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Paul Winters, Timothy Essam, Benjamin Davis, Alberto Zezza, Calogero Carletto and Kostas Stamoulis

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Paul Winters
American University
Washington, DC
USA
e-mail: winters@american.edu

Timothy Essam
University of Maryland, MD
USA
e-mail: tessam@arec.umd.edu

Benjamin Davis
Agricultural Development Economics Division
Food and Agriculture Organization
Rome, Italy
e-mail: benjamin.davis@fao.org

Alberto Zezza
Agricultural Development Economics Division
Food and Agriculture Organization
Rome, Italy
e-mail: alberto.zezza@fao.org

Calogero Carletto
World Bank
Washington, DC,
USA
e-mail: gcarletto@worldbank.org

Kostas Stamoulis
Agricultural Development Economics Division
Food and Agriculture Organization
Rome, Italy
e-mail: kostas.stamoulis@fao.org

Abstract

This article proposes a general pattern of rural development in which rises in per capita income are associated with a decline in the importance of agricultural production and a rise in the importance of non-agricultural income sources. Following the approach to examining Engel's Law, we use data from 15 developing countries and a merged data set to test whether such a pattern emerges. The analysis shows a strong, positive relationship between rising per capita income and the share of income earned from rural non-agricultural activities and a negative relationship between per capita income and agricultural production.

Key Words: Rural development patterns, structural transformation, rural nonfarm activities, livelihooods, cross country analysis.

JEL: O12, O13, O57, Q12.

Patterns of Rural Development:

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While social, political, and cultural factors cause the growth experience to differ across regions, countries, and even urban and rural areas, the fundamental components of an economy tend to be similar across these spaces. Arthur Lewis (1954) elaborated on the composition of economies, noting that development is largely a transition from labor-intensive, agriculturally-oriented enterprises to capital-intensive industries focused on production of manufactured goods. Expanding on the notion of a two-sector, "dual economy", Chenery and Syrquin (1975) showed that as a country grows, the share of GDP derived from the farm sector shrinks, while GDP from capital-intensive industries expands. While this pattern appears clear for the overall economy, less certain is the pattern of development that occurs in the rural areas of the economy.

In rural areas, a shrinking agricultural sector and expanding rural non-agricultural activities are likely features of economic development. The existence of a large and expanding non-agricultural sector seems plausible given the currently available empirical evidence. From Asia, to Africa, to Eastern Europe, to Latin America and the Caribbean, studies have repeatedly shown the importance of non-agricultural activities in the livelihood strategies of rural households (see Davis et al. 2007; FAO 1998; Reardon, Berdegue and Escobar 2001). When considered at this micro level, the structural transformation of an economy can be analyzed by looking at the income-generating activities chosen by households at different levels of income. Is it necessarily the case that

higher income rural households are, on average, going to be less involved in agricultural activities and more involved in other activities? If so, this implies that as development occurs and income per capita increases for rural households, these households will shift away from agriculture activities and towards other activities.

The existing literature on non-agricultural activities implicitly suggests that rural households across countries engage in similar activities as household income rises. What appears to be a defining feature of this process is that as an overall economy develops and shifts from agriculture to manufacturing and services, rural households invest and accumulate assets, particularly education, and participation in farm activities declines as participation in non-agricultural activities intensifies. At these higher income levels, this leads to a lower share of income per capita from farm activities and a higher share from non-agricultural activities.

The purpose of this study is to investigate if there exists a universal, micro-level pattern of rural household development. Previous studies (Lewis 1954; Chenery and Syrquin 1975) have relied on macro data to establish broad economy-wide development patterns. However, to our knowledge, no study has tested the presence of a universal pattern of rural development using microeconomic data. One of the difficulties of positing and testing such an ambitious, universal theory is that rural household behavior differs across countries for many reasons. Geopolitical issues, government regimes, resource endowments, and investment decisions are among the macro factors that influence household development. Micro-level differences, such as education, religion, and household demographics further influence a household's decision making. The resulting

development process is unique to each household and country. Moreover, even if macro and micro factors are similar across countries, the evolution of the rural economy may take on vastly different forms, thereby making comparison rather difficult. Given this qualification, one of the objectives of this study is to separate the universal factors affecting household development from the country-specific characteristics. If this can be achieved, we believe the structural shift in income-generating activities at the household level can be outlined in terms of a universal pattern and a micro-level, country-specific pattern.

Because methodologies of previous studies of rural income generating activities have typically not been comparable across countries (Lanjouw and Feder 2001), we evaluate development patterns using a newly constructed cross-country database composed of comparable variables and aggregates from high-quality household surveys. Other empirical studies from Latin America and the Caribbean indicate that the share of income derived from non-agricultural activities increases with household income (Reardon, Berdegue, and Escobar 2001; Davis et al. 2007), but none to our knowledge, have econometrically tested this relationship nor have they conducted cross-country micro analysis. By comparing the composition of household income in 15 countries across the four principal development regions—Asia, Africa, Eastern Europe and Latin America—we can separate universal development factors from country-specific factors and document the evolution of rural income-generating activities as they relate to rural development.

The specific objective of this study is to analyze rural income-generating activities to determine if, on average, certain activities become more important as incomes rise and

households develop. By decomposing total income into five shares, non-agriculture wage, agriculture wage, agricultural production, self-employment, and all "other" (including transfers), we expand beyond the basic industries defined by Chenery and Syrquin and hope to isolate the activities that are most important to households at different levels of development.

The tendency to shift away from agricultural production towards non-agricultural activities as household income increases is a pattern akin to Engel's Law, which hypothesized that poorer households devote a higher share of their income on food than wealthier households. Tests of Engel's Law seek to verify the relationship between food expenditure and total income while here we seek to determine a relationship between sets of income generating activities (agricultural production, agricultural wage, non-agricultural wage and non-agricultural self employment) and income earned. Since the approach to estimating Engel's law has been well established, a similar approach has been employed here. This approach allows an analysis not only of the relationship between income-generating activities and overall income for the 15 countries analyzed but also comparisons across the countries by the overall level of development (as defined by GDP per capita).

The study is arranged as follows. Section 2 presents the conceptual framework, building on early ideas of macro-level development patterns. Section 3 introduces the data and provides a descriptive analysis while the empirical approach is presented in Section 4. Section 5 presents the results and comments on the cross-country analysis. The final section summarizes the key findings.

Conceptual Framework

Classical economic studies, such as those by Engel, Lewis, Kuznet, and Chenery and Syrquin, often used intercountry macro-level comparisons to understand the process of economic and social development. At the core of these studies is the assumption that there exists a set of underlying processes that drive the development of an economy. While the interactions and details of the processes may differ at a country level, there is a universal behavioral relation that drives the development process.

The existence of macro-level, universal development patterns lend credence to the possibility of micro-level household development patterns. Much in the spirit of Chenery and Syrquin's idea of a shrinking farm sector and expanding industrial sector, we posit that household development exhibits a similar pattern. As the rural economy grows household participation and the intensity of involvement in farm activities declines and is gradually replaced by participation in non-agricultural activities. While gains in wealth do not lead to complete divestment from farm activities, the share of income derived from farm activities declines and the share from non-agricultural activities increases substantially. The pattern appears to be driven by a process of accumulation of assets and investment in education and infrastructure, contained within the framework of a dynamic rural economy and broader changes in the macroeconomy. These broader changes are those described in these previous macro-level studies which show an economy shifting from agricultural to manufacturing and services and consumers purchasing less food as a proportion of income earned and more non-food items. Along with this process, economic development brings greater investment in public services such as infrastructure and stronger institutions. On the

microeconomic side, there are reasons to expect that income rises occurring in this climate of development lead to a greater emphasis by households on non-agricultural activities and here we focus on this aspect of the transitioning rural economy.

Poor households in rural areas across the globe are nearly all lacking a similar mix of assets. In an analysis of the economic status of rural households, Zezza et al. (2007) explain that in rural spaces most small land and livestock holders lack access to key assets, inputs, markets, and basic services—all instruments necessary for rural agrarian households to achieve an agricultural-led pathway out of poverty. Compounding the plight of the rural poor is the fact that households tend to be less endowed with working age individuals, meaning fewer individuals must support the basic needs of the household. Finally, unequally distributed and low levels of education, where the majority of heads of rural households have less than a primary school education, further disadvantage the poorer rural household.

Based on this limited set of assets and the context in which households operate, households allocate their labor to equalize marginal returns across activities. Steep barriers to entry into high-productivity activities appear to limit entry into specialized high-value agriculture as well as into the non-agricultural economy. The only option is entry into low-level, low-productivity agricultural and non-agricultural activities. For poorer, less educated households this may mean high participation rates in agricultural and primary non-agricultural activities. In this primary stage of non-agricultural development, small-scale, low productivity operations, producing what Hymer and Resnick (1969) called "Z-goods" (such as mats and baskets) are often undertaken to provide supplemental income

(Reardon, Berdegue and Escobar 2001). Farm wage employment tends to be among the most popular of these primary activities because of the low entry requirements in terms of skills, education, and capital (Corral and Reardon 2001). Despite the apparent dead-end nature of these jobs, research shows they are essential for maintaining food security and keeping families above the poverty line (Ruben and Van den Berg 2001; Lanjouw and Lanjouw 2001). The defining feature of this initial stage is that the majority of household income is derived from agriculturally-related activities (agriculture wages and production) and little from non-agricultural tasks.

With basic needs met and access to some assets, households may begin to diversify their income sources. On the one hand, these households may lack the necessary levels human capital or infrastructure to participate intensively in non-agricultural activities. But, on the other hand, these households may have enough liquidity and human capital so that they do not have to rely primarily on farm activities for the majority of income and exploit these other opportunities. This transition usually involves a shedding of ties to low-productivity farm tasks and refocusing time and energy into higher-value agricultural production and non-agricultural activities where possible. Because investment, production, and consumption link the farm and non-agricultural sectors, households end up employing a complex livelihood strategy that blends income from both low and high productivity activities. When these transitioning rural households exploit the synergies of the farm and non-agricultural economy to the fullest, the diversification strategy can become a pathway out of poverty. However, if the barriers to entry for non-agricultural activities remain high, and the households cannot make the leap to high productivity/high income activities,

promotion of non-agricultural activities may exacerbate income inequality. The shift in activities is reflected in income shares. While agricultural activities remain the primary source of income for these transitioning households, self-employment and non-agricultural opportunities clearly generate more income than for asset-poor households and suggest a pattern of diversification.

Depending on the dynamics of the rural economy, two different types of non-agricultural activities appear to define households with higher levels of income. In areas with dynamic, rural economies, such as Latin America and Eastern Europe, transition into advanced development is characterized by specialization in non-agricultural wage activities. Davis et al. (2007) suggest that commerce, services, and manufacturing are the most available activities. In areas with less developed non-agricultural economies, such as South Asia and places in Africa, non-agricultural self-employment tends to emerge as the dominant activity. Regardless of geography and market structure, the defining feature of advanced development is that wealthier households all tend to earn a majority of income from non-agricultural activities, while the share of income from agricultural activities declines substantially. Some well-off households still remain in agricultural production but tend to specialize in high-value crops or be more productive than the asset poor.

Often determining entry into non-agricultural sector, education appears to be one of the fundamental household assets in the second stage of transformation. Numerous studies have shown that it is one of the key requirements for participating in high-productivity non-agricultural activities (Clay and Reardon 1997; Lanjouw and Lanjouw 2001; Elbers and Lanjouw 2001; Corral and Reardon 2001; Reardon, Berdegue, and Escobar 2001;

Winters et al 2007). As households accumulate education, they tend to adjust their allocation of time to activities offering higher returns. Physically demanding, low productivity, and low-paying agricultural work becomes less attractive as individuals use their elevated levels of human capital to gain entry into high-productivity, high-income occupations. If demand for skilled workers in the non-agricultural economy is not great, workers often take up part-time, high-productivity occupations or venture into self-employment professions. This may involve migration into urban centers or even abroad if the returns are high enough.

Table 1 presents a summary of the posited household-level development pattern. Common household characteristics, income share composition, and participation levels in income-generating activities are contrasted across per capita income categories, which we assume to coincide with household development patterns. The expectation is that in any rural economy this range of households will be found, but as the overall economy develops and structural transformation of the economy occurs, an increasing proportion of households will be found in the higher levels of household development and less in the lower levels of development.

Description of Data

This study uses data from fifteen countries that form part of the RIGA (Rural Income Generating Activities) database, which has been constructed from a pool of several dozen Living Standards Measurement Study (LSMS) and other multi-purpose household surveys made available by the World Bank through a joint project with the Food and Agriculture

Organization (FAO).[1] From this pool of possible surveys, the choice of particular countries was guided by the desire to ensure geographic coverage across the four principal development regions—Asia, Africa, Eastern Europe and Latin America—as well as adequate quality and sufficient comparability in codification and nomenclatures. Table 2 presents the countries used in the analysis, the year the survey was administered, the number of observations included and household per capita income by quartile. Note that all the data is nationally representative and only those households defined as rural are included in the analysis. The income data are calculated for each country using a consistent methodology to ensure the data is as comparable as possible.[2]

Along with the individual country data, we also created a pooled data set of all the data from each country. Income variables measured in national currencies were converted to US dollars using the purchasing power parity exchange rate used by the World Bank in the poverty assessments conducted for each country. The data are then adjusted to 2005 US dollars using the US consumer price index. The final data set included over 70,000 observations from households around the developing world. In what follows, we will refer to the pooled dataset as the 'megadata'.

For the analysis, we define five economic activities through which households can earn income: i) agricultural production, ii) agricultural wage employment, iii) non-agricultural wage employment, iv) non-agricultural self employment, and v) other income including private and public transfers as well as earning from rental activities.[3] These represent the broad categories of activities that households use to earn their income and are suitable for discerning broad patterns of rural development. Table 3 presents the

participation rates and mean shares of income earned from each of the activities for all countries and the merged data. For participation, one striking feature is the high level of participation in agricultural production in most countries. For the merged data, the value is 85 percent, and it is greater than 75 percent in all countries except Indonesia and Pakistan. This is not always reflected in the share of income from agricultural production which for the pooled data is only 44 percent of income. In Africa, mean income from agriculture remains over 50 percent for all countries but is generally lower in the Asian (ranging from 19 to 56 percent), Eastern European (17 percent and 43 percent) and Latin American (ranging from 26 to 36 percent) countries. Another striking feature is the percent of households receiving income from non-agricultural activities and the high share of income from these activities, particularly from the countries in Latin America and Asia. Here, over 30 percent of households participate in non-agricultural wage employment and in most of these countries over 20 percent in non-agricultural self employment. These two categories represent about a third of income in the Asian and Latin American countries. Overall, the data confirm the importance of a range of economic activities across countries.

Empirical Approach

Working's (1943) simple, semi-log approach and Leser's (1963) modification to evaluating Engel's Law are well suited for our primary hypothesis. The Working-Leser approach relies on the assumption that expenditure shares are a function of the logarithm of total income. Our primary hypothesis is nearly the inverse of Engel's law so it closely parallels the logic underlying the law. We assume that income shares are a function of the

logarithm of household per capita income. Building on this basic approach, we follow Deaton and Muellbauer (1986) incorporating demographic effects into the system to control for basic differences in household demographic structure. The resulting model is as follows,

$$S_f = \alpha + \beta \ln(\mathrm{y}) + \sum_{j=1}^{J} \delta_j n_j + \varepsilon \qquad (1)$$

where S_f is the share of income earned from activity f,

y is income per capita,

n_j is the number of persons in demographic category j (j = 1,….J),

ε is a stochastic term, and

α, β, and δ_j are parameters to be estimated.

Equation (1) is estimated for all five economic activities noted previously. Household demographic categories include quantity of household labor, female or male head of household, age and age squared of the head of household, religious and indigenous categories, and head education disaggregated into four categories (less than primary school (baseline), primary school, secondary school, and high school or greater). As per capita income captures many features of wealth, such as infrastructure or productive assets, we have not included any other control variables. To account for heteroskedasticity, all reported coefficients are computed using robust standard errors.

Since our econometric approach is essentially a semi-log model and we are primarily interested in the relationship between household per capita income (y) and income shares (S_f), all reported income coefficients are transformed into elasticities. First,

taking the derivative of our initial regression equation with respect to a change in per capita income yields the following,

$$\frac{\partial S_f}{\partial y} = \frac{\beta}{\mathrm{y}}$$

Next, this can be converted to a unitless elasticity by multiplying the derivative by (y/S_f), which gives

$$\frac{\partial S_f}{\partial y} * \frac{y}{S_f} = \frac{\beta}{S_f}$$

The advantage of using this unitless measurement is that comparisons can easily be drawn across countries.

While one of the main advantages of using a modified Working-Leser approach is the simplicity of the model, the approach could be enhanced in a variety of ways. First, Working's linear model performs well when the dependent variable is continuously distributed over positive values, however problems can arise when observations take on corner solution responses. Wooldridge (2003) notes that when the dependent variable takes on a wide range of strictly positive values, including 0, using a linear model can lead to negative fitted values. Using a censored regression model avoids such a problem. This study therefore reports the results of a censored-regression model (with censoring both at zero on the left-hand side and one on the right-hand side) to determine if accounting for censoring influences the results.

Because the procedure is less restrictive than the Tobit estimation technique, Holcomb, Park, and Capps (1995) suggest using a two-step Heckman procedure to circumvent the censored-response problem. If households are self selecting into certain

income-generating activities for reasons that cannot be observed or measured by household surveys, this technique may be appropriate and has been employed by numerous scholars testing forms of Engel's law (Holcomb, Park, Capps 1995; Byrne and Capps 1996; Lanfranco, Ames and Huang 2001; and Moon 1989). For such a model, however, it is necessary to have a continuous identifying variable in the first-stage selection equation that is not included in the second stage and such variables are often difficult to find. When such instruments are not available, the results are suspect. Even when available, there are potential problems with estimation if there is heteroskedasticity in the data as is likely in our case.[4] For these reasons, we choose not to employ this approach.

An alternative to Heckman approach and the censored model is a hurdle model where a first-stage probit on participation is estimated followed by a share equation where selectivity is not accounted for in this second stage. This approach was examined and the second stage yielded similar results to the OLS and censored model and were thus not reported. The first-stage probit results, however, are reported since they are of interest in themselves. As noted in the data description section, although shares of income from agricultural production tend to decline with increases in income, participation rates remain similar. As such, the relationship between activity participation and income per capita is worth exploring and we do so using probit models on activity participation. Marginal effects of increasing income at the sample mean are presented for the probit models.

An additional issue to consider is the possible endogeneity of income per capita in equation (1). The solution to this problem is to use an instrumental variable approach, which is often challenging since this requires an instrument to predict income per capita.

Fortunately, in all the data sets expenditure per capita is available and is reasonably assumed to be correlated with income but uncorrelated with the errors in equation (1). Equation (1) is thus also run using this approach and results are presented.

Note that a double-logarithmic form might also be considered instead of a semi-log specification. Houthakker (1957) employed this approach and also noted that Engel himself used the double-logarithmic model. While it does allow for easy interpretation of the coefficients in terms of elasticities, Holcomb, Park and Capps (1995) point out that in this model the elasticity is constant over all households and zero values in the dependent variable cannot be considered. Due to the imbalance of zero share values across countries, we chose not to use this model.

This empirical approach is employed for each of the 15 countries as well as the megadata. The hypotheses regarding the relationship between income shares from different activities and overall income posited above is then tested for each of the countries and the megadata. Along with testing this relationship directly, the results of the analysis are compared across countries based on their ranking in terms of GDP per capita. The expectation is that as development occurs (GDP per capita rises) the relationships between income shares and income per capita will become stronger since economic development will bring about the broader macroeconomic changes and structural transformation described previously providing more opportunities for households in the non-agricultural economy. Thus, our hypotheses regarding micro-level patterns of development are tested using the individual, country-specific empirical results as well as cross-country comparisons across level of development.

Results

Table 4 presents a summary of the results reporting, for the three specifications, the elasticity of shares with respect to a change in per capita income for the merged data and each country in the data set. The conceptual model predicts that a marginal change in per capita income is accompanied by an increase in the share of income obtained from non-agriculture wage and self-employment activities. The results provide strong support for this hypothesis with positive and significant results for the megadata and the majority of countries. The results for the censored regression model are presented by the country level of development[5] in figure 1.[6] The results indicate that as development occurs, the elasticity with respect to non-agricultural wage employment increases suggesting that, as hypothesized, non-agricultural wage employment is even more closely associated with high-income levels in more developed countries. While non-agricultural self employment is always positively associated with per capita income for the analyzed countries, there is no clear pattern that emerges across the level of development.

The results for agriculture are slightly more mixed, at least for Africa. In Madagascar and Malawi, among the poorest countries in our sample, we find a positive relationship between agricultural production and per capita income. For the remaining countries, as well as in the megadata, the relationship is clearly negative suggesting less income is earned from agricultural production by households with higher income per capita.[7] In fact, as seen in figure 1, the data show that elasticities become more negative with development suggesting that in more developed countries agriculture is less associated with high levels of income per capita.

Results for agricultural wage shares is even more mixed with the censored specification showing positive results for eight countries and negative results for five countries. This is somewhat surprising given that agricultural wage employment is often viewed as an occupation of last resort for the poorest households. Examination of the elasticities by the level of development (figure 1) offers a partial explanation for this result. As development occurs the elasticities appears to shift from negative to positive values indicating agricultural wage goes from being somewhat of a refuge sector of the poor to an activity that is more highly productive for those that participate in the activity.

Using the megadata results, it is possible to simulate the overall pattern of rural development. To allow a greater degree of flexibility in the shape of the curves a log per capita expenditure squared term is included in the specification along with log per capita expenditure (both are significant). The results are presented in figure 2 and indicate that as development occurs there is a shift from agricultural production toward non-agricultural wage employment and self employment. Furthermore, there are substantial changes in the composition of rural income at lower levels of development, but as development occurs there appears to be a slow and steady transition away from agriculture to the non-agricultural economy.

Although agriculture appears to decline in importance in income generation, the descriptive statistics presented previously in table 3 show consistently high levels of participation in agricultural production across all countries and in fact in some countries participation rates approach 100 percent. On the other hand, these descriptive statistics across all countries showed a range of participation rates in other activities. To explore the

relationship between participation and income per capita, table 5 presents results for a probit analysis and instrumental variable probit analysis for participation in each of the income-generating activities.[8] The results for non-agricultural wage and self employment are largely consistent with the censored regression results and indicate that participation in rural non-agricultural activities increases with income per capita. Results for agricultural production are mixed and no clear pattern emerges. Examining participation by level of development (figure 3), the results suggest that non-agricultural wage employment is even more associated with higher income per capita as development occurs. As with the results on income shares, no similar pattern emerges for non-agricultural self employment. Somewhat surprisingly, agricultural wage is positively associated with income per capita and this marginal effects increase with the level of development. This result indicates that the image of agricultural wage in developing countries as a refuge sector is inaccurate.

Finally, using the megadata figure 4 provides a simulation of the probability of participating in the different rural income-generating activities by level of development. Unlike the share of income from agricultural production, participation in agriculture does not substantially decline with the amount of income per capita earned. There is a small decline, but the figure suggests a broad level of participation in agricultural production even for those earning high income. This is in contrast to non-agricultural wage employment and self employment where participation levels increase dramatically with income per capita at lower levels of income and continue to climb by 4-5 percent for each US$1,000 additional income earned for those above US$1,000 per capita.

Conclusion

We have posited and tested the presence of micro-level, household development pattern in rural areas in fifteen countries as well as a pooled data set. The available literature suggests that a shrinking agricultural sector and expanding non-agricultural activities are likely features of economic growth. This is broadly linked to the macro structural transformation of economies that occur with economic development. But at the micro level, this transition tends to be characterized by a process of household accumulation of assets, which lead to greater participation in the non-agricultural economy. As per capita income of rural households increases, the share of income from the non-agricultural economy grows while the share from farming declines. Using a Working-Leser model and incorporating demographic control variables we have tested the relationship between per capita income and income composition. Results from individual country analysis and the merged data all corroborated our hypothesis. The pattern of rural development is one in which as per capita income increases households shift from agricultural production and toward non-agricultural wage and self employment. Furthermore, the shift to non-agricultural wage employment is even more pronounced in countries with higher levels of GDP per capita indicating the effect strengthens with development.

Of course, to the extent that some individuals and households move to the urban economy with development, this study underestimates the rate at which rural people shift away from the agricultural sector as development progresses. It does, however, establish that the shift away from agricultural is not solely through migration out of rural areas, but also occurs within the rural economy among those who remain.

Although this shift occurs, rural households remain remarkably attached to farming with those at all ranges of income per capita remaining involved to some degree in agricultural production. Furthermore, contrary to its reputation as a refuge sector of the poor, agricultural wage employment remains an important income-generating activity even for those at higher levels of income. In some countries, particularly those with higher GDP per capita, it is even associated with higher levels of income. This result has been found elsewhere and seems to be driven by the fact that with development the gap in wages between agricultural and non-agricultural wage activities narrows substantially and thus agricultural wage employment begins to mirror non-agricultural wage employment in terms of its productivity levels (Winters et al 2008).

One limitation to the study is that we examine a limited part of the development spectrum as our sample does not include developed countries since comparable data from these countries is unavailable. In a way, our sample is truncated on the right. This partially explains the fact that even the more advanced developing economies have high participation in agriculture. Among developed economies, it is likely that not only the share of income from agriculture declines but so do the participation rates. Unfortunately this is not possible to test with the available data.

Policy makers should be aware that the composition of the rural economy is ever changing and the non-agricultural economy, if appropriately harnessed, can become a pathway out of poverty for poor households. Understanding the development process and the state of the rural economy can aid in the design of rural development policy that incorporates the strengths and weaknesses of the agricultural and non-agricultural

economy. Of course, although a pattern emerges that suggests a declining agricultural sector, this should not be interpreted as a justification of the neglect of this sector in rural development policy. A dynamic agricultural sector is likely to induce growth in the non-agricultural economy and can be an important stimulus for rural development.

[1] Up to date information on the RIGA database can be found at http://www.fao.org/es/ESA/riga/index_en.htm.

[2] Details of the construction of the income aggregates can be found in Carletto et al (2007).

[3] Note that in the case of agricultural production and non-agricultural self employment it is possible that households had negative income earnings. Since the analysis focuses on shares of income, these values were censored at zero to avoid negative shares.

[4] See Deaton (1997) pages 101-105 for a discussion of the issues associated with using a Heckman two-step model.

[5] The level of development is determined by (i) obtaining the GDP per capita for the year in which the survey was administered from the World Development Indicators, (ii) putting this into US dollar terms using the purchasing power parity exchange rate, and (iii) calculating the value in real 2005 terms using the US consumer price index.

[6] In all figures, only the results that are significantly different from zero are included.

[7] Note, however, that in a few cases results change when an instrumental variable approach is used although the results for the overall data remain the same.

[8] Analysis of participation is not possible in a few cases where participation rates were too high (agricultural production for Madagascar, Nigeria, Nepal, Nicaragua, and Panama) or too low (self employment for Bulgaria).

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Table 1. Household Development Patterns

	Per Capita Income/Household Development		
	Lowest/Primary	**Middle/Secondary**	**Highest/Advanced**
Household Characteristics	• Poor Infrastructure • Low levels of education • Reliance on farm economy • Lack productive assets • Household labor/liquidity constraints • Lack access to markets	• Fair Infrastructure • Increasing levels of education • Slightly less reliant on farm economy; diversified income sources • Accumulation of assets • Increasing labor/liquidity access • Gaining access to markets	• Good Infrastructure • High levels of education • Non-agricultural wage & self employment primary sources of income • High asset levels • Labor and liquidity access • Access to markets
Income Composition	Specialization in agricultural production and farm wage labor	Emphasis on agricultural production and farm labor; Moderate income from non-agricultural activities; Peak in transfers/other income	Specialization in non-agricultural activities (commerce, services, and manufacturing); Small share of farm income
Income-generating activities – Participation Levels			
Non-agricultural wage employment	Low participation and income share	Low-moderate participation and income	High participation and income
Non-agricultural self-employment	Low participation and income share	Low-moderate participation and income	High participation and income
Agricultural Production	High participation and income share	High participation and moderate income share	High participation and low income share
Agricultural wage	High participation and moderate income share	Moderate participation and low income share	Low participation and low income share
Transfers/Other	Low participation and income share	Low participation and income share	Low participation and income share

Table 2. RIGA data

Region/Country	Survey Year	Number of rural households	Household Per Capita Income by quartile ($US 2005)		
			p25	*p50*	*p75*
Africa					
Ghana	1998	3,722	62	129	243
Madagascar	1993	2,632	29	47	74
Malawi	2004	9,822	18	44	102
Nigeria	2004	13,634	47	133	307
Asia					
Bangladesh	2000	5,031	86	129	191
Indonesia	2000	5,393	18	48	101
Nepal	1996	2,645	37	56	87
Pakistan	2001	9,887	73	114	176
Vietnam	1998	4,220	87	143	237
Eastern Europe					
Albania	2005	1,636	473	808	1420
Bulgaria	2001	877	194	378	545
Latin & Central America					
Ecuador	1995	2,474	164	307	581
Guatemala	2000	3,832	126	225	399
Nicaragua	2001	1,824	137	239	407
Panama	2003	2,928	264	574	1180
Merged Data		70,557	68	121	210

Table 3. Participation and shares of income earned

Region/Country	Agricultural production		Agricultural wage		Non-Ag wage		Non-Ag self employment		Transfers and other	
	participation	share	participation	share	participation	share	participation	share	participation	share
Africa										
Ghana	88.8%	0.603	3.7%	0.014	17.5%	0.093	40.0%	0.164	48.4%	0.101
Madagascar	95.4%	0.713	26.0%	0.065	18.2%	0.060	21.3%	0.079	49.6%	0.082
Malawi	96.3%	0.523	54.8%	0.158	16.5%	0.089	30.1%	0.112	90.5%	0.118
Nigeria	85.8%	0.719	3.7%	0.019	8.9%	0.067	18.4%	0.095	9.3%	0.023
Asia										
Bangladesh	82.0%	0.188	35.4%	0.196	31.9%	0.195	25.7%	0.158	74.5%	0.262
Indonesia	54.4%	0.261	19.3%	0.095	31.8%	0.199	32.7%	0.168	87.0%	0.242
Nepal	94.4%	0.480	41.6%	0.170	35.1%	0.161	19.9%	0.086	32.2%	0.103
Pakistan	69.7%	0.381	20.0%	0.081	48.5%	0.280	17.8%	0.100	41.2%	0.146
Vietnam	98.5%	0.564	20.0%	0.060	31.7%	0.089	38.4%	0.213	48.4%	0.074
Eastern Europe										
Albania	95.4%	0.430	5.3%	0.026	30.0%	0.178	10.9%	0.071	75.9%	0.296
Bulgaria	76.9%	0.170	16.5%	0.094	20.2%	0.112	2.4%	0.006	90.6%	0.600
Latin & Central America										
Ecuador	88.2%	0.326	39.2%	0.211	34.5%	0.180	38.8%	0.144	61.5%	0.130
Guatemala	89.9%	0.267	42.7%	0.215	34.6%	0.206	30.7%	0.126	66.6%	0.183
Nicaragua	91.6%	0.360	39.5%	0.211	35.4%	0.210	26.2%	0.112	42.9%	0.106
Panama	82.3%	0.257	30.4%	0.165	42.1%	0.271	28.3%	0.135	67.5%	0.166
Merged data	85.1%	0.443	24.2%	0.108	29.8%	0.158	24.9%	0.135	47.9%	0.138

Table 4. Elasticities

		Agricultural Production			Agricultural Wage			Non-Agricultural Wage			Non-Agricultural Self Employment			Transfers/Other		
		OLS	Censored	IV	OLS	Censored	IV	OLS	Censored	IV	OLS	Censored	IV	OLS	Censored	IV
Megadata	lnpcincome	**-0.0865**	**-0.0407**	**-0.1203**	**-0.0125**	**0.0020**	**-0.1311**	**0.0852**	**0.0459**	**0.0677**	**0.0771**	**0.0396**	**0.1221**	**-0.1178**	**-0.0482**	**0.0614**
	t-stat	**-33.57**	**-38.6**	**-17.8**	**-7.00**	**1.84**	**-23.8**	**45.20**	**50.14**	**12.5**	**43.70**	**48.49**	**24.1**	**-40.33**	**-31.12**	**7.80**
Ghana	lnpcincome	**-0.0268**	**-0.0149**	**-0.2113**	**0.0093**	**0.0321**	**0.0272**	**0.0441**	**0.0442**	**0.1414**	**0.1003**	**0.0463**	**0.1484**	**-0.2751**	**-0.1088**	0.006
	t-stat	**-3.04**	**-4.66**	**-10.20**	**3.05**	**4.46**	**2.77**	**7.51**	**9.18**	**8.34**	**9.02**	**11.55**	**6.88**	**-11.17**	**-11.55**	0.13
Madagascar	lnpcincome	**0.0383**	**0.0205**	**0.0953**	**-0.0419**	**-0.0247**	**-0.2082**	**-0.1268**	**-0.0533**	**0.1037**	**0.1354**	**0.0732**	-0.0254	**-0.201**	**-0.0931**	**-0.278**
	t-stat	**2.98**	**3.74**	**4.48**	**-2.44**	**-1.80**	**-6.50**	**-7.02**	**-5.04**	**3.93**	**7.32**	**8.46**	-0.84	**-5.03**	**-5.72**	**-4.74**
Malawi	lnpcincome	**0.0816**	**0.0404**	**0.0492**	**-0.1005**	**-0.0417**	-0.0459	**0.072**	**0.041**	-0.0006	**0.0389**	**0.0363**	0.0005	**-0.5525**	**-0.2943**	-0.116
	t-stat	**16.82**	**17.77**	**2.18**	**-16.06**	**-11.23**	-1.59	**21.67**	**22.07**	-0.04	**9.38**	**13.80**	0.02	**-36.05**	**-54.63**	-1.57
Nigeria	lnpcincome	**-0.0761**	**-0.0251**	**-0.1452**	**0.0274**	**0.0392**	-0.0083	**0.0472**	**0.0262**	**0.0649**	**0.0453**	**0.0228**	**0.1187**	**-0.0351**	**-0.003**	**0.059**
	t-stat	**-25.88**	**-28.23**	**-16.10**	**11.25**	**14.14**	-1.56	**20.59**	**19.60**	**9.57**	**15.88**	**17.65**	**11.40**	**-6.75**	**-0.74**	**4.43**
Bangladesh	lnpcincome	**-0.3701**	**-0.1919**	**0.1059**	**-0.1193**	**-0.047**	**-0.4037**	**0.0748**	**0.0349**	**-0.0739**	**0.1183**	**0.0485**	**0.1277**	**0.1049**	**0.0741**	**0.459**
	t-stat	**-14.03**	**-16.31**	**2.46**	**-9.57**	**-10.25**	**-17.20**	**9.37**	**8.92**	**-3.41**	**11.97**	**12.42**	**6.48**	**5.01**	**8.00**	**11.90**
Indonesia	lnpcincome	**-0.0586**	**-0.0137**	**-0.2072**	**0.0254**	**0.0168**	**-0.1216**	**0.1131**	**0.0635**	**0.0493**	**0.0815**	**0.0514**	**0.1947**	**-0.3507**	**-0.227**	**0.122**
	t-stat	**-6.38**	**-4.94**	**-6.75**	**6.19**	**6.11**	**-5.52**	**15.23**	**23.04**	**2.19**	**13.06**	**16.83**	**7.25**	**-21.67**	**-32.65**	**2.28**
Nepal	lnpcincome	**-0.1967**	**-0.1084**	**0.1058**	**-0.0788**	**-0.0368**	**-0.4290**	**0.1188**	**0.0691**	-0.0445	**0.1187**	**0.0743**	**0.1877**	**0.1013**	**0.0889**	**0.189**
	t-stat	**-11.02**	**-11.96**	**2.25**	**-4.52**	**-3.91**	**-8.78**	**8.00**	**7.97**	-1.17	**7.50**	**8.25**	**4.95**	**5.26**	**7.68**	**3.99**
Pakistan	lnpcincome	0.0148	0.0016	**0.2755**	**-0.0278**	0.0011	**-0.1362**	-0.0077	**0.0049**	**-0.2140**	**0.0537**	**0.0258**	0.0065	**-0.0484**	**-0.0172**	**0.068**
	t-stat	1.35	0.65	**10.70**	**-5.48**	0.34	**-7.76**	-1.07	**2.28**	**-9.44**	**11.10**	**11.23**	0.49	**-7.06**	**-4.95**	**3.91**
Vietnam	lnpcincome	**-0.3489**	**-0.2141**	**-0.3594**	**-0.0562**	**-0.0321**	**-0.0720**	0.0115	**0.0386**	**0.0636**	**0.3926**	**0.1981**	**0.3275**	**-0.0723**	-0.0148	**0.112**
	t-stat	**-34.45**	**-37.95**	**-17.00**	**-6.03**	**-4.42**	**-3.27**	1.38	**4.88**	**2.18**	**40.55**	**40.77**	**17.00**	**-5.28**	-1.63	**3.20**
Albania	lnpcincome	**-0.3635**	**-0.2593**	**-0.2463**	**0.034**	**0.0393**	-0.0150	**0.1477**	**0.0781**	**0.0684**	**0.1628**	**0.0987**	**0.1653**	**-0.0844**	**-0.0405**	**-0.056**
	t-stat	**-17.79**	**-20.04**	**-5.93**	**3.43**	**3.91**	-0.77	**9.22**	**10.37**	**2.05**	**10.95**	**11.57**	**7.02**	**-3.75**	**-2.85**	**-1.15**
Bulgaria	lnpcincome	-0.0433	0.0092	**0.5000**	**0.1431**	**0.0854**	**0.1200**	**0.1428**	**0.1041**	**0.2067**	**na**	**na**	**na**	**-0.2386**	**-0.1472**	**-0.479**
	t-stat	-0.70	0.42	**3.58**	**7.44**	**7.88**	**3.03**	**7.45**	**8.42**	**4.53**				**-5.98**	**-13.81**	**-7.86**
Ecuador	lnpcincome	**-0.1574**	**-0.0716**	-0.0480	**0.0308**	**0.0181**	**-0.2073**	**0.0558**	**0.0371**	0.0152	**0.083**	**0.0453**	**0.2169**	**-0.0683**	**-0.0072**	**0.143**
	t-stat	**-7.99**	**-10.52**	-1.22	**3.06**	**4.19**	**-6.16**	**6.48**	**7.71**	0.55	**6.41**	**7.74**	**6.33**	**-2.65**	**-0.64**	**2.70**
Guatemala	lnpcincome	**-0.3576**	**-0.2021**	**-0.3529**	**0.0192**	**0.0101**	**-0.2952**	**0.1693**	**0.0785**	**0.2817**	**0.1358**	**0.0878**	**0.2558**	**-0.1623**	**-0.0774**	-0.010
	t-stat	**-20.66**	**-21.42**	**-9.14**	**1.87**	**1.98**	**-9.88**	**16.97**	**16.80**	**11.50**	**11.96**	**13.39**	**8.77**	**-7.65**	**-7.65**	-0.24
Nicaragua	lnpcincome	**-0.2103**	**-0.1027**	0.0191	-0.0032	0.0022	**-0.3304**	**0.0867**	**0.0365**	**0.1100**	**0.1059**	**0.0665**	**0.2163**	0.0091	**0.0262**	0.034
	t-stat	**-10.52**	**-10.59**	0.41	-0.23	0.35	**-7.94**	**6.45**	**5.99**	**3.49**	**6.93**	**7.95**	**6.46**	0.41	**1.85**	0.61
Panama	lnpcincome	**-0.3795**	**-0.2206**	**-0.4312**	**0.0554**	**0.0243**	**-0.0863**	**0.1529**	**0.0784**	**0.1697**	**0.0668**	**0.0406**	**0.1323**	**-0.1379**	**-0.045**	**0.096**
	t-stat	**-24.25**	**-26.03**	**-16.20**	**7.21**	**6.12**	**-4.52**	**18.92**	**18.31**	**10.50**	**7.83**	**8.84**	**6.89**	**-6.51**	**-4.53**	**3.00**

Figure 1. Elasticities of share of income by level of development (censored results)

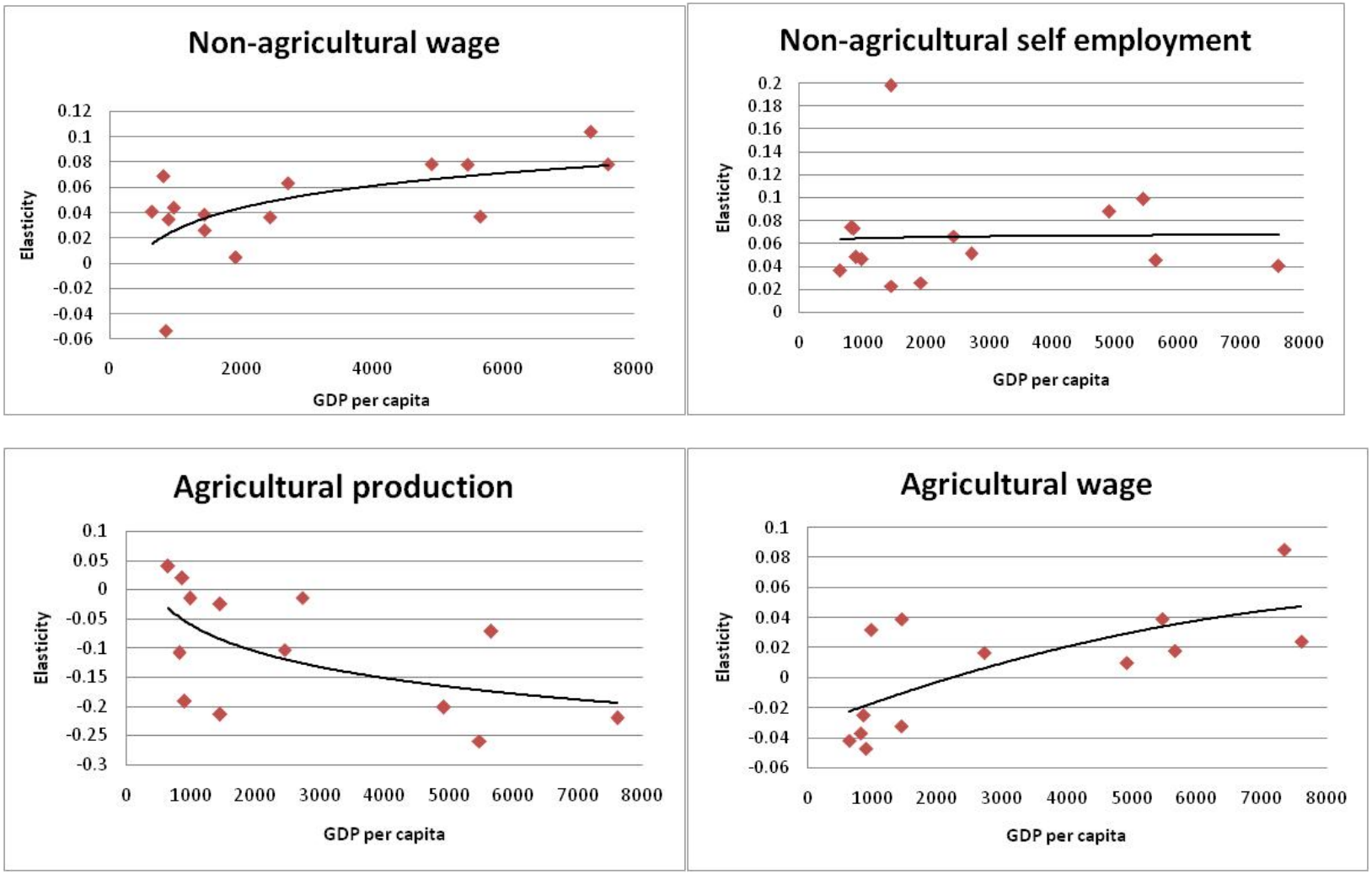


Figure 2. Patterns of rural development (censored analysis of megadata)

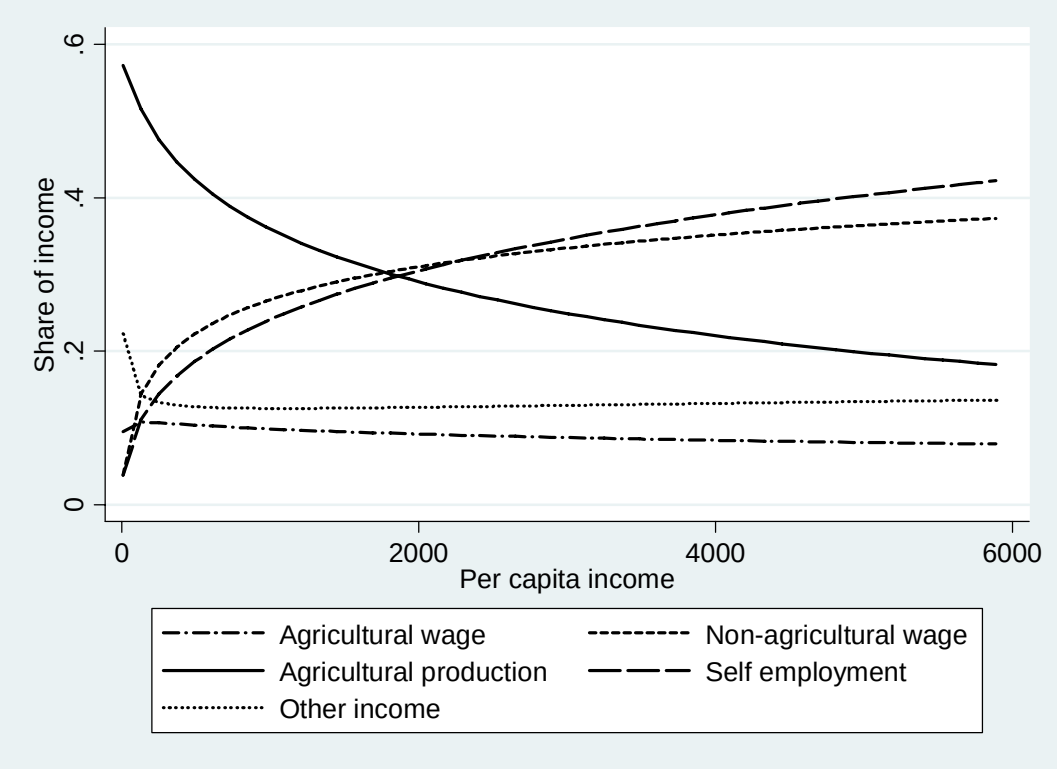
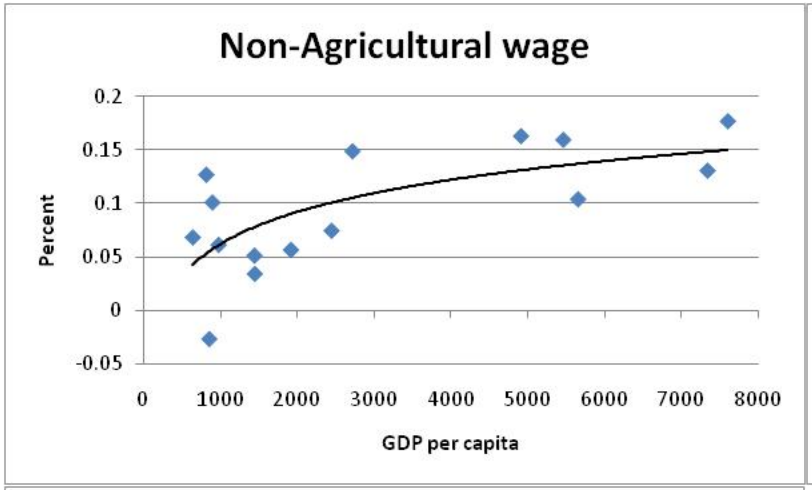
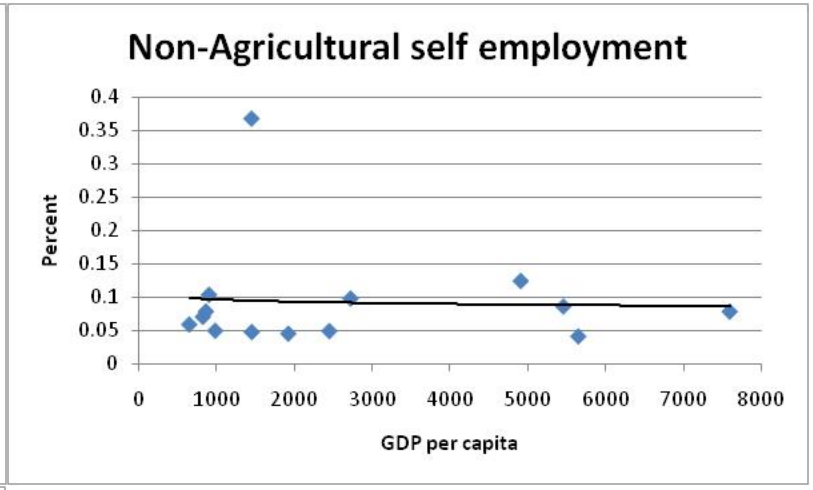


Figure 3. Participation rates in rural income generating activities by level of development (probit results)





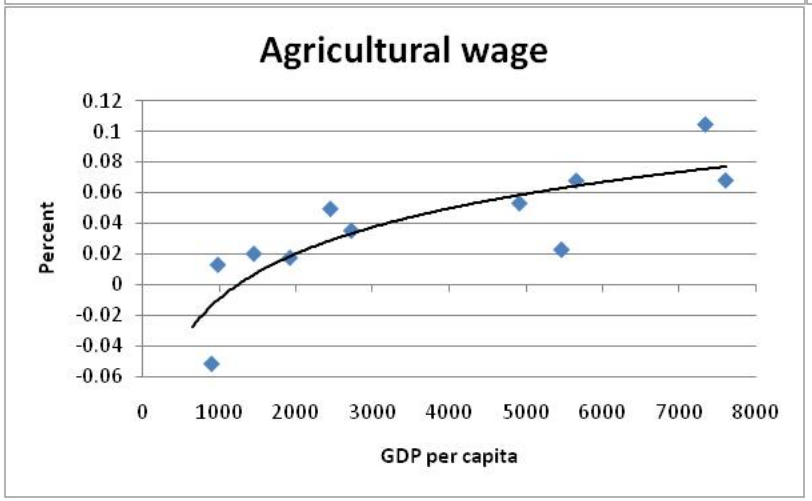
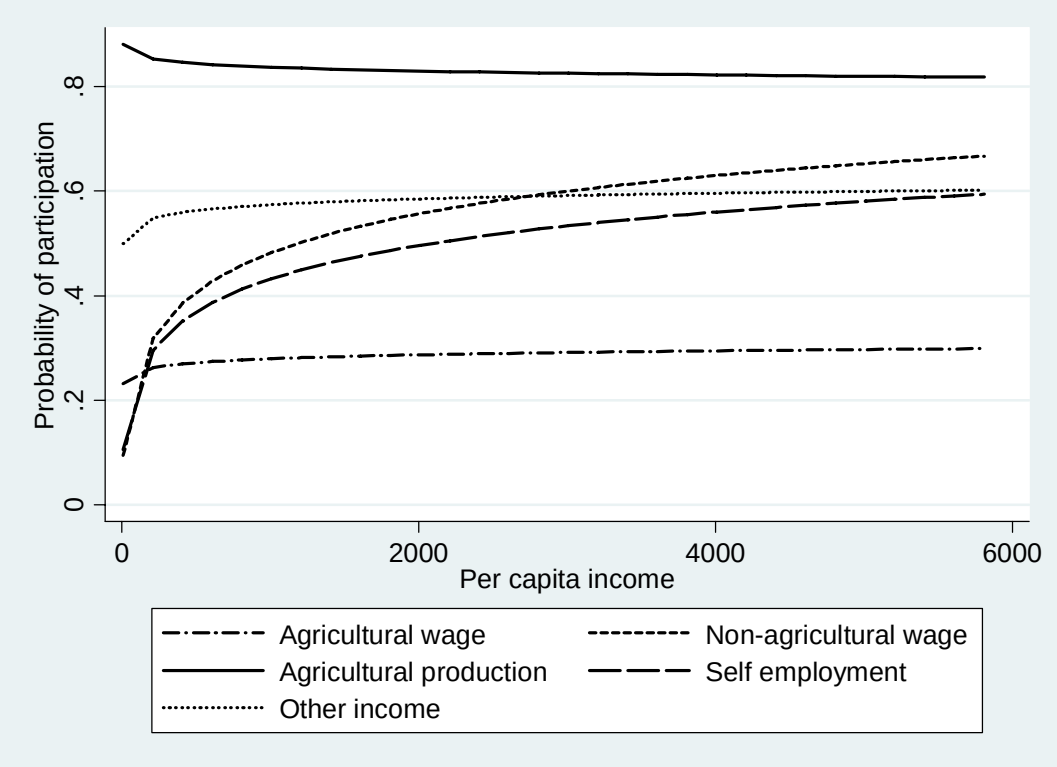


Table 5. Probits

		Agricultural Production		Agricultural Wage		Non-Agricultural Wage		Non-Ag. Self Employment		Transfers/Other	
		Probit	IV Probit	Probit	IV Probit	Probit	IV Probit	Probit	IV Probit	Probit	IV Probit
Megadata	lnpcincome	**-0.0001**	**-0.141**	**0.0141**	**-0.356**	**0.0935**	**0.129**	**0.0741**	**0.286**	**0.0197**	**0.143**
	t-stat	**-5.31**	**-6.67**	**8.81**	**-19.1**	**51.94**	**7.37**	**43.59**	**17.6**	**8.95**	**8.36**
Ghana	lnpcincome	**0.0003**	**-0.289**	**0.0133**	**0.313**	**0.0607**	**0.303**	**0.0505**	**0.286**	**0.0181**	0.00841
	t-stat	**3.57**	**-2.88**	**4.80**	**2.74**	**10.65**	**3.79**	**6.50**	**4.72**	**2.22**	0.12
Madagascar	lnpcincome	**na**	**na**	-0.0024	**-0.453**	**-0.0274**	**0.137**	**0.0791**	**-0.312**	0.0162	-0.0776
	t-stat			-0.20	**-5.97**	**-2.74**	**1.67**	**7.12**	**-3.71**	1.17	-0.89
Malawi	lnpcincome	**0.0076**	-0.121	-0.0015	0.0212	**0.0677**	0.0506	**0.0597**	-8.20E-05	0.003	-0.00515
	t-stat	**5.66**	-1.30	-0.41	0.43	**23.04**	0.82	**16.51**	0.00	1.40	-0.07
Nigeria	lnpcincome	**na**	**na**	**0.0205**	0.0182	**0.0336**	**0.41**	**0.0485**	**0.424**	**0.0053**	**0.337**
	t-stat			**16.33**	0.30	**22.99**	**7.78**	**17.68**	**10.90**	**2.76**	**6.14**
Bangladesh	lnpcincome	-0.0052	**-0.128**	**-0.0514**	-0.837	**0.1004**	-0.0751	**0.1041**	**0.296**	**0.0842**	**0.445**
	t-stat	-1.02	**-1.74**	**-4.94**	-12.00	**8.89**	-1.19	**10.24**	**4.69**	**9.17**	**7.54**
Indonesia	lnpcincome	**0.0205**	**-0.135**	**0.0356**	**-0.605**	**0.1483**	-0.135	**0.0985**	**0.441**	**0.0094**	**0.493**
	t-stat	**3.75**	**-1.84**	**7.89**	**-5.80**	**21.75**	-1.52	**15.60**	**5.91**	**3.47**	**5.44**
Nepal	lnpcincome	**na**	**na**	-0.0131	**-0.59**	**0.1263**	**-0.212**	**0.0713**	0.0487	**0.116**	**0.544**
	t-stat			-0.88	**-5.12**	**8.29**	**-1.89**	**5.95**	0.4	**7.97**	**3.61**
Pakistan	lnpcincome	**0.0034**	**0.233**	**0.0179**	**-0.259**	**0.056**	**-0.42**	**0.0461**	0.0279	**-0.0217**	**0.403**
	t-stat	**2.66**	**4.50**	**3.53**	**-4.78**	**8.45**	**-8.49**	**9.90**	0.50	**-3.29**	**7.21**
Vietnam	lnpcincome	**-0.0005**	**-0.483**	-0.0089	-0.0161	**0.0507**	0.028	**0.3668**	**0.307**	**0.0202**	**-0.16**
	t-stat	**-2.18**	**-2.79**	-1.27	-0.20	**5.75**	0.39	**27.95**	**3.69**	**2.16**	**-1.99**
Albania	lnpcincome	-0.0026	**0.506**	**0.0232**	-0.0214	**0.159**	**0.368**	**0.0866**	**0.982**	**0.0295**	**0.574**
	t-stat	-1.41	**-2.33**	**4.67**	-0.12	**10.52**	**3.40**	**11.20**	**6.59**	**2.46**	**5.20**
Bulgaria	lnpcincome	0.003	**0.633**	**0.105**	0.421	**0.1302**	0.189	**na**	**na**	0.0053	**-0.61**
	t-stat	1.38	**2.04**	**7.48**	1.28	**7.79**	0.57			0.90	**-1.77**
Ecuador	lnpcincome	**-0.0012**	**-0.221**	**0.0682**	**-0.372**	**0.1034**	-0.0459	**0.0421**	**0.237**	**0.0443**	0.127
	t-stat	**-2.53**	**-2.04**	**6.57**	**-4.13**	**9.25**	-0.52	**4.09**	**2.95**	**4.58**	1.62
Guatemala	lnpcincome	**-0.0003**	**-0.464**	**0.0535**	**-0.629**	**0.1625**	**0.385**	**0.1246**	**0.31**	0.0101	**0.331**
	t-stat	**-4.17**	**-4.44**	**5.02**	**-7.2**	**14.54**	**4.86**	**12.47**	**3.97**	1.10	**2.37**
Nicaragua	lnpcincome	**na**	**na**	**0.0498**	**-0.47**	**0.0739**	0.107	**0.0499**	**0.464**	**0.0393**	0.0761
	t-stat			**3.37**	**-4.42**	**5.16**	1.02	**4.29**	**4.31**	**2.72**	0.71
Panama	lnpcincome	**na**	**na**	**0.0684**	**-0.236**	**0.1764**	**0.331**	**0.079**	**0.277**	**0.037**	**0.528**
	t-stat			**7.21**	**-3.67**	**15.34**	**5.42**	**8.61**	**4.83**	**4.51**	**6.77**

Figure 4. Patterns of rural development--participation (probit on megadata)



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Agricultural Development Economics Division (ESA)
The Food and Agriculture Organization
Viale delle Terme di Caracalla
00153 Rome
Italy

Contact:
Office of the Director
Telephone: +39 06 57054358
Facsimile: + 39 06 57055522
Website: www.fao.org/es/esa

e-mail: ESA@fao.org