

## ADB Economics Working Paper Series



### Creating Good Employment Opportunities for the Rural Sector

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Andrew D. Foster

No. 271 | August 2011





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# **Creating Good Employment Opportunities for the Rural Sector**

**Andrew D. Foster**

August 2011

Andrew D. Foster is Professor of Economics and Community Health, Director of Population Studies and Training Center, Brown University. This paper was prepared as background material for the theme chapter of the *Key Indicators for Asia and the Pacific 2011*. The author is grateful to participants at the workshop, “Creating Quality Employment in Asia”, held 17–18 May 2011, in Manila, Philippines for their comments and suggestions. The author accepts responsibility for any errors in the paper.

**Asian Development Bank**

Asian Development Bank  
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[www.adb.org/economics](http://www.adb.org/economics)

©2011 by Asian Development Bank  
August 2011  
ISSN 1655-5252  
Publication Stock No. WPS113948

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## **Abstract**

This paper examines the potential for sector-specific productivity growth, human capital, credit markets, and infrastructure to contribute to the development of stable, well-paid employment in rural areas of low-income countries. Particular emphasis is placed on the way that different sectors of the rural economy interact with each other and with local and regional product markets. A simple theoretical framework and descriptive analysis of panel data from India suggests that more emphasis should be placed on increasing the production of goods that incorporate local agricultural products as inputs.





## I. Introduction

Despite increasing urbanization in Asia countries, a large fraction of Asia's poor remain in rural areas. Many of these individuals work in casual labor markets in both the agricultural and nonagricultural sectors in which there are few returns to skill and labor market experience, and where earnings are thus limited by the marginal product of manual labor. Given overall supply and demand conditions, the return to this labor may not generate household earnings that are sufficient for a household that includes nonworking dependents to rise above the poverty line. While a system of transfers to low-income households may reduce poverty at least over the short term, such transfers provide a major drag on state budgets and may preclude the state from making productive investments in public resources that lead to long-term sustainable growth and development. On this basis it would seem desirable to better understand the nature of rural earnings growth with a view to how best to promote well-paying employment.

A great deal has been learned about the process of rural earnings determination in the last decade in large part because of the increased availability of long-term panel data sets that combine detailed household-level data with information on village characteristics and infrastructure. While there are some important differences in terms of patterns of change that may in large part reflect differences in the policy environment and openness to markets of different areas, the conclusions as a whole provide a consistent pattern and are generally supportive of economic models of competitive labor markets, in which wages are affected by local supply and demand and workers and employers allocate resources in response to economic returns. This consistency is useful because it provides a framework for considering alternative policy options.

Ultimately, allocation of public effort requires an empirical understanding of magnitudes of different policy effects. But even in the presence of detailed observational panel data, it is not so clear that one can uncover even internally valid estimates of policy effects. While experimental data can increase internal validity it often does so at the expense of external validity and is generally not well suited to capturing the kind of general equilibrium effects that are central to changing the returns to labor. Given the large flexibility in village labor markets and increasing mobility across villages, a very large experiment would be needed to determine whether a particular exogenously introduced experimental intervention actually has the desired effects. Multiple experiments of this sort would be necessary in order to determine the relative efficacy of different policy environments. Moreover, neither experimental nor nonexperimental data sets, nor to some extent, a competitive framework, is particularly well suited to uncovering the process of

occupational diversification and expansion in scale economies, which is central to the process of economic development and arguably must ultimately be the source of rising rural earnings. As a result, while understanding off-farm rural employment has improved substantially in the last 20 years, there are important limits to what we know and, in a sense, to what we can know.

This paper provides a brief and somewhat parochial discussion emphasizing recent evidence by development economists examining expansion of rural employment and earnings. Central to this paper is the idea that an expansion of good jobs in rural areas is about increasing the productivity of rural workers. Ultimately workers will have stable and reasonably well-paid employment if they have explicit or implicit ownership of productive assets. These assets include their own labor, of course, but can also include physical assets such as land, financial assets such as access to working capital, human assets such as education or experience, public assets such as access to electricity or low-cost transportation infrastructure, or social assets such as the ability to organize and coordinate other people. Moreover, how the returns to these different assets change depends importantly on the composition of local employment; the extent to which product and labor markets are integrated with the wider world; as well as access to credit markets, effective transportation, and other forms of basic infrastructure. In particular, the implications of farm and nonfarm productivity growth are quite different depending on whether nonfarm activity is present at all and, if so, whether it is dominated by the provision of local services, the production of tradable factory-produced goods, or the production of value-added goods in agriculture.

The organization of the paper is as follows. Section II briefly discusses some recent empirical evidence on technology and rural nonfarm employment, then presents a framework for the process of rural employment change based in large part on the model in Foster and Rosenzweig (2005). In the context of effects of productivity growth on rural employment, three alternative sources of nonfarm rural employment are examined: value-added production in agriculture, expansion in the production of local services and other nontradable goods, and expansion in the production of manufactured tradable goods. In each case sources of growth are identified, as well as particular aspects of these sectors that are likely to increase worker productivity. The paper briefly examines data on almost 40 years of household earnings in rural India, extending the model to consider the implications of human capital (Section III), credit markets (Section IV), and infrastructure (Section V). Section VI concludes by examining the relative potential for employment generation and productivity growth in each of the different sectors.

## II. Technology

One of the most basic issues that is debated in the literature on rural employment is the question of whether agricultural productivity growth is sufficient to generate good jobs in rural areas, either directly or through its effects on nonfarm employment. Put another way, is investment in productivity growth in agriculture, particularly among small farmers, the most effective mechanism to improve rural employment? An important element of this debate relates to the role of agricultural productivity growth in producing employment in other sectors. Here there seems to be some divergence in the literature. Foster and Rosenzweig (2004 and 2005), for example, provide evidence that improvements in agricultural productivity result in a significant reduction in nonfarm employment. In particular they find that a 10% increase in yields of high-yielding variety crops over the 1982–1999 period results in a 16% reduction in the number of factory or manufacturing workers. On the other hand, they find that the number of village service industries is increasing in agricultural productivity. In particular, a 10% increase in agricultural productivity results in a 7.9% increase in the number of village service enterprises. Overall, agricultural productivity has a significant negative effect on nonfarm income. While Felkner and Townsend (2011) do not explicitly consider the distinction between the production of tradable and nontradable services, they find that the level and activity of nonfarm enterprises is highest in those areas that are most productive in terms of agricultural output inclusive of high soil fertility, lower elevation, and less rainfall variability. In particular they find that a 1 standard deviation increase in soil fertility results in an 11% increase in the growth rate of entrepreneurial income.

To make sense of these different results it is helpful to think through a series of models of rural labor markets. This approach puts a significant burden on the reader but is critical in terms of bringing to light the basic economic forces at work; it also provides a useful framework in which to consider the implications of other variables that may affect rural employment inclusive of human capital, credit markets, and infrastructure. The models contrast four sectors. The first sector is one that produces farm products for both local consumption and export (to other villages). This sector would include basic food crops such as grains and vegetables but could also include raw materials such as cotton. A key feature of this sector is that it is intensive in the use of land. The other sectors would, for the most part, be considered nonfarm. A basic list of nonfarm establishments, how they are categorized by sector, and their prevalence and employment in rural India in 2007 from the ARIS-REDS data used by Foster and Rosenzweig (2004 and 2005) are provided in Table 1. The second sector is one that provides basic local services that are consumed locally and includes such activities as tailor, tea houses, and bicycle repair. As one might expect, given the focus on providing for local needs, most of these establishments are present in the vast majority of villages, though employment per village is modest.

The third sector is manufacturing. Factory employment is only observed in about half of villages, but where such employment is observed, the level of employment is reasonably

high. It is also worth noting that many of these factories are located outside of the villages and employ workers from a large catchment area. Average total employment in “factory” establishments that employ village workers is 479, while the number of workers employed in a particular village with some employment in a factory is 26.4 (Table 1).

**Table 1: Establishments and Employment in ARIS-REDS Villages, India, 2007**

<b>Establishment Type</b>	<b>Activity Type</b>	<b>Villages with Workers in This Establishment Type (%)</b>	<b>Average Village Employment in This Establishment Type</b>
Factory	Manufacture	0.53	26.4
Lime kiln	Manufacture	0.08	8.4
Brick kiln	Manufacture	0.59	25
Bakery	Service	0.64	5.2
Bicycle repair	Service	0.98	3.7
Vehicle repair	Service	0.84	5.3
Tea shop	Service	0.98	8.2
Eating House	Service	0.85	7.4
Tailor	Service	0.99	5.4
Blacksmith	Service	0.92	3.3
Mason	Service	0.88	13.0
Carpenter	Service	0.97	5.7
Cobbler	Service	0.62	2.7
Potter	Service	0.59	6.3
Handicraft	Service	0.19	6.5
Washerman	Service	0.85	6.8
Barber	Service	0.99	4.7
Cinema	Service	0.49	3.1
Vegetable shop	Service	0.93	6.5
Grocery shop	Service	0.95	6.8
Public call office	Service	0.96	6.7
Weaver	Value added	0.22	45.1
Grain dryer	Value added	0.21	10.0
Rice huller	Value added	0.68	6.2
Flour mill	Value added	0.89	3.5
Raw sugar (Gur)	Value added	0.18	28.5
Processed sugar (Kha.)	Value added	0.09	12.4
Vegetable oil extraction	Value added	0.58	4.2
Dairy farm	Value Added	0.45	4.5
Poultry farm	Value Added	0.34	5.0
Pig farm	Value Added	0.20	4.0

Sources: Author’s calculations; Rural Economic and Demographic Survey, National Council of Applied Economics Research (2007).

The fourth sector is focused on value-added production—i.e., processing of agricultural goods for local or more distant markets. This sector includes grain mills and sugar making, and less conventionally, pig, dairy, and poultry farms. While these sectors would normally be considered farm products, from a modeling standpoint, they have much in common with more traditional value-added work. In particular, they can be used to turn locally grown crops into higher-value products such as meat and milk, and they need not be highly land-intensive.

Unfortunately the REDS 2007 survey, on which Table 1 is based, does not distinguish clearly between value-added processing or manufacturing for the local market and for more distant markets, a distinction that will be important in the model below. Nor does it distinguish whether local inputs are used in production. Certainly bricks are largely being produced for the local market and thus sensitive to local demand. Weaving may be a small-scale activity for producing simple textiles for home use; or it may involve manufacture of textiles for exports. Also, weaving may make use of locally grown raw materials such as cotton but it also may import materials from elsewhere.

Overall, based on this categorization in the ARIS-REDS villages, 53% of nonfarm establishment-based workers are in services, 34.4% in manufacturing, and the remaining 12% in value-added production. This amounts to just over 94.6 village workers per village that averages 668 households. Given the interest in good and steady employment in rural areas, this focus on establishments seems appropriate, but it also should be noted that it substantially understates the contribution of nonfarm work to income. In particular, using household data from 1999, Foster and Rosenzweig (2004) report that 41% of income arises from nonfarm sources. The difference reflects the higher earnings in some nonfarm jobs and the fact that some nonfarm work is casual or carried on within the household on a part-time basis and is thus not linked to particular establishments.

Turning now to theory, a simple market is assumed, in which all labor is allocated to agricultural (crop) production, all goods are traded at fixed prices, and all households are of equal size with land area. In particular, agricultural profits are assumed for a representative household to be

$$y_g = \theta_g \alpha f_g(l_g / a) - w l_g \quad (1)$$

where  $\theta_g$  denotes agricultural technology,  $\alpha$  denotes land,  $w$  denotes the wage, and  $l_g$  denotes agricultural labor. We assume that this household maximizes utility given income and prices by choosing levels of consumption of different goods inclusive of agricultural and manufactured goods. Households are endowed with labor  $l$  so each household has total income

$$y_g + w l \quad (2)$$

Agricultural and manufactured tradable goods are exchanged at world prices. The commodity balance for agricultural good dictates that

$$c_g(y, p) + \chi_g = \theta_g a f(l/a) \quad (3)$$

where  $c_g(y, p)$  denotes agricultural good consumption a function of income and prices and  $\chi_g$  denotes net exports of agricultural goods. Given that at this point there are no locally produced factory goods, all such goods must all be imported

$$c_m(y, p) + \chi_m = 0 \quad (4)$$

Given that all goods are traded with the outside world, the local and external prices are the same, and the equilibrium wage is determined by the marginal productivity of labor in agriculture when all workers are employed in that activity. That is,

$$p_g \theta_g f'(l/a) = w \quad (5)$$

It immediately follows that a doubling of agricultural productivity  $\theta_g$  doubles wages. The only other way to have wage growth is to increase labor per unit of land either by expanding land by decreasing the number of households, or by decreasing the number of workers per household. At least in the present of the constant returns to scale technology posited above, and because prices are set globally, a change in the distribution of land by, for example, allocating all land to a fraction  $\rho_A$  of households does not affect the wages, though of course it does affect incomes because all profits would be allocated to the landed households.

It is important to note that the fixed nature of land is critical to the above model. As a result, expanding rural wages without overall reductions in the quantity of rural labor would seem to be difficult without the introduction of a nonfarm sector. In general, as noted, the data suggest that there are three distinct sources of nonfarm rural employment with distinct implications for rural employment: local provision of nontradable services, manufacture of tradable goods, and value-added production of agricultural goods.

The nontradable service sector in rural areas of low-income countries may generally be thought of as relatively labor-intensive small family firms (Foster and Rosenzweig 2005). To capture the main implication of this sector we suppose that labor is the only input into this sector and that the sector exhibits constant returns to scale in labor, so profits are

$$y_s = p_s \theta_s l_s - w_s l_s \quad (6)$$

Demand for these services is  $c_s(y, p)$ . Because this good is not traded, the price for service goods, along with the wage, must be determined endogenously, balancing the demand and supply of service and equating the marginal revenue product of labor.

That is,  $c_s(y, p) = \theta_s l_s$  and  $p_s \theta_s = w = p_g f'(l_g / a)$ . Moreover, because a competitive labor market ensures services sector profits are zero in equilibrium, household income is just  $p_g a f(l_g / a) + w l_s$ .

In the special case of Cobb-Douglas preferences with service good share  $\beta$  the expenditure share is constant. So the labor allocated to agriculture is independent of agricultural technology and there is a unit elasticity of the wage with respect to that technology. Conversely, if the share of the service goods in consumption increases with income, as seems plausible, then the wage will rise more than proportionately with technology. Expansion in the technology of production in the service sector tends to push labor out of the service sector because demand is fixed locally. In particular, for Cobb-Douglas preferences an increase in service sector technology means that the price of labor and the price of the service good falls, agricultural labor rises, and agricultural profits increase. In contrast to the case of the pure agricultural market, changes in the fraction of the poor will affect the equilibrium wage if landless and landed households consume different shares of the service good. If the income share of service goods grows with income the equilibrium wage will be lower when land is distributed more equitably, although of course the redistribution of profits will have salutary effects on equity.

Now consider the addition of a mobile capital sector that produces tradable goods. In particular assume that the profits in the factory or manufacturing sector are

$$y_m = p_m \theta_m k_m f_m(l_m / k_m) - w(1 + l_m / \delta_m) l_m - r k_m, \quad (7)$$

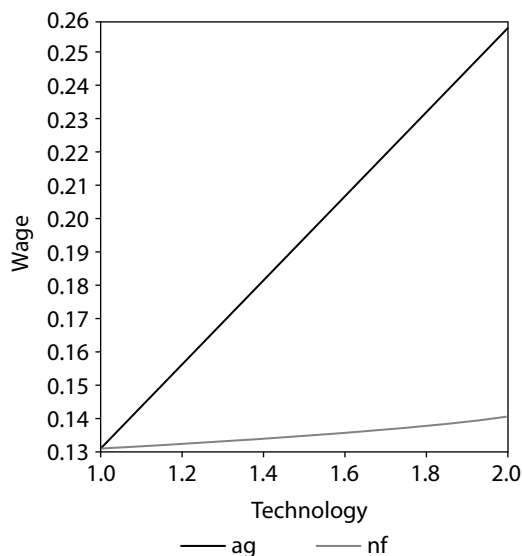
where these profits accrue to external owners of the capital and thus do not affect household income and therefore consumption in the village except through the wage. Note that capital is assumed to be supplied perfectly elastically but that there are increasing marginal costs of labor. This latter assumption is made for technical reasons (otherwise capital jumps discretely when the wage falls below a profitability threshold) but might be thought of as reflecting differential suitability of workers for this activity, logistical issues associated with employing a large number of workers or, as is the case in India (Foster and Rosenzweig 2005), increased legal structures that apply to larger employers.

A key element of this profit function is that the entry of capital depends on the price of labor, for example, if  $f_m(x) = x^{\alpha_m}$  then  $l_m = \kappa_1 - \kappa_2 w$ . As a result the effects of increases in agricultural productivity on the wage may be somewhat lower than they would be in the absence of endogenous entry of factory capital. As agricultural productivity pushes up the demand for labor there is exit of external capital and factory labor declines, although how the wages change depends importantly on what happens in the nontraded service sector.

While closed form results cannot be obtained for this model, simulations using parametric models can be useful in terms of understanding the basic nature of economic forces that arise in the presence of factories financed with external capital. In particular

we assume the production function for manufactures and agriculture are Cobb-Douglas with labor share at one half and consumption share of service goods at one third. Shares of other goods are not relevant because prices of these goods are determined externally. The tradable factory and goods prices and the cost of capital are then set to 1, each household is endowed with 1 unit of land and 30 units of labor, and the increasing returns to labor parameter  $\delta_m$  is set to 1 as well. The effects of increases from 1 to 2 in the technology for agriculture and for factory tradables are simulated separately, keeping in each case the productivity of the other technologies at 1. The results appear in Figures 1–3. As seen in Figure 1, a doubling of agricultural technology leads to a doubling of the wage and substantial reduction in the factory labor force (Figure 2). The effects of an increase in factory technology on factory labor are large as expected but the effects on the wages are surprisingly modest. This latter result is best understood with reference to Figure 3, which plots household income, and illustrates the importance of the nontradable sector. In particular, as agricultural land is locally owned, an expansion in profits substantially increases income. This increases demand for the nontraded goods, bidding up the price of services that help support the increase in wages. On the other hand, as factory capital is assumed to be externally financed, there is limited feedback in terms of growth in demand for local services arising from growth in this sector. Of course this result is somewhat sensitive to the assumption that factory profits do not accrue to local residents. If businesses were locally owned then any profits that are generated would feed back into income. However, since unlike land, capital is flexible and externally traded, assuming competitive entry, profits net of finance costs will be small—only arising in this case because of the increasing cost of employment.

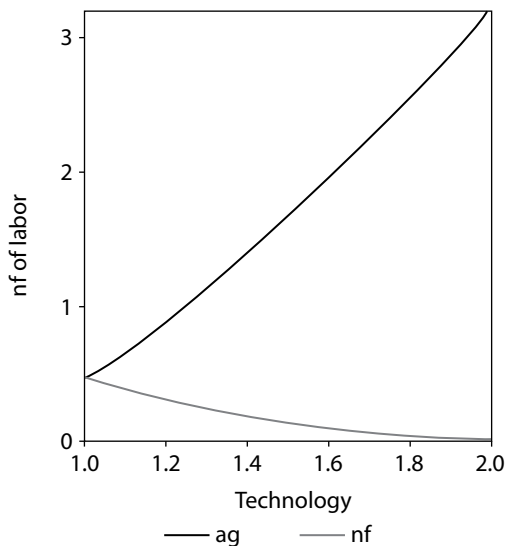
**Figure 1: Simulated Effects of Agricultural and Factory Technology on Wages**



Ag = agriculture, nf = nonfarm.  
Source: Author's calculations.

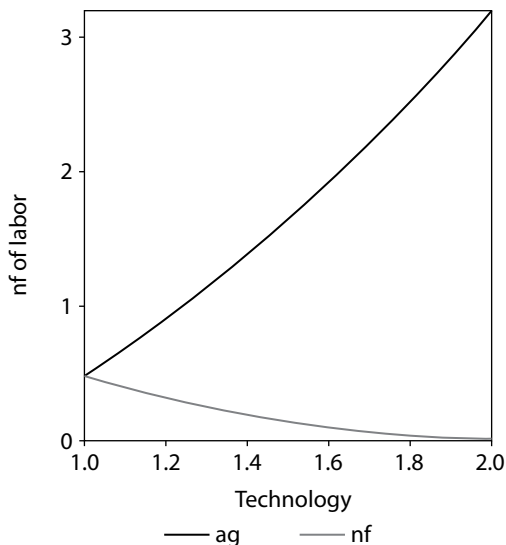


**Figure 2: Simulated Effects of Agricultural and Factory Technology on Factory Employment**



Ag = agriculture, nf = nonfarm.  
Source: Author's calculations.

**Figure 3: Simulated Effects of Agricultural and Factory Capital on Income**



Ag = agriculture, nf = nonfarm.  
Source: Author's calculations.

Another way of looking at this model is that it shows that entry of manufacturing capital provides an alternative mechanism for expanding rural employment in areas with relatively stagnant agriculture, for example, as a consequence of poor soil or climatic conditions. But this finding raises the alternative question of whether it is possible for nonfarm employment in the production of tradable goods to be complementary with good

agricultural conditions. In particular, the notion that growth in agriculture can lead to the expansion of value-added production in agriculture needs also to be considered.

In order to capture value-added production that is complementary with agricultural production, two aspects of factory and capital need to be adjusted. First, agricultural goods should be an input in the production process and second, prices of agricultural commodities must be lower in higher-productivity areas so that it is advantageous for value-added industries to locate in those areas despite relatively high prevailing wages. In order to create such low prices, given the assumption that agricultural goods are generally tradable, one needs a degree of friction in the agricultural product market.

Thus the model is augmented to assume that it is costly to transport agricultural commodities. In particular, the profitability of transporting agricultural goods from the local market to the outside world is the value of the output on world markets minus the value on domestic markets minus a figure reflecting output lost in transit:

$$(p_g^* - p_g)\chi_g - \chi_g^2 / \delta_g \quad (8)$$

where the superscript \* denotes world prices. It is assumed for simplicity that there is free entry into the export business and that the loss is based on total goods exported (rather than amount per exporter), so that in equilibrium, the zero profit condition dictates

$$\chi_g = (p_g^* / p_g - 1)\delta_g \quad (9)$$

This equation applies in principle to both net exports and net imports in the sense that in the presence of net imports the world price will be less than the agricultural price. The equilibrium condition balancing trade in agricultural goods is

$$c_g(y, p) + (p_g^* / p_g - 1)\delta_g + i_g = \theta_g af(l_g / a) \quad (10)$$

where  $i_g$  denotes the amount of agricultural input used as an input in value-added production.

To keep the model relatively simple, it is assumed that value-added goods can be bought and sold at world prices. This assumption, of course, creates a bias in favor of exporting value-added goods relative to directly trading agricultural goods. In practice, there would also be some cost to exporting value-added goods (and importing manufactured ones), and the relative size of the value-added sector would depend on the relative transportation costs of agriculture and value-added goods. In fact, however, the notion that processed agricultural goods are cheaper to transport than are raw materials seems defensible and is, in any case, necessary to understand why on-site value-added production may be an important source of rural employment growth.

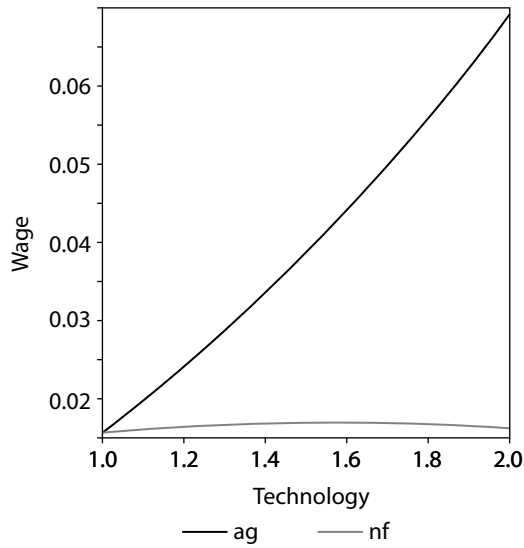
It is further assumed that value-added labor and agricultural inputs are perfect complements in the production of value-added services with a fixed ratio  $i_g / l_v = \mu$ . This assumption aids tractability and has minimal impact on the conclusions of the model, except that it shuts down one margin of adjustment in the value-added sector. In particular, in a more general model, if wages rise relative to the price of agricultural goods, one might expect to see increased use of the goods and lower levels of labor. In any case, given the assumption, one may write profits in the value added sector as

$$y_v = p_v \theta_v k_v f_v(l_v / k_v) - (w + l_v / \delta_v) l_v - p_g \mu l_v - r k_v. \quad (11)$$

The results of the simulated model using the same parameters as before with the addition that  $\mu = 1$  and  $\delta_g = 1$  are presented in Figures 4–6. Figure 4 plots wage growth arising from changes in the productivity of different technologies in the value-added production model. The results are quite different from those in Figure 1. In this case agricultural technology has almost no effect on equilibrium wages while value-added technology growth leads to more than tripling of wages. The reason for this difference is best understood with reference to Figure 5, which plots the local price of the agricultural good. Because of the costs of transporting agricultural goods, an increase in agricultural technology pushes down the local price of the agricultural goods thus offsetting the increases in agricultural productivity arising from technology change. By contrast, an increase in productivity of value-added production increases the demand for agricultural goods to be used as inputs. This bids up the price for agricultural goods and thus leads to an increase in the demand for agricultural labor. Of course, Figure 4 in a way oversells the consequences of agricultural technology on wages, because of the consequences for local prices. If local agricultural products (as opposed to value-added products which, in the model, are fixed at world prices) are a large share of consumption then the large rise in agricultural prices will erode the purchasing power of wage workers, leading in effect to lower increases in the real wage evaluated at local prices.

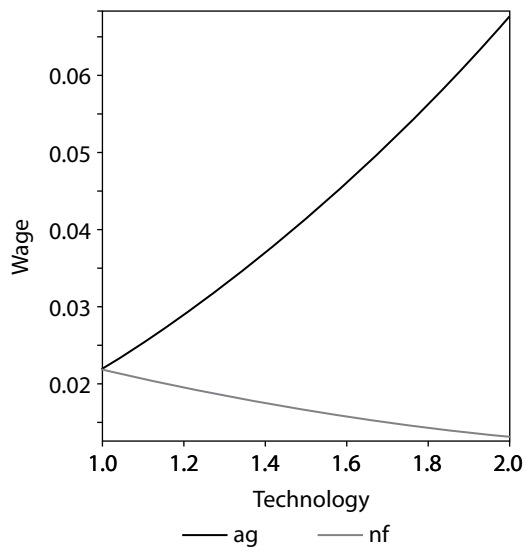
Figure 6 is quite surprising and again quite different from Figure 3. In particular, an expansion in value-added technology results in a modest increase in value-added labor while the corresponding increase in value-added labor arising from an increase in agricultural technology is quite large. This pattern arises because of the importance of the local agricultural goods price in terms of the profitability of value-added technology. If agricultural technology improves, that lowers the price of agricultural goods, thus making value-added production relatively profitable. On the other hand, an increase in value-added technology bids up the price of agricultural goods, as noted, thus drawing more workers back into the agricultural sector.

**Figure 4: Simulated Effect of Agricultural and Value-Added Technology on Wages**



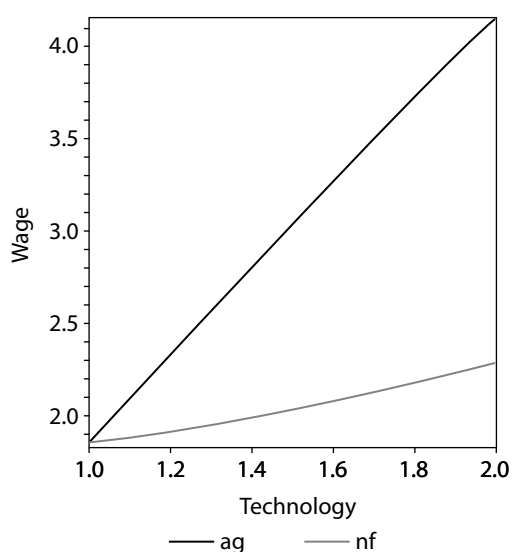
Ag = agriculture, nf = nonfarm.  
Source: Author's calculations.

**Figure 5: Simulated Effects of Agricultural and Value-Added Technology on Food Prices**



Ag = agriculture, nf = nonfarm.  
Source: Author's calculations.

**Figure 6: Simulated Effect of Agricultural and Value-Added Technology on Value-Added Employment**



Ag = agriculture, nf = nonfarm.

Source: Author's calculations.

All the modeling thus far has been in terms of factor-neutral technology. In fact, however, there may be important differences in the factor intensity of different technologies. In a recent paper, Foster and Rosenzweig (2010) explore the issue of scale economies in agriculture in India. They show that over the period 1982–2007 in rural India, there was a substantial increase in mechanization, particularly among larger farmers. While traditionally it has been suggested that small farmers in rural India are more productive than larger farmers, Foster and Rosenzweig show that at least in the last decade and after appropriately accounting for supervisory costs, potential search costs for off-farm employment, and potential endogeneity of land with respect to productivity, larger farmers are more profitable than small farmers, and this profitability is largely a result of the labor saving that is possible through increased mechanization. Maximal profitability per acre is achieved in farms ranging 10 acres in size, which while tiny in comparison to the average farm in the United States, is large indeed given that 60% of Indian farmers farm less than 1 acre, and 95% farm less than 5 acres according to the Indian Census of 2001 (Foster and Rosenzweig 2010).

The fact that mechanization is both labor-saving and importantly scale-dependent has two implications. First, in order to take advantage of this new technology, one may need to have farms that operate at effectively greater scale. This scale dependence is important in terms of earnings of poor households because it means that a larger share of the population would—barring some contractual arrangement where they shared in the profits of land being farmed in larger units—be dependent on labor-market earnings

rather than combining labor market earnings and profits. Second, mechanization can displace substantial amounts of labor which, in the context of the model, should result in lower wage rates. Moreover, while cooperatives and other forms of coordination of smaller farmers to capture returns to scale can ensure that small farmers continue to accrue the rents of land ownership, they do not avoid the problem of labor displacement if the primary source of scale economies is through mechanization. In this light, the value-added model of nonfarm labor developed here seems particularly attractive. Increased agricultural productivity through mechanization will release labor but, by pushing down the local price of agricultural goods, increase entry of value-added producers that in turn can absorb labor.

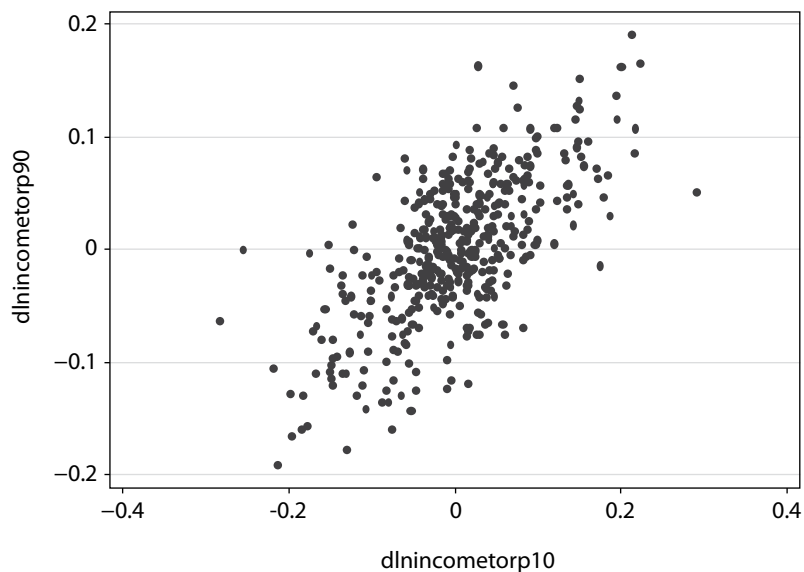
Data collected from the ARIS-REDS panel surveys of rural India provide some descriptive evidence that provide general support for the notion that value-added agricultural activity can play a particularly important role in nonfarm income growth. A particular feature of these data that has rarely been exploited empirically are the listing files, which provided a basis for each of the sampling frames in 236 villages in each of the years 1969, 1982, 1999, and 2006. These data provide levels of income for the census of households in these villages, including also data on occupation and source of income for 1969 and 2006. Overall the data sets contain information on 34,187 households in 1969 and 115,429 households in 2006.

To capture differences in different parts of the income distribution and how these changed over time, quantiles of the income distribution in each year and village are constructed and then adjusted for inflation over time. The data show a remarkable amount of village-specific income growth. Figure 7 plots the 1969–2006 change in the log of household income for the 10<sup>th</sup> and 90<sup>th</sup> percentiles of the income distribution and show a high level of correspondence in economic growth. Figure 8 plots the change for the 25<sup>th</sup> and 75<sup>th</sup> percentile and show an even closer correspondence. Indeed the correlation matrix in quantile village growth within India (Table 2) shows a high correlation of patterns of growth. The lowest correlation is for the 10<sup>th</sup> and 90<sup>th</sup> quantiles of 0.671. The 25<sup>th</sup> and 75<sup>th</sup> growth in income quantiles correlation is 0.876. This overall high correlation is indicative of the importance of thinking about employment growth in terms of what happens at the village level. Some villages show substantial growth across all quantiles while others do not.

It is then helpful to consider what features of economic growth are correlated with income growth in the different quantiles. While these regressions should not be interpreted causally, they do give some sense of what basic features of the village economy predict overall income growth at different quantiles of the distribution. In particular, village fixed effects are controlled and the log income of the corresponding quantile is used as the left-hand side variables, with several measures of economic activity on the right-hand side. These include village-level estimates of the fraction of workers employed in each of three categories of occupations (traded manufacturing, nontraded services, and value-

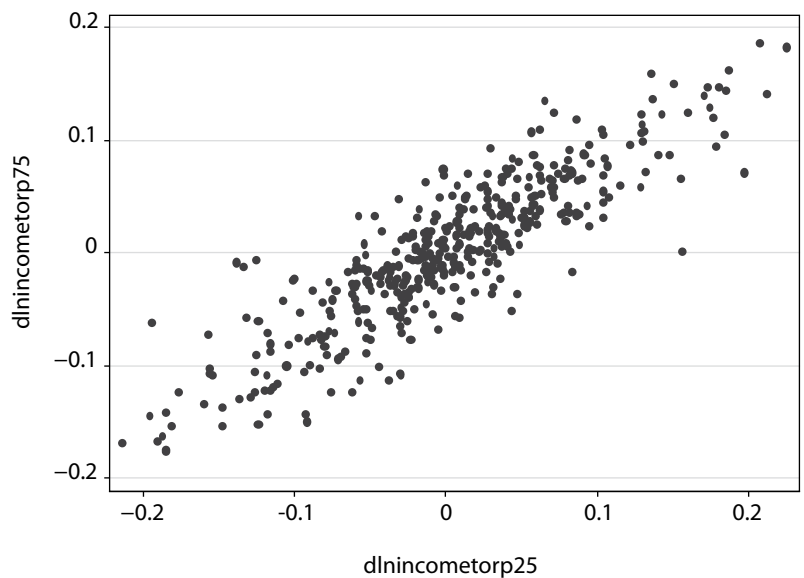
added in agriculture); the share of income from agriculture, self-employed nonfarm, and salaried work; yields in agriculture; population; and the distance to the nearest town (which changes over time due to the process of transformation of large villages into towns [settlement of at least 20,000]).

**Figure 7: Growth in 10th and 90th Quantiles of In Income by Village in Rural India, 1969–2007**



dlnincometorp10 = growth log(income) of the 10th percentile, dlnincometorp90 = growth log(income) of the 90th percentile.  
 Source: Author's calculations.

**Figure 8: Growth in 25th and 75th Quantiles of In Income in Rural India, 1969–2007**



dlnincometorp10 = growth log(income) of the 10th percentile, dlnincometorp90 = growth log(income) of the 90th percentile.  
 Source: Author's calculations.

**Table 2: Correlation Matrix of Growth Income Quantiles in Rural India, 1969–2007**

	10%	25%	50%	75%	90%
10%	1				
25%	0.9156	1			
50%	0.8488	0.9529	1		
75%	0.7662	0.8756	0.9489	1	
90%	0.6714	0.7641	0.8455	0.9325	1

Sources: Author's calculations; Additional Rural Income Survey and Rural Economic and Demographic Surveys, National Council of Applied Economics Research (1969–2007).

The results are presented in Table 3 (random effects) and Table 4 (village fixed effects). We first note that, as expected given the correlation figures, the predictors of income growth are very similar across quantiles. In terms of significance, three variables are consistently significant—(i) the per capita number of workers in value-added agricultural activity; (ii) agricultural yields, share of income from agriculture, and population; and (iii) distance to the nearest town. The mean of workers per capita in the sample in 2006 is 0.03 with a standard deviation of 0.05. Thus the coefficient in Table 3 suggests that a doubling of workers per capita as value-added employees results in an 8.0% additional income at the 10<sup>th</sup> percentile and 8.8% at the 90<sup>th</sup> percentile. The fixed effects estimates in Table 4 are smaller and not significant for the lower quantiles but still suggest growth of 5.3% from a doubling of workers per capita as value-added workers. While these figures are not large, the fact that overall levels of employment in this sector are low indicates there may be substantial opportunity in this regard.

Yields have a positive effect on income in each sector as one might expect, although the effects are larger at high incomes, presumably reflecting the role of agricultural profits. It is worth noting, however, that the yield elasticities are substantially less than 1, a result that is at least consistent with the notion that nonfarm employment responds endogenously to high wages.

In terms of the other coefficients, the fact that the share of agricultural income has a negative relationship with income is also indicative of the general importance of nonfarm activity as a source of rural earnings growth. As the mean share of agricultural earnings is 0.63 with a standard deviation of 0.33, these results indicate that a 1 standard deviation increase in the agricultural earnings share is associated with a 9% reduction in incomes at the 10<sup>th</sup> percentile. Note also that these effects are largest for the smallest households, which is indicative of the particular importance of nonfarm earnings as a source of growth of wages, which are the primary source of income in lower-income households. The strong positive population effects, particularly at the lower quantiles, and negative distance to town effects, particularly at the higher quantiles, are indicative of the adverse effects of relative isolation on income in rural India.



To conclude, the effects of agricultural technology growth on the nonfarm sector are complex with relatively small theoretical specification differences, leading to quite large differences in conclusions. In particular, agricultural productivity growth increases nonfarm activity in the services sector by increasing demand for local goods, decreases it in the factory sector by raising wages and thus discouraging capital entry, and increases it in the value-added sector by lowering the price of a key input. It is no surprise that empirical work on the effects of agricultural technology on nonfarm activity has led to quite mixed results. A brief empirical analysis provides some support for the potential importance of value-added employment as a source of earnings growth in rural India.

**Table 3: Random Effects Estimates of Relationship between Log Income Quintile, Sources of Income, and Infrastructure**

	10%	25%	50%	75%	90%
Traded workers/capita	0.133 (0.75)	0.172 (1.05)	0.219 (1.37)	0.274 (1.70)	0.263 (1.63)
Service workers/capita	-0.034 (0.23)	0.051 (0.36)	0.009 (0.07)	-0.091 (0.67)	-0.246 (1.79)
Value-added workers/capita	2.655 (3.63) **	2.172 (3.22) **	2.140 (3.27) **	2.859 (4.31) **	2.919 (4.41) **
Ln yield	0.105 (3.19) **	0.123 (4.03) **	0.134 (4.52) **	0.149 (4.94) **	0.133 (4.42) **
Agricultural income share	-0.163 (4.66) **	-0.122 (3.77) **	-0.095 (3.02) **	-0.020 (0.63)	-0.036 (1.15)
Self-employment income share	-0.074 (1.17)	-0.074 (1.25)	-0.043 (0.74)	0.046 (0.79)	0.019 (0.32)
Salaried income share	-0.085 (5.46) **	-0.080 (5.52) **	-0.078 (5.57) **	-0.065 (4.55) **	-0.050 (3.44) **
Ln population	0.027 (1.05)	0.040 (1.68)	0.036 (1.57)	0.050 (2.07) *	0.048 (1.89)
Ln distance to nearest town	-0.206 (3.05) **	-0.226 (3.64) **	-0.208 (3.45) **	-0.204 (3.32) **	-0.209 (3.39) **
Observations	403	403	403	403	403
Number of villages	234	234	234	234	234
R-squared	0.36	0.39	0.34	0.28	0.28

\* significant at 5%; \*\* significant at 1%.

Note: Absolute value of t statistics in parentheses.

Sources: Author's calculations; Rural Economic and Demographic Surveys, National Council of Applied Economics Research (1982–2007).

**Table 4: Fixed Effects Estimates of Relationship between Log Income Quantile, Sources of Income, and Infrastructure**

	10%	25%	50%	75%	90%
Traded workers/capita	-0.016 (0.06)	0.093 (0.38)	0.232 (1.01)	0.347 (1.54)	0.342 (1.61)
Service workers/capita	0.010 (0.04)	0.100 (0.41)	0.045 (0.20)	-0.092 (0.41)	-0.268 (1.28)
Value-added workers/capita	0.321 (0.30)	0.052 (0.05)	0.094 (0.10)	1.231 (1.30)	1.775 (1.99) *
Ln yield	0.103 (2.04) *	0.151 (3.14) **	0.168 (3.74) **	0.167 (3.77) **	0.141 (3.39) **
Agricultural income share	-0.185 (3.90) **	-0.112 (2.48) *	-0.065 (1.55)	-0.008 (0.19)	-0.039 (0.99)
Self-employment income share	-0.036 (0.39)	-0.080 (0.91)	-0.027 (0.34)	0.091 (1.14)	0.064 (0.84)
Salaried income share	-0.071 (2.58) *	-0.069 (2.64) **	-0.057 (2.35) *	-0.046 (1.91)	-0.045 (1.98) *
Ln population	0.242 (3.10) **	0.203 (2.74) **	0.152 (2.20) *	0.148 (2.17) *	0.136 (2.11) *
Ln distance to nearest town	-0.168 (1.62)	-0.199 (2.02) *	-0.185 (2.00) *	-0.176 (1.93)	-0.210 (2.45) *
Observations	403	403	403	403	403
Number of villages	234	234	234	234	234
R-squared	0.35	0.38	0.38	0.36	0.39

\* significant at 5%; \*\* significant at 1%.

Note: Absolute value of t statistics in parentheses.

Source: Author's calculations; Rural Economic and Demographic Surveys, National Council of Applied Economics Research (1982–2007).

### III. Human Capital

Whether expansion in human capital is necessary or sufficient to encourage an expansion in good jobs in rural areas is also a complex question. Some of the complexity arises in this case from the fact that human capital can mean different things. While economists typically think about human capital as arising from schooling, it is often helpful to think of human capital as anything that enhances worker productivity, including physical strength, schooling, experience, and entrepreneurial skill. Moreover, each of these attributes may have different returns in different sectors and within sectors based on one's role. Specifically, for example, Foster and Rosenzweig (1996) find substantial evidence that schooling increases the profitability of management of new agricultural technologies, but in other work find that if anything, schooling lowers agricultural wage rates at the individual level (Foster and Rosenzweig 1996). Recently, work by Pitt, Rosenzweig, and Hassan (2011) looks specifically at the issue of differential investment in physical

strength and schooling and find evidence that the returns to strength and schooling vary substantially by type of activity.

As with the case of agricultural technology, consideration of the effects of human capital on worker productivity benefits from taking a general equilibrium perspective. This idea is most obviously evident in the finding that investments in schooling tend to have a large effect on probabilities of migration. As documented in Foster and Rosenzweig (2008), for example, more educated individuals are more likely to move, presumably as a result of higher returns to schooling in rural areas. Given that overall wages in rural areas are importantly determined by the supply of workers as illustrated above, this increased migration may lead to higher wages in areas with higher levels of schooling, even if there are no effects of schooling on productivity per se.

How schooling, or human capital more broadly, affects earnings in rural areas more generally is a complex question. There is substantial debate, for example, with regard to the question of whether schooling is a necessary to be employed in nonfarm activities in rural areas of low-income countries. Lanjouw and Murgai (2008) for example, report that in rural India in 2004, levels of illiteracy are substantially higher among agricultural laborers and cultivators (35.9% and 32.5%, respectively) but substantially lower than those in regular nonfarm employment (2.2%). Illiteracy rates for self-employed and nonfarm casual are also low but more intermediate (11.6% and 11.8%, respectively). Evidence from Foster and Rosenzweig (2005) suggests, for example, that while areas with more secondary school graduates tend to have more factory jobs, the level of secondary education is not correlated with factory employment within villages. On the other hand they do find evidence that an increased supply of schooling in the village is associated with higher business income as might be expected if education increases entrepreneurial ability. The pattern may also simply reflect ecological variation arising from other sources.

Regardless of whether schooling itself is considered a critical input in the production of nonfarm employment, the organization of employment suggests that there is an important element of skill to many nonfarm jobs that may affect wages. The vast majority of agricultural employment in many low-income areas of rural countries is casual. For example, Lanjouw and Murgai (2008) report that 46% of all agricultural employment and 97% of agricultural workers by noncultivators is casual. By contrast, 25% of all nonfarm workers are casual and just 57% of nonself-employed nonfarm workers are casual. The casual labor market in agriculture is reflective at least in part in the shifting nature of agricultural labor demand but it is also indicative of a lack of specialization in a particular land or task. By contrast, in the nonfarm sector, most self-employed workers and most factory workers are doing the same thing at different points in time. A bicycle repairman has a specific skill that cannot easily be replaced by someone working in another sector. If so then presumably the rents associated with these skills should appear in terms of labor market earnings. The presence can also help us understand why there seems to be

a wage premium to many forms of nonfarm employment (Lanjow and Murgai 2008) even though on observable criteria there may be little *ex ante* differences between farm and nonfarm workers.

Interesting evidence on the presence of variation in nonschooling human capital is presented by Kodithuwakkua and Rosa (2002). They study sources of household earnings in an area that was part of a settlement project in the previous 10 years. Because of the way the settlement was carried out, households started off with similar land endowments, and village residents did not start off with strong internal social networks as they had previously lived in different areas. But after 10 years there were substantial differences in income among households, and these differences were importantly tied to entrepreneurial activity. Arguably, most of the business activities were available to most households, though it was clear that many were successful because they exploited social connections such as with particular traders or credit providers external to the village. Among the activities were bicycle repair shops, contracting irrigation channel maintenance, hiring out equipment, acting as a paddy broker, money lending, and selling agricultural inputs. Moreover, most of those who were successful were successful in a number of different, largely unrelated, ventures.

What is unclear from this fascinating study is whether and how entrepreneurship can be encouraged, for example, by training or other forms of human capital development. While entrepreneurship training is often packaged along with microcredit programs, the relative value-added of the different components is difficult to identify. One important exception is Karlan and Valdivia (2006) who studied a randomized treatment adding business training to an existing microcredit program. They find evidence that in this population the training increased repayment and increased business revenue for the clients. They also find that those showing the most benefit to the training were those who *ex ante* expressed the least interest in the program. Evidently there are important management skills that can be taught. However, since this is a study of people already using microcredit for business activity, it is not clear whether the training affects entrepreneurship per se.

A helpful way to incorporate human capital into the above model of rural employment is as a distinct endowment in the household. That is, one might imagine that in addition to being endowed with  $l$  units of labor, a representative household would be endowed with  $h$  units of human capital. Employers purchase the labor and human capital as a joint good in much the same way that a farmer might hire a tractor with a driver, evaluating each element based on its opportunity cost. Thus for example, in the service good case, one might imagine that service profits are

$$y_s = p_s \theta_s l_s f_s(h_s / l_s) - w l_s - v h_s, \quad (12)$$

and that the effective wage received by a worker is the sum of the wage he would receive in the agricultural labor market as well as the rents on human capital per unit labor,

$$w_s + v h_s / l_s . \quad (13)$$

If the service sector is the only place in which such human capital can be used, clearing in the human capital market implies

$$p_s \theta_s f'(h/l_s) = v . \quad (14)$$

As a result, an increase in service employment, given these assumptions, raises the rents on human capital and thus increases effective wages paid in this sector even if the wage in the agricultural sector stays fixed.

The presence of such an effect can have an appreciable effect on the patterns observed in the model on agricultural technology discussed above. For example, if factory labor is relatively dependent on skilled workers, then an expansion in factory technology that increases factory labor demand will also raise the effective earnings of households by raising the return to human capital. This effect in principle could reverse the patterns in Figure 1 so that the effective wage in the factory sector, for example, rises faster with factory technology than it does with agricultural technology. Note also that the model yields implications for the effects of differences across communities in endowments of human capital. If labor and human capital are complementary, then areas with higher endowments of human capital will have higher demand for factory labor, and this demand itself will push up the wage paid in sectors that do not use human capital.

## IV. Credit Markets

Like technology and human capital, the effects of credit markets on rural jobs are multifaceted. In Section I, the role of capital markets in terms of financing of factory employment has been incorporated. But credit markets can also clearly have a profound effect on agricultural productivity and self-employment through the provision of working and start-up capital. Unfortunately access to credit markets is even more difficult to measure than access to human capital. While there is ample evidence that household behavior falls well short of what might be expected if they had access to as much credit as needed as a market interest rate, until recently, few observational studies have said anything definitive about sources of variability in access to credit. And while the growing experimental literature on microcredit literature has shown that there are important sectors of the market that can make good use of access to structured credit in terms of higher productivity in small family businesses and better living standards, it is unclear whether these effects are often large enough to extend beyond the employment of family workers.

There is a growing body of evidence with relatively compelling sources of inference suggesting that increased access to banks has real effects on the nature of employment. This includes work by Burgess and Pande (2005), which examines the effects of India's social banking experiment that targeted banks to underserved areas of India; and Feler (2010), which uses bank privatization in Brazil to examine the consequences of reducing subsidies to rural banks. In the latter case, there was evidence that those areas losing subsidized banks and not having alternative sources of credit had reduced economic activity and decreases in skilled workers. These results broadly conform with evidence on the effects of bank deregulation on small business activity in rural areas of the United States (Beck, Levine, and Levkov 2010). Kaboski and Townsend (2010) also find evidence of increased business economic activity associated with Thailand's million Baht fund, although they argue that the social costs of the program exceeded the social benefits. Overall, Townsend (2011) argues that financial deregulation has had substantial positive effects on economic growth in Thailand by providing a better match between entrepreneurial skill and access to capital, but notes that in some cases, subsidized credit has led to an inefficient overdispersion of economic activity. Foster and Rosenzweig (2010b) in their detailed study of scale economies in rural agriculture find evidence that low levels of access to credit seem to adversely affect profitability in smaller farmers, leading to underuse of inputs such as fertilizer, and to lagged profits on current input use and profitability. Taken as a whole, this work confirms that credit markets are far from perfect, and that imperfect access to credit is an important barrier to efficient economic behavior.

It is unclear however if and when this necessarily creates a compelling case for public intervention. Fundamentally problems of imperfect information plague credit markets and it is not obvious that the public sector can sufficiently overcome these difficulties to make public credit a cost-effective mechanism to increase the quality of rural employment, although it also is not obvious that it cannot. At the very least it is important to recognize, in the context of the above models of nonfarm employment, that increased access to working capital that increases agricultural or small-scale service sector profitability affects not only those directly receiving the credit but also other workers in general, by changing the wage and possibly other locally determined prices.

## **V. Infrastructure**

There is also emerging new evidence on the role of infrastructure in helping to support development of effective employment. Felker and Townsend's (2011) recent study on the geographic concentration of enterprises in Thailand considers the proximity of areas to local roads. They conclude that there is a 1.8% reduction in the number of enterprises per kilometer of distance from a major highway. Enterprise income falls by 11.5 Baht per kilometer. There is also evidence of increasing growth in areas proximate to other areas

that are quite active. Overall the picture that emerges is one where there are substantial positive agglomeration economies affecting enterprise development in rural areas. Aragon and Rud (2010) show additional evidence of the role of demand effects in generating local economic activity by looking at the effects of proximity to mines that are affected by commodity price booms.

Donaldson (2010) finds evidence that the introduction of railroads in India leads to greater economic activity by exploiting gains to trade between different regions. Overall Donaldson's results can be incorporated in the above structure through explicit modeling of transportation costs as was done in the case of the value-added model. Note, however, that better transportation may decrease the relative merits of value-added production particularly if there are returns to scale in processing. In particular, there is less opportunity for the kind of local agricultural goods prices effects that encourage value-added production in that model.

Electrification also seems to have important effects on rural employment. Dinkelman (2010) in South Africa takes advantage of patterns of electrification to examine effects on rural employment. She finds evidence that electrification leads to increases in labor supply on the part of men and women and decreases in female wages. Basic results suggest that electrification has primary effects on small-scale family enterprises by releasing time needed by women for domestic chores. Overall this pattern might be characterized as an effective expansion in household labor, with the reduction in wages being indicative of the kind of local labor market hypothesized above. Rud (2010) argues that firms faced with poor and unreliable electricity supplies must invest in a relatively costly replacement technology.

## **VI. Conclusion**

The primary purpose of this paper has been to consider factors that lead to the development of good jobs in rural areas of developing countries. Central to the discussion is the question of how technological change, whether a consequence of changes in production technologies or indirectly through better provision of infrastructure, leads to increasing worker productivity and thus wages. If landholdings are equally held and all workers are employed on their own farm, then expansion in agriculture technology will increase household earnings. But this simplified model fails in two respects. First, land is unequally distributed in most parts of the world. Whether due to a legacy of inequality or due to returns to scale in farming activity, there are substantial differences in landholdings across individuals and thus there is substantial labor market activity. For farmers that do not hold land, the earnings from agriculture depend importantly on the wages that they receive. It does not in general follow that increases in agricultural technology will

improve wages. For example, if agricultural technology improvements result in increasing mechanization, which substitutes for labor, then wages may fall.

Second, agriculture is not the only source of earnings in most low-income countries. In fact, nonfarm earnings now approach almost half of all earnings of rural areas in developing countries. Thus what happens to wages will depend critically on what happens to the nonfarm sector. But the nonfarm sector is quite heterogeneous. On one hand, the nonfarm sector can consist of small-scale farms selling services on the local market. Since demand in this market is generated locally and the products of this market are not easily transferred across space, it seems plausible that this sort of nonfarm activity will increase with agricultural incomes, thus having a salutary effect on agricultural wages, at least if there is some reasonable degree of mixing between working in such small-scale services and working in agriculture as seems plausible. On the other hand, the nonfarm sector can consist of firms that produce tradable goods for the external market. Here, the situation is less clear. Increases in agricultural productivity that increase demand for agricultural labor will increase overall labor demand and thus bid up wages in the factory sector as well. But the overall consequences for wages depend on how this sector responds. If the higher wage results in exit from the factory sector, the effect of agricultural productivity on rural wages may be dampened. A further complication arises with respect to the potential for value-added production in agriculture. Since value-added production uses agricultural production as an input, growth in this sector tends to both create greater employment in that sector and to increase the demand for labor in the agricultural sector. This pairing of changes has a particularly salutary effect on wages.

There is both theoretical and empirical basis to believe that value-added production in agriculture is a potentially valuable source of rural earnings growth. But if this is indeed the case it raises questions about how it may be best encouraged. While we see preliminary evidence that employment in this sector is correlated with income growth in India, for example, its incidence is quite low. There is also the evident difference in the correlation of nonfarm and farm activity between Thailand as documented in Townsend (2011) and in India. One obvious question that arises is how this process is affected by government intervention in grain markets. For example, one might conjecture that the large-scale procurement programs in India—up to 40% of grain in the market for some areas—decrease rural growth in value-added activities by reducing incentives for farmers and local entrepreneurs to seek out new opportunities in this area.

The paper also explored the role of human capital, credit markets on infrastructure on worker productivity, and thus earnings. Again the results are multi-faceted and depend on particular issues and structures. It seems clear that all three inputs can have a substantial effect on rural employment. But the presence of such effects need not necessarily imply that these interventions are cost-effective, particularly with regard to relatively remote areas or those with unfavorable conditions for productive agriculture. In such areas, policies that promote migration, inclusive of improved schooling and better access to



urban labor markets, may also have salutary effects on rural employment by encouraging workers to move to areas where they can find better job, by reducing labor supply in sending areas, and by stimulating local demand through remittances from successful migrants.

There also may be substantial complementarity across interventions in these areas in which a series of inputs creates the conditions for a substantial increase in the local labor market that feeds back on itself through greater productivity in agriculture, higher demands for local service goods, and increased production of both manufactured tradables, particularly value-added agricultural goods. Expansion in rural employment is likely to be most responsive to a broad spectrum of different interventions with particular attention to how individual programs and effects affect the operation of local markets for products and labor and the broader connections of these markets to the wider world.

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### **About the Paper**

Andrew D. Foster examines the potential for sector-specific productivity growth, human capital, credit markets, and infrastructure to contribute to the development of stable, well-paid employment in rural areas of low-income countries. Particular emphasis is placed on the way that different sectors of the rural economy interact with each other and with local and regional product markets. A simple theoretical framework and descriptive analysis of panel data from India suggests that more emphasis should be placed on increasing the production of goods that incorporate local agricultural products as inputs.


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6 ADB Avenue, Mandaluyong City  
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[www.adb.org/economics](http://www.adb.org/economics)  
ISSN: 1655-5252  
Publication Stock No. WPS113948

August 2011

 Printed on recycled paper



Printed in the Philippines