresos y Gastos), includes 1956 rural households.

The survey for El Salvador was fielded from January to December, but the survey for Honduras only covers September to November, Nicaragua only covers May to July and Guatemala covers July to December. This may introduce seasonality effects[3]..

Table 1 depicts the types of non-farm activities that are performed by rural households in the countries under study. The first column is the share of households that perform each activity. The universe for this column is the total sample of rural households. In every country agriculture is the activity with the highest shares of households participating in it, ranging from 54 to 81 percent. The main non-farm activities (according to the share of households that

[3] However, any possible seasonality effect is apparently minimal, because with and without controlling for the survey month, the core results remain unchanged in the four countries

participate in them) are manufacturing; construction; trade; health, social work, and private services, all of which (except construction in Nicaragua) present shares of around 10 percent or higher.

For columns 2 through 8, the universe for each row is the set of households that are engaged in each particular activity (i.e. those households who allocate time to it)[4]. The second column shows the mean share of time allocated to each activity. Households engaged in agriculture allocate between 81 and 85 percent of their time to agricultural activities, while most ratios for nonfarm activities are between 0.5 and 0.6 (except for El Salvador, where they are between 0.6 and 0.7).

The third column shows the mean income of the households that perform each activity, while the fourth reports the mean years of schooling of the household head. Together these variables give a rough but solid idea of the general socio-economic characteristics of the households that perform each activity. Not surprisingly, households engaged in agriculture consistently report the lowest income and their heads report the lowest levels of schooling. On the other hand, households engaged in financial services report the highest mean income, and heads of households engaged in education report the highest levels of schooling.

Column 5(6) shows the median (mean) income obtained from each activity[5], as a share of total household income. These columns show on average how important is each activity as source of income to the household. The shares for nonfarm activities in most cases fluctuate between 50 and 75 percent, while the shares for agriculture range from 74 to 78 percent.

Columns 7 and 8 replicate 5 and 6 but report the mean and median income as shares of the household RNFY. This sheds light on how much of the household's non-farm income depends on each activity. The shares are surprisingly high, with most medians being 1. In addition, income from agricultural activities represents from 0.4 to 0.6 of RNFY. The high mean values are due to small fractions of households reporting extremely large agricultural incomes and almost null nonfarm incomes. Therefore, the median ratio is considered to give a better description of the distribution in this case.

Taken as a whole, the table shows two interesting facts. In first place, there is a strong negative correlation between the share of households that are engaged in a particular activity and the mean (or median) household income.

In second place, the share of income generated by each rural non-farm activity is equal to or, more often, greater than the share of time that the household allocates to that particular activity. In turn, the share of income obtained by farm activities is smaller than the share of time allocated to this type of activities. Therefore, it seems clear that nonfarm activities generate more units of income per unit of time than farm activities. This is a first hint that reallocation of the households' time towards nonfarm activities would increase household incomes.

[4] Except in the case of columns 5 and 8 one can easily get the respective figures for the whole rural sample by multiplying each number by their corresponding share in column 1.
[5] By households engaged in each respective activity.

However, households engaged in agriculture allocate over 80 percent of their time to farm activities. For those households, agriculture activity is by far their main source of income. It is clear that households dedicate a larger share of time to agriculture than to any non-farm activity. Among the households that are engaged in agriculture, at least 50 percent of them allocate all of their time to agriculture.

This is consistent with labor income per hour by activity, as shown in Table 2. Nonfarm activities render much higher income per hour than farm activities.

4. The Model

The conceptual framework is based on the literature on rural households, following the work by Escobal and Torero (2004) and de Janvry and Sadoulet (1996). The objective of each household is to maximize their utility subject to a set of constraints, including: 1) a liquidity constraint; 2) production technologies in each activity; 3) exogenous prices for non-tradable goods; 4) an equilibrium condition for auto-subsistence producers; and 5) an equilibrium condition for family labor. Thus, the following variables are endogenous to the model: the quantity of consumption goods acquired by the household, the quantity of inputs, the change in stocks, and the quantity of family labor assigned to each activity. The exogenous variables are: household demographic characteristics, market prices for traded goods, initial stock of wealth, transfers received by the household, availability of family labor, and the structure of asset holdings.

The set of first order conditions generates a system of supply and demand functions, which allow the assignation of family labor into the different activities. The reduced forms corresponding to each of the variables associated to the production process are:

Inputs

$$i_{ij} = f_{ij}\,(Z, w, p, R, T, L, A) \qquad (1)$$

Family labor in each activity

$$l_j = g_j\,(Z, w, p, R, T, L, A) \qquad (2)$$

Produced quantity in each activity

$$q_j = h_j\,(Z, w, p, R, T, L, A) \qquad (3)$$

Net incomes in each activity

$$\Pi_j = k_j\,(Z, w, p, R, T, L, A) \qquad (4)$$

Where Z is the set of demographic characteristics of the household, w is a vector of input prices for each activity, p is a vector of consumption goods prices, R is the initial stock of

wealth, T is the amount of transfers received by the household, L is the total amount of labor available, and A is a vector of productive assets in each activity.

Lopez (1986) shows that if time allocation inside or outside the farm has different valuations in terms of utility or if there are positive search costs associated to work outside the farm, then the shadow price of farm labor is determined endogenously. If this is so, consumption and production decisions are non-separable and therefore it would be expected that household characteristics affect time allocation decisions. This is why demographic characteristics are included in the reduced forms shown above.

The model predicts that households allocate resources into different activities, according to the profits obtained from each one of them. In that sense, an increase in the activity-specific assets increases the amount of resources allocated to that particular activity and reduces the amount of resources allocated to other quantities. Furthermore, exogenous impacts like the changes in relative prices, consequence of trade liberalization, will affect the way the household allocated labor resources. Estimating the reduced forms will allow finding the main determinants of the income strategy chosen by the household.

Empirical Specification

The empirical endogenous variables are the number of hours dedicated to each activity divided by the number of economically active household members. The empirical variables to be used as determinants of participation can be classified as follows:

a) Exogenous variables of changes in relative prices relevant to the economic sector. The effects of these variables were proxied by the median income in each activity in each primary sampling unit. The main idea behind this is that price changes that are favorable (unfavorable) to a particular activity should be associated with higher (lower) incomes in that particular activity. Similarly, price changes that are favorable (unfavorable) to a particular activity's alternatives should be associated with lower (higher) incomes in that particular activity. By aggregating at the level of the primary sampling unit we take the effect at the local level (local to the household). This gives more flexibility than imposing changes at larger geographical disaggregation, which would overlap with the regional dummies.

b) Social and private assets: years of schooling of the household head and a polychoric index of assets and machinery owned by the households.

c) Public assets: access to infrastructure, to wit: telephone, running water, electricity, and distance to nearest market.

d) Physical assets: land

e) Natural assets: the geography faced by households is partially captured by regional dummies. The inclusion of other geographic information like weather, information about the terrain, altitude, and slope would be ideal but is not available.

f) Demographic characteristics: marital status, ethnicity, gender, and age of the household head, as well as the number of household members by age group.

g) Monthly time dummies are included to control for possible seasonality effects in the allocation of labor along the year.

Econometric Specification

The main analysis comes from the estimation of equation (2) as a reduced form. The econometric model we estimate is a bivariate Tobit. This model consists on a system of Tobit regressions where the disturbance terms are assumed to follow a bivariate normal distribution, and is adequate to model several decisions being taken simultaneously. According to the model developed earlier, each household decides whether to participate in each activity. Bivariate Tobit models allow each agent to choose more than one activity. The covariance matrix between the residuals allows to test whether activities are complements or substitutes of each other.

The main advantage of this model is that, unlike in a multinomial or ordered Probit setting; the researcher doesn't need to impose thresholds to qualify a household as "farm" or "nonfarm" according to certain share of time allocated to each type of activity.

In general, bivariate regressions are preferable to systems of equations because they do not hinge on exclusion restrictions, like seemingly unrelated regressions, or multinomial Probits and Logits, because the cross equation correlation is the object of interest in estimating the covariance matrix. Identification comes from making variance assumptions about the structure of the cross-equation correlation, not variable exclusions. This actually is one of its advantages because exclusion restrictions can be somewhat arbitrary and are difficult to test convincingly, although different specifications are, of course possible in the multivariate Probit.

To check the robustness of the results we tested several specifications. In first place, we included income as an additional regressor. Income results significant, but the main results hold. We did not include income in the final model because the theoretical model income is not an exogenous variable. In second place, we divided farm and nonfarm activities in wage and nonwage, thus having four types of activities (using in this case a multivariate Tobit with four equations). The results remain consistent to the final model. For the sake of simplicity we present the results of the bivariate Tobit.

5. Main results

This section summarizes the main results of estimating equation (2) by means of bivariate Tobit models. We estimate bivariate Tobits for the number of hours allocated to farm and nonfarm activities in each country. Table 3 shows the main results of the estimation and Table 4 shows the elasticities and mean values of each variable.

Not all non-farm activities offer better payment than farm activities. Some non-farm activities generate extremely low income, and are typically performed by landless households. To get only

the "desirable" non-farm activities, the regressions were estimated only for those households with non-zero landholding. By doing so, we select households who have an opportunity cost of at least equal to working on their own land and thus participate in activities that are at least as profitable. By doing so, we avoid the inclusion of landless households who may be performing extremely low-paying non-farm activities. This is not expected to eliminate richer households from the sample because most of them own land.[6]

In first place, the test that the correlation of the errors between the equations is null is strongly rejected in every country, which favors the bivariate Tobit specification. The analysis of covariance of errors shows that, as expected, in every case farm and nonfarm activities are complements. After having said this, to avoid diverting the attention from the focus of this paper, we will concentrate in the analysis of the nonfarm equations.

The median income in each primary sampling unit (PSU) for each activity was included to account for profit in the activity and its opportunity costs. The PSU was selected because it is the closest to the household's "neighborhood". The higher the median household's income in nonfarm activities, the more prone will be the household to participate in that activity, and the more hours will the household allocate to them. Conversely, the probability that the household will participate in farm activities is lower the higher the median household's income in farm activities are. All the coefficients for the competing activities are either negative or non-significant.

The number of types of infrastructure is positive and strongly significant. More importantly, the effect of two types of infrastructure is more than double the effect of one type. This is strongly consistent with previous findings that ownership of a combination of two or more assets usually has a higher impact on household expenditure than the sum of the individual impacts (Escobal and Torero 2005:157)

The age of the household head results in most cases positive, and its squared is generally negative but they are not significant in El Salvador and Guatemala. This means that households tend to participate in more types of activities as the household head gets older, but past certain age threshold of the household head, the probability of engaging in each activity decreases. This sheds some light on the household's life cycle.

The coefficient of years of schooling is positive for non-farm activities (wage or non-wage) and negative for farm activities. This shows that schooling is an important entrance gate to non-

[6] It is important to mention that in the case of Honduras only around 10% of the sample reports non-missing land ownership, so land was not included in the regression (when land was included the hypothesis of joint insignificance is not rejected). In this case, households reporting non-zero landholding were included in the regression (i.e., we included households who reported landholding either greater than zero or missing).
It may be argued that this creates a bias on variables that may be correlated with land, because land may be significant if it were available for the whole sample. The variables of interest in the section 5 are years of schooling and infrastructure. We looked at the correlation between these variables and land (and land squared) in the other countries. Every correlation is not significant in at least one country. The only exception is the correlation between land and access to two or more types of infrastructure, which is positive in El Salvador and negative in Guatemala and Nicaragua, so there is no consistent pattern in between these variables either. This is at least indirect evidence that we are not introducing bias by dropping the landholding variables.

farm activities. It is worth discussing about the econometric endogeneity of years of schooling. In wage equations it is usually argued that years of schooling are likely to be correlated with unobserved variables like innate ability, which is also expected to determine wage, and thus the coefficient of years of schooling would arguably be biased. In this case, some of the richest individuals in the dataset allocate most of their time to farm activities (and thus few hours to RNFE). Farm activities are associated with a low number of years of schooling. Since they are the richest they would arguably be in the higher end of the distribution of ability. In addition, the number of years of schooling is so low that one would think that the limit is due to a lack of supply rather than a lack of demand. Therefore there is no clear prior that years of schooling would necessarily be positively correlated with higher ability.

In every country, it is clear that male-headed households are less likely to engage in non-farm activities than female-headed households, and thus relay more heavily than the latter on farm activities. The order of magnitude is similar to the effect of two types of infrastructure.

No clear patterns emerge from the analysis of the marital status of the household head. Households were the head is married report a positive and significant coefficient in El Salvador and Nicaragua, but in Guatemala and Honduras the coefficient is not significant.

The demographic composition of the household shows that having an extra member in working age (15 to 65 years old) allows the household to diversify their working time away from farm activities.

The asset index, proxy for household wealth, is a positive and significant determinant of participation in nonfarm activities in every country except Guatemala.

Marginal Effects and Elasticities

Tobit models have three types of marginal effects. This section will focus on the marginal effect of years of schooling and infrastructure on the expected value of the hours allocated to RNFE.

Table 5 shows the marginal effects of schooling of the household head and of infrastructure for each country by income quartile. In first place, all elasticities are all positive, significant and positively correlated with income. The higher quartiles get more advantages from schooling and infrastructure: perhaps associated with higher marginal productivity of labor and capital, social networks, or higher entrepreneurial ability. However, the most important fact is that the poorest would also benefit.

In second place, the change in E[y|x] from passing from 1 to 2 types of infrastructure is much higher than the change from 0 to 1 type of infrastructure. Honduras and El Salvador show larger differences than Guatemala and Nicaragua.

If a household from the poorest income quintile in El Salvador with no access to infrastructure suddenly received two types of infrastructure, the model predicts that this household will allocate 3.18+4.56= 7.74 additional hours per month to nonfarm activities. To see what this would mean in terms of income per month, let's assume that each additional hour in nonfarm

activities implies a one-to-one decrease in farm activities. From Table 2 we know that the difference in mean incomes between farm and nonfarm income is $2.27 per hour. Applying this difference to the extra hours in nonfarm activities, the income of the hypothetical household would rise by 7.74*2.27=17.57, which is 11% of the median rural income in the El Salvadorian sample. Applying the same exercise to the other countries we find that households in the poorest income quartile would increase their monthly income by 6% in Guatemala, 14% in Honduras and 10% in Nicaragua. We don't take income in each quartile as 100% to avoid artificially inflating the figures due to important shares of households reporting null incomes.

The relationship between E[y|x] and income

According to the theoretical model from section 4.1, income is not one of the exogenous variables determining time allocation to nonfarm activities. However, there is an interesting relationship that deserves to be analyzed. When rural households reach an income threshold they should specialize in agriculture (where rural areas have comparative advantages compared to urban areas) and allocate less time to nonfarm activities. Hence the relationship between E[y|x] and income should show an inverted U curve.

Graphs 1 to 4 show the relationship between the predicted values of E[y|x] and income. In every case the inverted U curve falls is clear. In El Salvador and Guatemala the highest income households allocate no time at all to RNFE. Note that a consequence is that the confidence intervals to the right of the income threshold are wider, due to the scarce number of observations with those incomes. Those are the richest rural households, and the graph shows that they tend to allocate less hours to nonfarm activities than the middle class, but also than most of the highest income quartile. These households are in the top 1% of the distribution.

6. Conclusions

This paper shows the main empirical determinants of time allocation to rural nonfarm employment (RNFE) in four Central American countries: El Salvador, Guatemala, Honduras and Nicaragua. We use a bivariate Tobit approach to account for the fact that some unobservables may be correlated with unobservables in the equation of time allocation to farm activities, like entrepreneurial skills.

The main determinants of participation in RNFE in these countries are access to infrastructure, gender and years of schooling of the household head, and median income in farm and nonfarm activities. Female-headed households allocate more time to nonfarm activities than male headed households. This may be exploited by gender empowerment programs.

The marginal effects of access to infrastructure and years of schooling were analyzed in detail in section 5.2. Access to infrastructure can lead to important increases in rural income by increasing the time that households allocate to nonfarm activities. The effect is higher for richer households, but is positive and significant for all households, including those in the poorest income quintile.

The joint effect of two types of infrastructure would imply an increase of between 3 to 8 additional hours per month in nonfarm activities in the poorest quintiles. Even when the increase is as small as 3 hours per month the monthly income would rise by 6%.

Households that engage in a given non-farm activity on average allocate between 50 and 60 percent of their time to that particular activity. Hence, it appears that there is little room for expanding nonfarm activities in these countries. However, nonfarm activities yield higher hourly labor income than farm activities, with the ratio of nonfarm to farm hourly income ranges from 1.89 to 2.55. The econometric model shows that even shifts as small as 3 extra hours per month in nonfarm activities instead of farm activities (without decreasing leisure time) would boost income of households in Guatemala's poorest income quartile by 6% (change in income over median rural income – see section 5.2 for explanation).
An increase of this magnitude is consistent with the provision of two types of infrastructure to households

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Table 1 - RNFE Time Allocation and Income Generation

	% of households	% of time	household head years of schooling (mean)	household income (mean)	% of household income		% of household Rural Nonfarm Income	
					median	mean	median	mean
El Salvador								
Agriculture	0.54	0.83	2	192	1.00	0.78	0.49	1.36
mining and quarrying	0.00	0.75	1	158	1.00	0.87	1.00	0.93
manufacturing	0.16	0.67	6	375	0.80	0.69	1.00	0.78
electricity,gas,water supply	0.00	0.64	6	514	0.77	0.76	1.00	0.80
construction	0.09	0.75	4	320	1.00	0.78	1.00	0.82
wholesale and retail trade	0.23	0.71	4	324	0.85	0.70	1.00	0.81
transport, storage and com	0.05	0.69	6	391	0.85	0.74	1.00	0.78
financial intermediation	0.00	0.60	6	519	0.55	0.62	0.55	0.70
public admin,defense	0.03	0.74	8	485	0.96	0.78	1.00	0.82
education	0.02	0.58	12	732	0.88	0.76	1.00	0.80
health,social work, services	0.22	0.65	5	331	0.78	0.69	1.00	0.79
Honduras								
Agriculture	0.81	0.81	2	3,686	1.00	0.74	0.61	2.55
mining and quarrying	0.00	0.54	0	5,824	0.92	0.75	1.00	0.92
manufacturing	0.18	0.45	3	5,898	0.47	0.52	1.00	0.72
electricity,gas,water supply	0.01	0.59	5	13,048	0.80	0.69	1.00	0.78
construction	0.09	0.48	3	6,132	0.63	0.60	1.00	0.77
wholesale and retail trade	0.21	0.49	3	6,523	0.50	0.53	1.00	0.77
transport, storage and com	0.03	0.45	4	10,839	0.50	0.54	0.86	0.73
financial intermediation	0.00	0.54	8	34,420	0.53	0.57	0.91	0.89
public admin,defense	0.02	0.56	6	7,872	0.74	0.67	1.00	0.77
education	0.03	0.46	11	11,181	0.57	0.59	0.73	0.66
health,social work, services	0.16	0.43	3	7,007	0.39	0.48	0.83	0.68

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Table 1 (continued) RNFE Time Allocation and Income Generation

	% of households	% of time	household head years of schooling (mean)	household income (mean)	% of household income		% of household Rural Nonfarm Income (RNFY)	
					median	mean	median	mean
Guatemala								
Agriculture	0.74	0.83	3	227	1.00	0.76	0.42	3.08
mining and quarrying	0.00	0.45	3	647	0.33	0.38	0.33	0.48
manufacturing	0.17	0.49	4	423	0.44	0.50	1.00	0.69
electricity,gas,water supply	0.00	0.49	8	566	0.42	0.54	0.57	0.63
construction	0.11	0.57	4	478	0.76	0.69	0.93	0.77
wholesale and retail trade	0.24	0.54	4	461	0.60	0.59	1.00	0.73
transport, storage and com	0.03	0.59	5	693	0.71	0.69	1.00	0.75
financial intermediation	0.01	0.66	6	887	0.81	0.68	0.83	0.71
public admin,defense	0.02	0.62	6	677	0.85	0.73	0.96	0.79
education	0.02	0.41	10	698	0.74	0.66	0.84	0.73
health,social work, services	0.11	0.49	4	548	0.46	0.53	0.84	0.66
Nicaragua								
Agriculture	0.77	0.85	2	428	1.00	0.77	0.46	1.57
mining and quarrying	0.02	0.70	4	906	1.00	0.75	1.00	0.77
manufacturing	0.11	0.57	4	797	0.68	0.65	1.00	0.77
electricity,gas,water supply	0.01	0.77	7	718	1.00	0.85	1.00	0.91
construction	0.06	0.61	3	817	0.77	0.69	1.00	0.79
wholesale and retail trade	0.17	0.53	4	791	0.61	0.59	1.00	0.76
transport, storage and com	0.03	0.60	5	1,000	0.67	0.62	0.70	0.72
financial intermediation	0.00	0.51	4	1,362	0.38	0.48	0.38	0.50
public admin,defense	0.02	0.58	6	1,059	0.64	0.64	0.72	0.69
education	0.05	0.46	8	701	0.46	0.56	0.69	0.70
health,social work, services	0.15	0.54	4	665	0.62	0.63	1.00	0.78

Source: 2004 EHPM (El Salvador), 2000 ENCOVI (Guatemala), 2002 MECOVI (Honduras), and 2000 ENIG (Nicaragua). The first column is the share of households that perform each activity. For columns 2 through 8, the universe for each row is the set of households that are engaged in each particular activity. Column 3 shows the mean income of the households that perform each activity, while the fourth reports the mean years of schooling of the household head. Column 5(6) shows the median (mean) income obtained from each activity, as a share of total household income. Columns 7 and 8 replicate 5 and 6 but report the mean and median income as shares of the household RNFY.

Table 2. Labor income per hour in domestic currency, rural areas

	El Salvador	Guatemala	Honduras	Nicaragua
Farm (1)	2.55	1.88	8.38	3.98
Nonfarm (2)	4.82	4.80	18.30	9.30
Difference (2) – (1)	2.27	2.92	9.92	5.32
Ratio (2)/(1)	1.89	2.55	2.18	2.34
Median Rural Income	153.5	136.2	435.3	287.9

Table 3 (continued). Time Allocation to Farm and Nonfarm Activities - Bivariate Tobit (dependent variable is monthly hours per member in working age: 15-65)

	El Salvador		Guatemala		Honduras		Nicaragua	
	nonfarm	farm	nonfarm	farm	nonfarm	farm	nonfarm	farm
Nonfarm income (PSU) [1]	0.058***	-0.025***	0.052***	-0.034***	0.005***	-0.004***	0.045***	-0.026***
	(0.014)	(0.009)	(0.004)	(0.002)	(0.001)	(0.001)	(0.011)	(0.006)
Farm income (PSU) [1]	-0.023	-0.052	-0.042***	0.021***	-0.002**	0.002**	-0.032**	0.01
	(0.084)	(0.046)	(0.007)	(0.003)	(0.001)	(0.001)	(0.015)	(0.007)
One type of infrastructure [2]	5.331**	-2.562**	4.28***	-2.259***	3.658	-0.92	8.234***	-1.929
	(2.191)	(1.233)	(1.407)	(0.685)	(2.584)	(1.877)	(2.551)	(1.233)
Two or more types of infrastructure[2]	10.818***	-5.03***	6.656***	-2.001***	10.97***	-9.922***	10.745***	-2.706*
	(2.19)	(1.252)	(1.427)	(0.702)	(2.902)	(2.157)	(3.015)	(1.52)
Age	0.02	0.205	0.283	0.213**	0.728*	0.389	1.055**	-0.452**
	(0.275)	(0.16)	(0.2)	(0.104)	(0.426)	(0.317)	(0.446)	(0.207)
Age squared	-0.002	-0.002	-0.003	-0.001	-0.008*	-0.006*	-0.009*	0.004*
	(0.003)	(0.002)	(0.002)	(0.001)	(0.004)	(0.003)	(0.005)	(0.002)
Schooling	1.285***	-0.781***	0.644***	-0.558***	1.161***	-0.533*	1.959***	-0.566***
	(0.231)	(0.141)	(0.178)	(0.102)	(0.399)	(0.306)	(0.415)	(0.214)
Gender (male=1)	-6.282***	4.579***	-5.643***	8.114***	-7.427*	13.466***	-7.696**	2.658
	(2.181)	(1.277)	(1.737)	(0.965)	(3.923)	(3.011)	(3.737)	(1.861)
Marital Status (married=1)	4.321**	-0.67	-2.078	-3.331***	5.432	-3.503	7.477**	-3.347*
	(2.071)	(1.187)	(1.719)	(0.914)	(3.526)	(2.659)	(3.593)	(1.737)
Ethnicity (indigneous=1)	1.166	-0.696	0.877	-0.544	4.772	0.097	6.503	-1.792
	(1.575)	(0.942)	(1.005)	(0.538)	(3.636)	(2.735)	(6.658)	(3.088)

Continues…

Table 3 (continued). Time Allocation to Farm and Nonfarm Activities - Bivariate Tobit (dependent variable is monthly hours per member in working age: 15-65)

	El Salvador		Guatemala		Honduras		Nicaragua	
	nonfarm	farm	nonfarm	farm	nonfarm	farm	nonfarm	farm
Members 0-6 years old	0.4	-0.145	-1.112***	-2.285***	0.398	0.711	1.629*	-0.421
	(0.637)	(0.379)	(0.36)	(0.194)	(0.851)	(0.653)	(0.888)	(0.447)
Members 7-14 years old	-0.641	0.003	-0.402	-0.551***	-0.067	0.265	2.16***	-1.591***
	(0.485)	(0.287)	(0.348)	(0.187)	(0.785)	(0.598)	(0.756)	(0.382)
Members 15-65 years old	4.965***	-0.615**	2.066***	0.513***	0.502	-0.061	1.147*	-0.068
	(0.465)	(0.277)	(0.326)	(0.176)	(0.698)	(0.542)	(0.693)	(0.347)
Members 66 years or over	6.225***	-1.492	-0.134	-0.114	4.069	-0.551	-3.673	-0.801
	(1.649)	(0.986)	(1.203)	(0.647)	(2.698)	(2.102)	(3.061)	(1.477)
Asset index	1.9***	-1.147***	1.163	-0.545	5.377***	-3.003***	3.289***	-1.46***
	(0.693)	(0.417)	(0.962)	(0.523)	(1.212)	(0.929)	(1.025)	(0.518)
Landholding	-1.523***	1.031***	56.737**	0.45	*NA*	*NA*	0.045	0.002
	(0.233)	(0.136)	(23.602)	(0.709)	*NA*	*NA*	(0.081)	(0.037)
Landholding (squared)	0.018***	-0.011***	-40.912**	-0.022	*NA*	*NA*	0	0
	(0.004)	(0.002)	(18.751)	(0.032)	*NA*	*NA*	(0)	(0)
Sigma	29.334***	18.637***	17.275***	10.647***	28.388***	24.353***	29.279***	17.151***
	(0.581)	(0.277)	(0.436)	(0.173)	(0.939)	(0.502)	(1.087)	(0.351)
Atan (rho)	-4.091***		-1.089***		-1.477***		-2.797***	
	(0.183)		(0.608)		(0.109)		(0.207)	
Number of obs	2815		2504		1235		1259	
Wald chi2	437.45		592.55		256.03		233.9	
Prob > chi2	0.000		0.000		0.000		0.000	
Log likelihood	-16572.421		-12720.388		-8392.2945		-7189.2521	

[1] Median income in the primary sampling unit **[2]** of the following: market (closer than 1 hour from the household), telephone, running water or electricity **[3]** A reported coefficient of 0.000 means that the absolute value of the estimated coefficient is lower than 0.0005 **[4]** Intercept, month of the survey and region dummies were included in the model but are not reported in the table **[5]** * significant at 10%; ** significant at 5%; *** significant at 1% [6] Standard deviation in parenthesis

Table 4 Sample Means and Marginal Effects

	El Salvador			Guatemala			Honduras			Nicaragua		
	Mean	dE[y|x]/dxj		Mean	dE[y|x]/dxj		Mean	dE[y|x]/dxj		Mean	dE[y|x]/dxj	
RNFY – PSU [1]	16.31	0.05	***	52.38	0.10	***	618.59	0.00	***	49.45	0.05	***
RFY – PSU [1]	0.88	-0.02		52.14	-0.08	***	1032.48	0.00	**	125.41	-0.04	**
Infrastructure = 1 [2]	0.26	2.02	**	0.30	0.19	***	0.37	1.47		0.34	2.42	***
Infrastructure = 2+ [2]	0.61	2.75	***	0.54	0.15	***	0.37	5.51	***	0.25	0.90	***
Age [3], [4]	49.44	0.01		44.48	0.55		47.17	0.63	*	46.99	1.18	**
Schooling [4]	2.39	1.04	***	1.84	1.28	***	2.45	1.02	***	1.90	2.23	***
Gender [2], [4]	0.84	-3.41	***	0.90	-0.44	***	0.89	-3.65	*	0.87	-2.65	**
Marital Status [2], [4]	0.79	2.15	**	0.89	-0.14		0.84	2.31		0.82	2.11	**
Ethnicity (Indigenous=1) [2], [4]	0.18	0.41		0.54	0.05		0.11	2.28		0.97	1.78	
Household members 0 to 6	0.85	0.32		1.48	-2.21	***	1.19	0.35		1.25	1.86	*
Household members 7t o 14	1.23	-0.52		1.41	-0.80		1.28	-0.06		1.48	2.46	***
Household members 15 to 65	2.97	4.03	***	2.88	4.11	***	3.05	0.44		3.27	1.31	*
Household members 66+	0.27	5.05	***	0.20	-0.27		0.24	3.57		0.22	-4.19	
Household Asset index	-0.12	1.54	***	0.13	2.31		-0.62	4.72	***	-0.13	3.75	***
Land [3]	2.10	-1.21	***	0.04	-49.91		*NA*	*NA*		14.01	0.05	

[1] Median income in the primary sampling unit **[2]** discrete change **[3]** quadratic change **[4]** of the household head **[5]** * significant at 10%; ** significant at 5%; *** significant at 1%. All the marginal effects come from the estimation results of Table 3.

Table 5 Average Marginal Effects of Infrastructure and Schooling on E[y|x] by income quartiles

income quartiles	El Salvador			Guatemala			Honduras			Nicaragua		
	Schooling [1]	infra 0-1 [2]	infra 1-2 [3]	Schooling [1]	infra 0-1 [2]	infra 1-2 [3]	Schooling [1]	infra 0-1 [2]	infra 1-2 [3]	Schooling [1]	infra 0-1 [2]	infra 1-2 [3]
1 (poorest)	0.54	3.18	4.56	0.22	1.25	1.53	0.44	2.60	3.65	0.53	2.06	3.26
	(0.18)	(1.9)	(2.23)	(0.08)	(0.93)	(0.95)	(0.16)	(1.78)	(2.04)	(0.3)	(1.98)	(2.58)
2	0.58	3.68	5.12	0.22	1.30	1.56	0.49	3.06	4.18	0.57	2.37	3.62
	(0.19)	(2.11)	(2.42)	(0.1)	(1.11)	(1.13)	(0.19)	(2.11)	(2.39)	(0.33)	(2.38)	(2.96)
3	0.67	4.66	6.23	0.25	1.77	2.01	0.56	3.92	5.13	0.71	3.33	4.85
	(0.2)	(2.43)	(2.68)	(0.13)	(1.53)	(1.52)	(0.22)	(2.69)	(2.91)	(0.36)	(3.03)	(3.52)
4 (highest)	0.76	5.87	7.52	0.32	2.68	2.89	0.65	5.12	6.36	0.80	4.09	5.74
	(0.2)	(2.81)	(2.94)	(0.17)	(2.03)	(1.97)	(0.25)	(3.4)	(3.5)	(0.39)	(3.4)	(3.87)

[1] marginal effect of years of schooling of the household head **[2]** marginal effect of passing from 0 to 1 types of infrastructure **[3]** marginal effect of passing from 1 to 2 or more types of infrastructure. **[4]** Standard deviation in parenthesis. **[5]** All the marginal effects come from the estimation results of Table 3. The value of the marginal effect is calculated for each household and then averaged across the respective income quartile.

Figure 1. El Salvador - E[y|x] and monthly household income

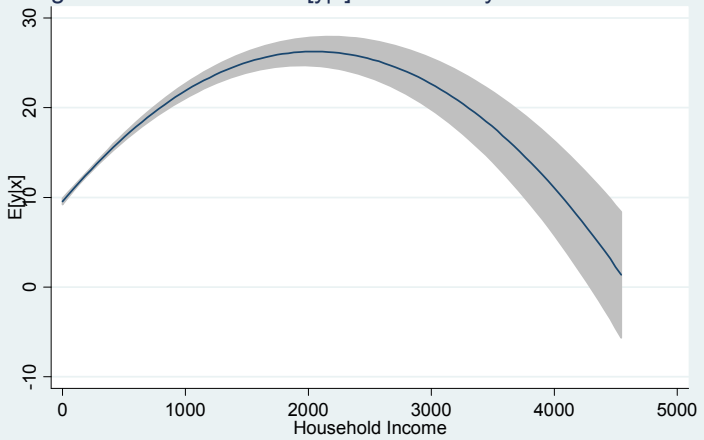

Figure 2. Guatemala - E[y|x] and monthly household income

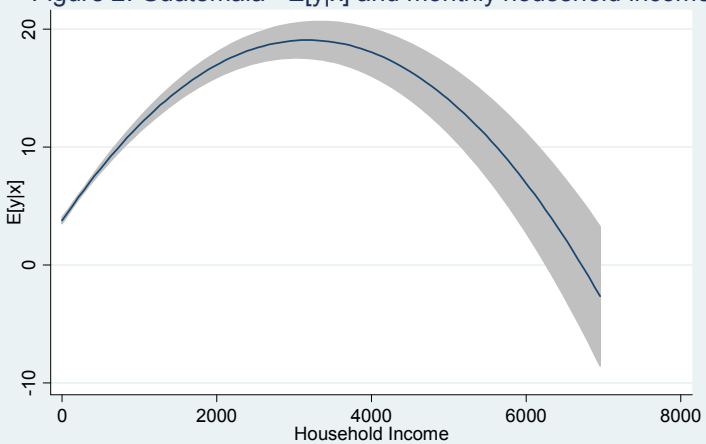

Figure 3. Honduras - E[y|x] and monthly household income

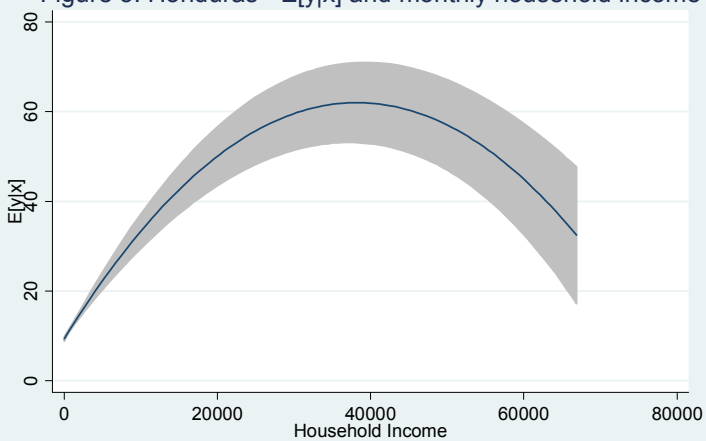

Figure 4. Nicaragua - E[y|x] and monthly household income