How Does Poverty Decline?
Suggestive Evidence from India, 1983-1999

By
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Abstract

The economic processes by which productivity growth in agriculture and non-agriculture matter to the poor in India are investigated here. Poverty is measured by the wage rate of agricultural labor—a variable that is highly correlated with head-count measures. The paper sets up a theoretical model to contrast the effects of productivity increase in the farm and non-farm sectors. The effects depend on whether the region under consideration is a closed or an open economy. Drawing on the theoretical model, the paper undertakes a counterfactual exercise to estimate the relative contribution of the non-farm sector to the increase in the agricultural wage earnings during the period 1983-1999. The contribution is found to be no more than a quarter of the observed wage earnings. The extension of this methodology to individual states requires the assumption that agricultural productivity growth leads to a net increase in non-farm employment. The paper presents econometric evidence in support of this assumption.

Keywords: Farm and non-farm productivity growth, non-farm employment, poverty, wage earnings

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1. Introduction

In a less developed country, the most consequential aspect of GDP growth is its impact on poverty. A convincing empirical case has been made in the literature that higher growth translates into lower poverty [e.g., Besley and Burgess (2003), Dollar and Kraay (2002), Kraay (2004), Ravallion (2001)]. Using cross-country data for a number of years, Besley and Burgess (2003) estimate that a 1% increase in GDP growth reduces poverty by 0.73%, on average. However, this average impact hides variation between countries. For example, the elasticity of poverty with respect to economic growth is –1.00 in East Asia but only –0.59 in South Asia [Besley and Burgess(2003)]. In order to be able to discriminate between policies promoting growth, we need to understand the process by which different growth strategies impinge on the incomes of the poor. The purpose of this paper is to propose a framework that would enable us to analyze such a process by drawing lessons from the last two decades of growth and poverty decline in India. More specifically, we will try to evaluate the relative impacts of productivity growth in agriculture and non-agriculture on India's poverty decline.

Typically, the non-farm sector in developing countries exhibits higher rates of growth since non-farm technology can be transferred more easily from developed countries; it may need less climatic adaptation. It is also the case that, unlike the farm sector, it is not crucially dependent on a fixed factor like land. Yet, a significant part of the labor force in developing countries makes its living in agriculture. A well-known stylized fact is that the poorer the country, the greater is the share of the labor force in agriculture. How does the growth in the non-farm part of GDP translate into a boost in the incomes of those working in the farm sector? This question must be answered in order to understand the process by which poverty declines. If poverty declines during a period of high growth, it does not follow that the faster-growing sector is mostly responsible for this. It is quite possible that growth is mostly attributable to one sector and poverty decline to the other.

India is one of the fastest growing economies in the world today. It also has the dubious distinction of having the largest share of the world's poor. In addition, it has some of the better quality data among the developing countries. It therefore makes an ideal case study for our purpose. Since the early 1980's, India has enjoyed an average GDP growth rate of 5.5% per annum. More importantly, the proportion of the population below the poverty line declined from about 44.5% in 1983-84 to 26% in 1999-00. It is instructive, therefore, to examine the process through which the policies responsible for growth may have raised the incomes of the poor. It is worth noting that agricultural GDP grew at a much lower rate than the non-farm GDP during 1980-2000. Agricultural GDP grew at a rate of 3.36% in the 80's and at 2.5% in the 90's. Industry and services grew at 7.54% and 6.23% in the 80's and at 5.6% and 7.07% in the 90's respectively. An important question is: which sector contributed more to the observed poverty decline? The answer to this question matters because it ought to inform the policy-orientation that poor countries should adopt in order to rapidly reduce poverty.

2. Literature

Using country level panel data sets, several researchers (cited in the introduction) have looked at the growth-poverty relationship. This literature finds a strong negative association between growth and poverty. This relationship holds only on average, however, and country (and regional) experiences could be diverse. As Ravallion (2001) points out, the growth-poverty link may be quite weak in the face of rising inequality.

An identity links changes in the level of poverty in any given country with changes in the average income level (i.e., growth) and changes in income inequality. Changes in poverty can therefore be decomposed into a growth and a distribution component and their relative importance can be quantified. Besley, Burgess and Esteve-Volart (2005) undertake such an exercise for different states of India, revealing the heterogeneity of the growth-poverty link. This finding calls for a deeper examination beyond growth-poverty correlations.

Cross-country regressions that relate inequality or poverty to the variables that have been known to be robust correlates of growth ("rule of law", openness to international trade, inflation, size of government, measure of financial development) have pretty much drawn a blank [Dollar and Kraay (2002), Kraay (2004), Lopez (2004)]. Kraay (2004) and Ravallion (2001) conclude that country-specific research is necessary to understand the heterogenous outcomes (of growth) for the poor.

In the Indian case, scholars have used state level panel data to establish the correlates of poverty. Ravallion and Datt (1996) find rural economic growth to have a significant impact in reducing urban and rural poverty while urban growth has little impact on rural poverty. In the rural sector, higher farm yield is the key variable that reduces poverty [Datt and Ravallion (1998)]. On the other hand, the impact of non-farm economic growth varies across states, depending on initial conditions [Datt and Ravallion (2002)]. Their work complements the substantial literature starting with Mellor (1976) (and more recently Timmer (2005)) that has argued that the most effective way to reduce poverty is through agricultural growth. In a similar analysis of panel data, however, Besley, Burgess and Esteve-Volart (2005) report opposite results. They find economic growth in the secondary and tertiary sectors to contribute more to poverty reduction than primary sector growth.

State level panel data has also been used to examine the impact of specific policies on poverty – including labour regulation [Besley and Burgess (2004)], land reform legislation [Besley and Burgess (2002)] and expansion of rural banking [Burgess and Pande (2005)]. Topalova (2005) assembled a district level panel data set and used it to establish that districts that experienced greater tariff reductions recorded slower decreases in poverty. Finally, Palmer-Jones and Sen (2003) perform a cross-sectional analysis at the region level (intermediate between districts and states), relating rural poverty to agricultural growth and several control variables. Useful as they are in enhancing our empirical knowledge of which policies were associated with greater poverty reduction, these analyses have not established the causal mechanisms by which the poor have gained from the growth process.[1]

In a recent study, Foster and Rosenzweig (2003, 2004) present a causal framework that links agricultural productivity increase and capital flows into the rural factory sector on the one hand with the agricultural wages on the other. They test this framework with panel data over the years 1983 through 1999. They find that, in their framework, agricultural productivity improvement increases inequality across regions

[1] While her focus is not on poverty reduction per se, in a recent paper Kijima (2006) has examined why wage inequality has increased in urban India over the period 1983 through 1999.

while the rural factory sector helps to decrease it. They argue that it is only the non-traded segment of the rural non-farm sector that is positively affected by agricultural growth. The traded non-farm sector (consisting of rural factories) competes with the farm sector for labour and is therefore attracted to regions with low agricultural productivity. Their empirical results show that much of the growth in the rural non-farm sector in India was due to the rural factory sector and not due to the non-traded sector. Furthermore, the growth in the rural factory sector was important in accounting for the increase in rural wages over the period 1982-99.

We have two points of departure from Foster and Rosenzweig (2003, 2004). First, at the theoretical level we model preferences more realistically by incorporating Engel's law (the share of expenditure on food declines as income increases). This matters because the nature of consumer demand determines the extent to which labour is released from agriculture (which exhibits diminishing returns) following a productivity increase [Lewis (1954), Matsuyama (1992), Eswaran and Kotwal (1993)].[2] And this, in turn, affects the rate of agricultural wage increase. Our second point of departure is that, at the empirical level, we use the nationally representative employment and wages data from the National Sample Survey (NSS). Our model, however, is simpler than that of Foster and Rosenzweig (2003, 2004) in other respects: it has only two, as opposed to three, sectors. Our goal is to assess the relative contributions of productivity growths in the farm and non-farm sectors to the observed growth in wages rather than to evaluate their impact on the regional income distribution.

[2] Crafts (1980) has demonstrated that the high elasticity of demand of food exerted a drag on the process of industrialization in Britain during the its Industrial Revolution. This is in sharp contrast to the case of Japan during the Meiji restoration, where the elasticity of demand of food was relatively low.

3. Using Agricultural Wages as a Poverty Measure

Official estimates of head-count ratios of poverty in India are computed from national expenditure surveys and a poverty line developed by the Planning Commission. Due to a change in the survey design in 1999 relative to 1993, the rate and direction of change in poverty in the 1990's cannot be established in a straightforward way. Adjustments have to be made to render the surveys comparable and this has generated a large debate about the merits of different types of 'adjusted' poverty measures.[3] The official poverty lines have also been criticized for the way in which they are updated from survey to survey. Deaton and Tarozzi (2005) and Deaton (2005) have proposed alternative price deflators which yield poverty lines and poverty measures that are different from the official estimates. This underscores another difficulty with conventional poverty measures: they are sensitive to the distribution of the population around the poverty line, and so results could vary widely depending on the choice of the poverty line.

This paper sidesteps these measurement issues by choosing to work with agricultural wages. It is well known that agricultural laborers constitute a large fraction of the poor in India and that their wages are strongly correlated (negatively) with headcount ratios. A recent study that documents this association is Kijima and Lanjouw (2005), which shows agricultural wage rates at the region level to be strongly (inversely) correlated with region-level poverty rates in the three years between 1987 and 1999 for which such survey data were available.

Deaton and Dreze (2002) argue that agricultural wages can be taken not just as a proxy for poverty but as a poverty measure in its own right since it is the reservation wage of the very poor. It is also easier to theorize and model agricultural wages than poverty measures, which are complicated non-linear functions of underlying average income and of income inequality.

To see the logic of our argument regarding the relative effects on the wage rate of farm and non-farm productivity growth, consider a dual economy comprising these sectors. Total factor productivity (TFP) in the farm and non-farm sectors can be thought of as exogenous to this model. One connection between farm TFP and the agricultural wage is quite direct: at a given level of production inputs, an increase in farm TFP will raise the marginal product of labor and hence the wage rate. A second (general equilibrium) effect is that, if the demand for food does not change commensurately, the demand for non-farm goods may change even as labour is being released from or absorbed into agriculture. That is, there could be a reallocation of labour that will further affect the wage rate. If labour is released from the farm sector, given diminishing returns to labour when land is a fixed factor, the agricultural wage will rise further. What, on the other hand, is the relationship between non-farm TFP and agricultural wages? Here the link is through labor allocation only: if an increase in non-farm TFP increases the value of the marginal product of labor in the non-farm sector, it will draw labor away from agriculture and this will increase the wage rate. There is no presumption, however, that farm and non-farm TFP growth will be equally efficacious in raising the wage rate.

The extent of the wage increase due to non-farm TFP growth would depend, of course, on the amount of labor drawn away from agriculture. In China, the percentage

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[3] See the collection of papers in Deaton and Kozel (2005).

of labor force engaged in agriculture plummeted from 70% in 1979 to 47% in 1999. In other East Asian countries, like Taiwan and South Korea, this process of structural transformation was equally swift.

In India, the reduction of the labor force in agriculture has been nothing like what was witnessed in East Asia. Estimates from employment surveys show that the share of agriculture in the labor force for males (measured in person days) declined from about 60% in 1983 to 53% in 1999-00. The share of services has increased by about the same amount, since the share of manufacturing has changed very little over these 16 years. For females, the sectoral pattern of employment has remained stagnant: 72% of the female labor force continued to be employed in agriculture in 1999-00, compared to 74% in 1983.

For the 15 major Indian states, Figure 1 plots the average real daily wages (in 1999 rupees) in agriculture against the labour-land ratio (days per hectare of gross cropped area) for 1983 and 1999. It can be seen that, for all but four states (Kerala, Haryana, Punjab and Rajasthan), the labour use per hectare of land has increased over this period. Yet, for all but one state (Assam), real wages have increased during this period. At the all-India level, real daily wages increased by 69% between 1983 and 1999. Quite clearly, if either farm TFP or agricultural inputs such as fertilizers had not increased during this period, agricultural wages would have declined. It becomes interesting, therefore, to ask how much the non-farm sector growth has contributed to the growth of agricultural wages.

4. A Theoretical Framework

To isolate the contributions of the farm and non-farm sectors to the growth of the Indian economy, we adopt the dual economy framework that harks back to Lewis (1954) but later modeled, as in Matsuyama (1992) and Eswaran and Kotwal (1993), with neoclassical labour markets. We set out a model of a typical 'regional' economy, where a 'region' could mean—depending on our focus—the entire country, a state within the country, a district, or even a village. (Whether the region should be treated as a closed economy or as an open economy within the country will be dealt with below.) There are two sectors within the region: a farm sector (which produces an aggregate good, food) and a non-farm sector (which produces an aggregate of all other goods). Food production requires labour and land, whereas non-farm output requires only labour.

The total amount of land is fixed in the region. Since the distribution of income is not a primary focus of attention here, we assume that land is uniformly divided across all agents. There are $\overline{L}$ agents in the economy, each inelastically providing one unit of labour. Since land is only used in farming, labour is the only input whose allocation across the two sectors needs to be determined in the general equilibrium.

It is our contention that the preferences of agents over farm and non-farm products in their consumption are an important determinant of the allocation of labour across these two sectors. The assumption of homothetic preferences does not ring true in the context of developing countries, for they imply linear Engel curves. As Engel observed over a century ago, when income increases, the proportion of income consumers spend on food remains high initially and then declines quite rapidly. Explicit attempts to incorporate non-homothetic preferences were made in Matsuyama (1992), which employs Stone-Geary preferences, and Eswaran and Kotwal (1993), which invokes lexicographic ('hierarchical') preferences with satiation with respect to the farm product but not the non-farm product.

To capture the essential features of Engel's Law, albeit in stark form, we posit here that agents have quasi-linear preferences over the two consumption goods. The utility function, $U(x,z)$, representing a consumer's preferences is given by:

(1) $$U(x,z) = u(x) + \gamma z, \quad \gamma > 0,$$

where *x* and *z* denote her consumption of farm and non-farm goods, respectively. We assume that the sub-utility function satisfies $u'(.) > 0, u''(.) < 0$, and $u'(.)$ goes to infinity as its argument goes to zero, that is, the farm good is essential. The marginal utility of this good declines with consumption, while that of the non-farm good is constant.

We take the farm good as the numeraire and denote by *p* the relative price of the non-farm good. A price-taking consumer with income *y* then solves

(2) $$\max_{x,z} \quad u(x) + \gamma z \qquad s.t. \quad y \geq x + pz.$$

Denote the solution by $[x^*(y,p), z^*(y,p)]$. It is readily seen that the solution will not be interior (the agent will only consume the farm good) if her income is sufficiently low. In fact, $x^*(y,p) = y$ and $z^*(y,p) = 0$ when $y \leq H(\gamma/p)$, where $H(\gamma/p) \equiv u'^{-1}(\gamma/p)$ is the (declining) inverse function of the marginal utility of the farm good. When $y > H(\gamma/p)$, the agent's consumption of this good is independent of her income: $x^*(y,p) = H(\gamma/p)$. All her income in excess of $H(\gamma/p)$ is spent on the non-farm good, since her marginal utility from this good is constant. The income elasticity of the non-farm good remains zero until the agent consumes $H(\gamma/p)$ units of the farm good; at higher income levels, her income elasticity of the farm good falls to zero. Quasi-linear preferences, therefore, simulate the dramatic decline in the share of income devoted to food when income rises to sufficiently high levels. However, the maximum per capita consumption of farm output, $H(\gamma / p)$, increases in the relative price, *p*, of the non-farm output; there is substitutability between farm and non-farm output.

On the supply side, we assume the farm production function exhibits constant returns to scale. The aggregate farm output, *X*, is written

(3) $$X = A F(L_f),$$

where *A* denotes the total factor productivity parameter (augmented by an increasing and concave function of the fixed amount of land), and L_f is the agricultural labour input. The function $F(L_f)$ is increasing and, since the fixed land input is suppressed, exhibits diminishing returns with respect to labour: $F''(L_f) < 0$.

The aggregate non-farm output, *Z*, is produced using only labour and exhibits constant returns in the amount of labour employed, L_n:

(4) $$Z = B L_n,$$

where *B* is the total factor productivity parameter, again augmented by other factors of production such as capital that are left out of the analysis.

An important consideration here is whether the region should be thought of as self-sufficient or as one that freely trades with neighbouring regions. We analyze two scenarios that are polar extremes: one in which the region is taken to be completely closed, and the other in which each region is treated as a small open economy. The former is a good approximation to the Indian economy while the latter could be a reasonable representation of a smaller economic unit.

Region as a Closed Economy

Suppose each region is fully self-sufficient. We assume all markets (labour, land, farm and non-farm goods) are perfectly competitive. If L_f is the labour employed in agriculture, labour market clearance implies that the non-farm employment is given by $L_n = \overline{L} - L_f$. Since the returns to each factor is given by the value of its marginal product, the wage rate, w, is given by

(5) $$w = AF'(L_f).$$

Since the farm production function is linearly homogeneous, the total remuneration to labour and land must exhaust the output. Thus, for a given labour allocation, the aggregate rental income accruing to land is $AF(L_f) - wL_f$, that is, $AF(L_f) - AF'(L_f)L_f \equiv R(L_f, A)$. This aggregate rental income is readily seen to be increasing in the amount of agricultural labour (since that raises the marginal product of land) and in the total factor productivity. Since all agents own an equal share of the land, the land rental income of each agent is $R(L_f, A)/\overline{L}$. The income, *y*, of a representative agent, which is the wage rate and the rental income may be written in terms of farm employment as

(6) $$y = AF'(L_f) + R(L_f, A)/\overline{L}.$$

Since 1/B units of labour are required to produce a unit of non-farm output, the marginal cost of producing the non-farm product is *w*/*B*. Competition in the non-farm market will ensure that the (relative) price of this good is given by

$$p = w / B . \tag{7}$$

The general equilibrium is readily determined in this model. The crucial endogenous variable here is farm employment, L_f. Once this is determined, the wage rate and the land rental incomes are known. These determine the price of the non-farm output (which depends only on the wage rate), and these, in turn, determine the demands for farm and non-farm outputs. General equilibrium then requires that the original labour allocation be such that all markets clear. The land market clears trivially, since land is only used in agriculture and the production function (3) implicitly assumes this. The market for labour clears since we have set $L_n = \overline{L} - L_f$. Using Walras' Law, we can drop the market for the non-farm good, which leaves the market for the farm product. We shall assume that we are in the regime where the solution to the consumers' optimization problem is interior, that is, they demand farm and non-farm goods. Market clearance requires that the excess demand for farm output be zero. This excess demand can be written

$$\overline{L}\,H(\gamma / p) - A\,F(L_f)\,,$$

which upon substituting for the relative price of non-farm output from (7) and using (5) becomes

$$\overline{L}\,H(\gamma\,B / (A\,F'(L_f)) - A\,F(L_f) \equiv E(L_f, A, B)\,. \tag{8}$$

In equilibrium, the excess demand for the farm product must be zero:

(9) $$E(L_f, A, B) = 0.$$

It is readily seen that the excess demand function, $E(L_f, A, B)$, is everywhere declining in L_f. The unique solution to this equation determines the equilibrium farm labour, $L_f^*(A, B)$, and nails down the general equilibrium of the region. Since the farm product is essential to consumers, we can never obtain the corner solution $L_f^*(A, B) = 0$. We are assuming that we do not obtain the corner solution with $L_f^*(A, B) = \bar{L}$. (This corner solution would obtain only when agricultural productivity is so low that the entire closed economy needs to specialize in farm production.) Since there exists a non-farm sector even in the smallest of villages, we may disregard this possibility in what follows and assume that the solution to (9) is strictly interior.

The following proposition records the comparative statics of the general equilibrium farm employment with respect to the productivity parameters.

Proposition 1:

(a) An increase in non-farm total factor productivity reduces the equilibrium farm labour allocation.

(b) An increase in farm total factor productivity has an ambiguous effect on the equilibrium farm labour allocation.

Proof:

(a) Totally differentiating (9) with respect to B, we obtain

(10) $$[\partial E(L_f^*, A, B) / \partial L_f](dL_f^* / dB) + \partial E(L_f^*, A, B) / \partial B = 0.$$

From (8),

$$\partial E(L_f^*, A, B) / \partial B = \overline{L} H'(\gamma B / (A F'(L_f^*)))(\gamma / (A F'(L_f^*))) < 0 ,$$

where the inequality follows on using the fact that $H(.)$ is decreasing in its argument. Since the excess demand function is declining everywhere in L_f, (10) yields the result

$$dL_f^* / dB < 0 .$$

(b) Totally differentiating (9) with respect to A, we obtain

$$[\partial E(L_f^*, A, B) / \partial L_f](dL_f^* / dA) + \partial E(L_f^*, A, B) / \partial A = 0 . \tag{11}$$

From (8),

$$\partial E(L_f^*, A, B) / \partial A = \overline{L} H'(\gamma B / (A F'(L_f^*)))(-\gamma B / (A^2 F'(L_f^*))) - F(L_f^*) .$$

Since the two terms on the right hand side of this expression are of opposite sign, we see from (11) that the sign of dL_f^* / dA is ambiguous: an increase in A has an indeterminate effect on equilibrium farm employment. □

The intuition for this result is as follows. Productivity increase, whether in the farm or the non-farm sector, apart from obviously raising income, changes the relative price of the non-farm good. When it is non-farm productivity that increases, at given relative prices, the demand for farm output stays constant (with quasi-linear preferences) while that for non-farm output increases. But, at the original labour allocation, the relative price of non-farm output declines following the productivity increase, and this induces consumers to curtail their consumption of farm output and substitute non-farm output. The decline in demand for farm output releases labour from agriculture. In terms of releasing labour from the farm sector, the income and substitution effects associated with non-farm productivity increase work in the same direction. This explains part (a) of the proposition.

When it is farm productivity that increases, at given relative prices, here too the demand for farm output stays constant while that for non-farm output increases. But, at the original labour allocation, the relative price of non-farm output increases following the productivity increase, and this induces consumers to substitute away from non-farm output and increase their demand for farm output. The increase in demand for farm output raises the demand for labour in agriculture by working against the productivity increase (which tends to release labour from the farm sector). In terms of releasing labour from the farm sector, the income and substitution effects associated with farm productivity increase work in opposite directions. This accounts for the ambiguous effect of farm productivity increases on farm employment, as stated in part (b) of the proposition.

The analysis above would seem to suggest that non-farm productivity increases would be more efficacious than farm productivity increases in generating non-farm employment. However, this would be an unwarranted conclusion: the relative effects of the two productivity increases depend on the sensitivity of the consumer demand for farm output with respect to the price of non-farm output—in other words, they depend on the cross-price elasticity of farm output consumption.

To see this more clearly, we assume that the sub-utility function from farm output consumption is given by

(12) $$u(x) = -x^{-\alpha}, \alpha > 0,$$

and the production function for this good is Cobb-Douglas:

(13) $$F(L_f) = A(L_f)^{\delta}, 0 < \delta < 1,$$

where δ represents the share of labour income in farm output. It is readily verified that, in this case,

(14) $$H(\gamma / p) = (\alpha\, p / \gamma)^{1/(1+\alpha)},$$

which is an agent's consumption of the farm good when the solution to her utility maximization problem is interior. The wage rate of a worker when L_f workers are employed in the farm sector is given by

(15) $$w = A\delta (L_f)^{\delta - 1}.$$

The market clearing condition (9) for the farm good, which determines the equilibrium farm employment, becomes

$$\bar{L}(\alpha\, \delta\, A/(\gamma\, B))^{1/(1+\alpha)}\, (L_f)^{(\delta-1)/(1+\alpha)} - A(L_f)^{\delta} = 0,$$

the solution to which is

(16) $$L_f^{*}(A,B) = C/(A^{\alpha} B)^{1/(1+\alpha\,\delta)}, \qquad \text{where } C = (\bar{L})^{(1+\alpha)/(1+\alpha\,\delta)}(\alpha\delta / \gamma)^{1/(1+\alpha\,\delta)}.$$

The elasticity of equilibrium farm employment with respect to *A* and *B* are, respectively, $-\alpha/(1+\alpha\,\delta)$ and $-1/(1+\alpha\,\delta)$. Thus the absolute value of the elasticity of farm employment with respect to farm productivity exceeds that with respect to non-farm productivity if $\alpha > 1$.

The parameter α is related to the cross-price elasticity, $\eta_{x,p}$, of farm output demand with respect to the non-farm price. From (14), we see that $\eta_{x,p} = 1/(1+\alpha)$, so that $\alpha = 1/\eta_{x,p} - 1$. The condition $\alpha > 1$ translates into the inequality $\eta_{x,p} < 1/2$. Thus if a 1% decline in the price of non-farm output curtails the demand for farm output by less than 0.5%, the absolute value of the elasticity of farm employment with respect to farm productivity would exceed that with respect to non-farm productivity. In the extreme case of lexicographic preferences (zero substitutability in consumption between farm and non-farm output, that is, $\eta_{x,p} = 0$), non-farm productivity improvements will release no labour at all from agriculture [Eswaran and Kotwal (1993)]. For farm productivity improvements to be more efficacious than non-farm productivity improvements in removing labour from agriculture, the cross-price elasticity $\eta_{x,p}$ has to be "sufficiently" small. Since the demand for food is driven by the biological instinct for survival, however, there would be very limited scope for substitution between farm and non-farm output, especially at low levels of income.

Whether this is so or not is, of course, an empirical matter. Some evidence that corroborates this hunch is found in Deaton (1997, Ch. 5, Table 5.7), which is drawn from Deaton, Parikh, and Subramanian (1994). This Table presents the cross-price elasticities of the demands for eleven food items with respect to nonfood goods for rural Maharashtra for 1983. Many of these cross-price elasticity coefficients are insignificantly different from zero. We aggregate all food items into a single 'farm product', and obtain the imputed cross-price elasticity of this product with respect to the price of the nonfood aggregate (using budget shares) and setting the statistically insignificant elasticities to be zero. We obtain the figure of 0.11 as the cross-price elasticity for the aggregate good denoting 'farm' product, which is much less than 0.5.

We can push this exercise a little further and investigate when the wage rate will be more sensitive to productivity improvements in the farm sector than in the non-farm sector. Substituting (16) into (15), the equilibrium wage rate may be written in terms of A and B:

(17) $$w = \delta C^{\delta - 1} (A^{1+\alpha} B^{1-\delta})^{1/(1+\alpha\delta)} .$$

We immediately see from (17) that the elasticity of the equilibrium wage rate with respect to farm productivity is always higher than that with respect to non-farm productivity (since $\alpha > 0$ for the assumed functional form). For more general functional forms for $u(.)$, from what we have already argued, we would expect the difference between these elasticities to be higher (in favour of farm productivity) the lower is the cross-price elasticity, $\eta_{x,p}$. This is because low cross-price elasticities facilitate the release of labour from the farm sector when the productivity in that sector increases, reinforcing the wage increase brought about by the productivity improvement.

Region as a Small Open Economy

We briefly consider the other polar extreme, where each region is deemed a small open economy. The prices of the outputs are assumed to be set at the all-India (or the world) level. From the point of view of a single region, the relative price of non-farm output is assumed to be fixed at some level $\bar{p}$. We assume labour to be immobile across regions. While there is labour migration in reality, especially from some specific regions of India to others specific regions, at the country-level migration is small enough to render labour immobility a reasonably good working assumption.[4]

The consumers' optimization problem is the same as that in the case of a closed economy; only the market determination of the relative price of the non-farm sector

[4] *Migration in India* [NSSO (2001)] reveals that migrants constitute 27% of the labour force. Of these, 77% are females, who move for marriage reasons or because their spouses have moved. That is, around 1/4 of the 27% (about 7%) can be thought of as comprising the labor force. Of these 7%, only 14% are from out of state [NSSO (2001, Table 8, column 5)]. Thus only around 1% of the labor force can be thought of as migrants who are from out of state.

changes. For ease of comparative statics, we assume that the region does not completely specialize; that is, there are always operational farm and non-farm sectors—however small—within the region.[5] The equilibrium is easily nailed down: the equilibrating condition is that the value of the marginal product of labour must be equated between the farm and non-farm sectors. That is,

$$A F'(L_f) = \bar{p} B . \tag{18}$$

The comparative static derivatives of the equilibrium farm employment, $\hat{L}_f(A,B)$, are trivially determined. We record this for ease of subsequent reference:

Proposition 2: When the region is a small open economy within the country,

(a) an increase in non-farm productivity decreases equilibrium farm employment,

(b) an increase in farm productivity increases equilibrium farm employment.

Proof: Immediate, on totally differentiating (18) with respect to the productivity parameters and invoking strict concavity of the farm production function:

(a) $d\hat{L}_f(A,B)/dB < 0$, and (b) $d\hat{L}_f(A,B)/dA > 0$.

Local consumer demand is irrelevant here since the region can import from and export to other regions in the country. Higher total factor productivity improves the region's comparative advantage (or reduces the comparative disadvantage) in that sector and more labour is absorbed into it as a result. The region will either export more of the good to other regions or import less of it.

[5] Theoretically, complete specialization can never occur in the non-farm sector because the marginal product of labour is unbounded when farm output is zero; complete specialization, if it ever occurs, can

Parts (a) of Propositions 1 and 2 are identical, that is, whether the region is a closed economy or a small open economy, an increase in non-farm productivity releases labour from agriculture. However, since the result in the case of a closed economy is ambiguous, parts (b) of the two propositions can be potentially different. [This result is somewhat reminiscent of Matsuyama (1992) though, because he employs Stone-Geary preferences, the effect of agricultural productivity increase in a closed economy is unambiguous in his case, as it is in Eswaran and Kotwal (1993)].

The comparative statics of the equilibrium wage rate with respect to the two productivities present a stark contrast:

Proposition 3: When the region is a small open economy, the equilibrium wage rate has

(a) zero elasticity with respect to farm productivity, and

(b) unitary elasticity with respect to non-farm productivity.

The proof of this proposition is apparent from condition (18). As long as the region has even a smallest of non-farm sectors, the value of the marginal product of labour is pinned down by this sector. If farm productivity increases, this sector absorbs more labour until the entire initial increase in the wage rate is dissipated: farm productivity increases have zero effect on the equilibrium wage rate. Non-farm productivity increases, on the other hand, increase the wage rate in proportion by drawing out labour from the farm sector.

The sharp difference in the predicted effects of increases in the two productivities on the wage rate arises from the fact that labour faces diminishing returns in the farm

occur only in the farm sector.

sector (due to a fixed factor) but not in the non-farm sector. The latter stark assumption thus militates against the effect on wages (and, hence, on poverty) of farm productivity in comparison to non-farm productivity in an open economy. We could introduce diminishing returns to labour even in the non-farm sector by, for example, incorporating capital as an input (in both sectors) and having capital be a fixed factor in the short run. In that case, both productivity increases would raise the wage rate—the outflow of labour from a sector to the one experiencing the productivity increase would raise the equilibrium value of the marginal product of labour (in both sectors). We would expect, however, the equilibrium wage rate to be more elastic with respect to non-farm than farm productivity as long as diminishing returns to labour is less constraining in the non-farm sector.

5. Estimating the contribution of the non-farm sector

In this section, we use the theoretical framework of the previous section to outline a procedure that can assess the contribution of the non-farm sector in explaining the increase in agricultural wages during the period 1983-1999. It involves the estimation of a counterfactual scenario where all change in wages is due to the rise in non-farm productivity alone. (The counterfactual exercise is required because crucial data on non-farm TFP is unavailable, as described in more detail in a later section). In this exercise we ask, "What is the agricultural wage that would have prevailed in 1999 had there been *no increase* in non-farm TFP over the period 1983-1999?" By comparing that wage to the actual wage in 1999, we obtain an estimate of the non-farm contribution to the agricultural wage increase.

First, consider a closed economy. Let the 1983 levels of TFPs in the farm and non-farm sector be denoted by A_1 and B_1, respectively. General equilibrium determines the values of agricultural labor force L_{f1}, the non-farm sector labor force L_{n1}, and the wage rate w_1. We denote the 1999 levels of these parameters and variables by merely replacing the subscript 1 by 2.

It is convenient to conceptualize the shift in TFP parameters as occurring in two steps. In the first step, farm TFP rises from A_1 to A_2 but non-farm TFP remains unchanged at B_1**.** In this unobserved intermediate (counterfactual) position, let the equilibrium values of agricultural labor force, non-farm labor force, and wage rate be denoted by L_{fc} , L_{nc} and w_c. In the second step, farm TFP is held fixed at A_2 and non-farm TFP increases from B_1 to B_2**.** The observed change in wages due to TFP increases in both sectors is $(w_2 - w_1)$; of this, $(w_2 - w_c)$ is the contribution of the productivity increase in the non-farm sector. It is this contribution, as a proportion of the observed wage increase $(w_2 - w_1)$, which we seek to estimate in this section.

The observed change in non-farm labor force during the 1983-1999 period is $(L_{n2} - L_{n1})$; of this, $(L_{n2} - L_{nc})$ is due to TFP change in the non-farm sector and the remainder $(L_{nc} - L_{n1})$ is because of TFP change in the farm sector. Hence w_c, the wage that obtains in the scenario of no change in non-farm TFP, is the wage that clears the labor market when the agricultural labor force in 1999 acquires the value of $(L_{f2} + L_{n2} - L_{nc})$. If the marginal product schedule in agriculture is known, w_c can be read off this curve when employment is $(L_{f2} + L_{n2} - L_{nc})$. The difficulty is that this requires knowledge of the counterfactual value of non-farm labour, L_{nc}, which is unobserved.

It was argued in the earlier section that in a closed economy, as long as substitutability in consumption between the farm and non-farm goods is low enough, $(L_{nc} - L_{n1})$ will be positive. Assume for the moment, however, that this quantity is zero. Then the entire change in non-farm employment $(L_{n2} - L_{n1})$ would be due to productivity change in the non-farm sector. Now $(L_{n2} - L_{n1})$ is observed and it can be utilized to estimate the wage that would obtain in the hypothetical scenario where the agricultural labor force in 1999 was to be $L_{f2} + (L_{n2} - L_{n1})$. Denote this wage as w_H. This is the (hypothetical) wage rate that would have prevailed in agriculture if the agricultural TFP increase contributed *nothing* to non-farm employment (and so all added non-farm employment over the period 1983-1999 was due to non-farm TFP increase). The contribution of the non-farm sector to the wage increase in this scenario is $(w_2 - w_H)$.

In general, however, agricultural TFP growth will contribute to non-farm employment and so $(L_{nc} - L_{n1})$ will be positive. Therefore, the hypothetical 1999 agricultural labor force $L_{f2} + (L_{n2} - L_{nc})$ will be smaller than $L_{f2} + (L_{n2} - L_{n1})$. Since the marginal product of labour in agriculture declines in the amount of farm labour, it follows that $w_c > w_H$ and so $w_2 - w_H > w_2 - w_c$. Thus, while we are unable to estimate $(w_2 - w_c)$, we can estimate an upper bound of the contribution of the non-farm sector, namely, $(w_2 - w_H)$.[6]

Under what conditions would we expect our estimate from the above procedure to be truly an upper bound on the non-farm contribution to the agricultural wage increase? The answer to this question hinges crucially on how agricultural TFP increase impinges on non-farm employment. We have presumed in our discussion above that this effect is positive. If this is indeed the case, by assigning the entire non-farm employment increase over the period 1983-1999 to non-farm TFP increases we are overestimating the contribution of the non-farm sector. Therefore, our procedure indeed does provide an *upper bound* on the non-farm sector's contribution to the wage increase. If, however, farm TFP increase reduces non-farm employment by absorbing labour into the agricultural sector, then by attributing the entire change in non-farm employment increase over the period 1983-1999 to non-farm TFP increases we are underestimating the contribution of the non-farm sector. Non-farm TFP would have contributed more to the non-farm sector, in this case, had not agriculture clawed back some workers. In this eventuality, the counterfactual procedure we employ would provide a *lower bound* on the contribution of the non-farm sector to agricultural wage increases.

How does agricultural TFP increase affect non-farm employment? This, of course, is an empirical issue. In the following section we provide persuasive

[6] In a Cobb-Douglas technology, all inputs are complementary and therefore all non-labour inputs would have in fact been higher than what we have assumed and consequently the hypothetical wage w_H would have been higher than the one computed under our assumption.

econometric evidence to suggest that farm TFP *increases* non-farm employment. Therefore, we are confident that our counterfactual estimates provide an *upper bound* on non-farm's contribution to agricultural wage increases.

Now suppose each region is a small open economy. In extending our procedure to an open economy, we must also consider the role of trade. From equation (18), it is evident that trade can contribute to the change in wages by changing the relative price of the non-farm good. Continuing with the earlier notation on sectoral productivities, employment and wages, suppose also that p_1 and p_2 denote the relative price of the non-farm good in 1983 and 1999, respectively. In the second conceptual step, farm TFP is held fixed at A_2 while we allow changes to both the non-farm TFP and the relative price of the non-farm good. The change in wages because of TFP increases in both sectors *and* trade is $(w_2 - w_1)$, of which $(w_2 - w_c)$ is the contribution of the productivity increase in the non-farm sector. With this interpretation, the rest of the procedure is as before. In other words, what we designated in a closed economy framework as a bound on the contribution of the non-farm productivity growth would, in fact, be a bound on the *combined contribution* of productivity growth in the non-farm sector and the relative price change of the non-farm good due to trade.

To take our analysis further, we need to estimate the marginal product of labor curve for agriculture sector. Assume that the agricultural output, *Q*, is given by a Cobb-Douglas production function:

$$Q = AL^{\delta} \prod_{i=1}^{n} X_i^{\rho_i} \text{ , with } \delta + \sum_i \rho_i = 1,$$

where L denotes the amount of labor employed in agriculture, X_i denotes the ith input other than labor (such as land, fertilizers etc), and A denotes the total factor productivity.

A good reason to choose Cobb-Douglas technology is that it allows us to form some judgment on the relative contribution of the non-farm sector on the basis of the only available empirical information on the production side – labour share of input costs in agricultural production. It is for this reason that the Cobb-Douglas production function is frequently used in the literature to represent agricultural technology [e.g., Hansen and Prescott (2002), Coeymans and Mundalak (1993)].

As before, let subscripts 1 and 2 denote variables in the years 1983 and 1999 respectively. Taking the price of agricultural output as the numeraire, the wage rate in period 2 (given by the marginal product of labor) may be written

$$w_2 = \delta A_2 L_{f2}{}^{-(1-\delta)} \prod_{i=1}^{n} X_{i,2}^{\rho_i} = \delta A_2 \prod_{i=1}^{n} (X_{i,2} / L_{f2})^{\rho_i}$$

Suppose $l \equiv (L_{n2} - L_{n1})$ denotes the increase in non-farm employment over the period 1983-99. The hypothetical wage w_H that would have prevailed in 1999 if l was absorbed by the agricultural sector is given by

$$w_H = \delta A_2 \prod_{i=1}^{n} (X_{i,2} /(L_{f2} + l))^{\rho_i} = \delta A_2 \prod_{i=1}^{n} (X_{i,2} / L_2)^{\rho_i} (1 + l / L_{f2})^{-\rho_i} = w_2 \prod_{i=1}^{n} (1 + l / L_{f2})^{-\rho_i} ,$$

where we have assumed that all inputs other than labor are employed at the same level as that in 1999. [7]

The above may be rewritten as

[7] Note that it follows from footnote 5 that the assumption of unchanged levels of non-labour inputs in our analysis is yet another reason to believe that the relative contribution of non-farm productivity increase is an overestimate.

$$w_H = w_2(1 + l / L_{f2})^{-\sum \rho_i} = w_2(1 + l / L_{f2})^{-(1-\delta)}$$

The upper bound to the contribution of the non-farm sector is then

$$w_2 - w_H = w_2[1 - (1 + l / L_{f2})^{-(1-\delta)}].$$

The proportional increase in the agricultural wage *attributable to non-farm employment* is

(19) $$(w_2 - w_2^H)/(w_2 - w_1) = (w_2 /(w_2 - w_1))[1 - (1 + l / L_{f2})^{-(1-\delta)}].$$

This expression is couched entirely in terms of observable quantities and can be readily computed if we have an estimate of δ.

6. The Role of the Non-farm Sector: Data and Estimates

Agricultural wage and employment data is available from the all-India employment surveys of the National Sample Survey Organization (NSSO), where households are the final sampling units and the survey reports the employment status of each member of the household. In this paper we use that part of the schedule where, for the reference period of a week, the survey elicits an individual's time disposition during each half-day of the week. This data takes into account multiple economic activities and employment patterns that are characteristic of poor households. Furthermore, as households are surveyed uniformly throughout the year, the aggregates derived from weekly data are representative of annual aggregates. The NSS surveys are conducted at 5-year intervals and the unit level data from 1983, 1987-88, 1993-94, and 1999-00
surveys are available.

For the reference period of a week and for each economic activity reported by an individual, the employment survey also reports the weekly earnings.[8] Our measure of agriculture wage is the daily earnings from that activity. It is computed by dividing the weekly earnings from agriculture divided by the number of days worked in that activity. To control for cost of living differences across time and across states, wages have to be deflated. The Planning Commission uses the consumer price index for agricultural labourers and the consumer price index for urban manual workers to update its poverty line in nominal values. We use the deflator implicit in the Planning Commission poverty lines to deflate wages across time and states.

The second column of Table 1 reports the observed change in agricultural wages during the period 1983 to 1999. At the all India level, wages increased by 69%. The column also displays the growth in agricultural wages for 15 major Indian states that accounted for 98% of agricultural employment in 1999. The median figure is 68.4% and it belongs to Uttar Pradesh, the largest state in the country. Assam with negligible growth and Tamil Nadu with wage growth rates in excess of 100% are the outliers.

The third column in Table 1 shows, in percentage terms, how much higher agricultural employment would have been in 1999 if the sector had to absorb the entire increment to non-farm employment during the period 1983-99 (i.e., l/L_{f2}). At the all-India level, the agricultural labor force would have been higher by 25% in 1999, if the non-farm sector employment was frozen at 1983 levels. At the state level, this variable varies between 11% (Orissa) to 43% (Punjab) leaving aside the outlier of Kerala where non-farm employment growth is 80% of the stock of agricultural employment in 1999.

[8] Earnings are not available for self-employed individuals, however.

It is noteworthy that the states that are well-known for having attracted relatively greater investment in the modern industrial sector (i.e., Gujarat, Haryana, Karnataka, Maharashtra and Tamilnadu) have created considerable employment in their non-farm sectors but no more than around 37% of the 1999 agricultural employment levels. On the other hand, the state that has created the most non-farm employment (relative to agricultural employment) in this period is Punjab which is well known for its farm sector development. Clearly, some of the non-farm employment growth in Punjab is because of agricultural growth. Our estimate of the contribution of non-farm sector in Punjab would therefore be a generous upper bound.

In competitive markets, δ is equal to the output share of labor. We take the sum of the value of crop output and livestock as the value of agricultural output.[9] Agricultural employment and average daily wages are computed from the NSS employment and wages survey. To keep our estimates of agricultural employment and wages comparable with the value of output data, we excluded work in forestry, fisheries and activities other than cultivation and livestock. The share of labour in agriculture, is the ratio of the estimated wages paid out to labour to the value of output in agriculture. These labour shares are displayed as the fourth column in Table 1.

The fifth column of numbers in Table 1 shows the maximum projected proportional change in agricultural earnings that could possibly be attributed to the

[9] The data are collected from various issues of Value of Output from Agriculture and Livestock, Central Statistical Organisation, Ministry of Statistics and Programme Implementation, Govt. of India. The crops included are cereals, fruits and vegetables, total fibres, pulses, sugar, oilseeds, spices, total drugs and narcotics, total by-products, indigo and other crops.

growth of the non-farm sector during 1983-99. The sixth column shows the proportion of the observed increase that can be attributed to the non-farm sector. It is computed using expression (19). In the final two columns of Table 1, we present standard errors and the associated t-statistics for the contribution of the non-farm sector presented in the fifth column. These standard errors are obtained by a cluster bootstrap with a thousand replications.[10] Other than for Assam, the contribution of the non-farm sector is precisely estimated.

At the all-India level, the maximum contribution of the non-farm sector is less than a quarter of the observed wage increase. Ignoring Assam, where the estimates are not precise, the maximum contribution of the non-farm sector varies from a low of 9% for Bihar to a high of 56% for Punjab. As mentioned earlier, it is highly probably that the estimate for Punjab is a generous upper bound. States where the maximum possible contribution of the non-farm sector is greater than 30% are are Haryana, Kerala, Punjab and West Bengal. Other than Gujarat, Maharashtra and UP, in all the other states the maximum impact of the non-farm sector is limited to less than 20% of the earnings increase.

As pointed out earlier, the interpretation of our estimates in Table 1 as the upper bound of the contribution of the non-farm sector to wage growth rests on the assumption that rising agricultural productivity leads to an increase in non-farm employment. We provide evidence for this in the next section.

[10] As noted earlier, the NSS surveys have a two-stage design where clusters (villages in the rural sector and urban blocks in the urban sector) are sampled in the first stage and households from the selected clusters in the second stage. There are 10527 clusters in the 1983 survey and 8530 in the 1999 survey (in our sample of 15 states). The bootstrap draws 1000 samples of the clusters (with replacement) and the contribution of the non-farm sector is calculated for each sample. The standard error of this statistic is calculated from its distribution over all the samples.

For the economy as a whole, there is little trouble in regarding it as closed. In their classification of economies as having open or closed trade policies, Sachs and Warner (1994) categorize India as having a closed trade policy until 1994. With the same methodology but an updated data set Wacziarg and Welch (2003) classify India as closed right up to the end of the 1990s. Table 2 displays the proportion of exports of foodgrains to its production (both measured in tons) for the decade of the 1990s.[11] The column next to it is the proportion of gross exports to production. Measured either way, exports are a negligible fraction of total production. It is unlikely therefore that average agricultural wages in the economy are much affected by trade. Thus, we can conclude that our all-India estimate of non-farm's contribution to agricultural wage increase in Table 1 is indeed an upper bound.

7. Are Our Estimates Upper Bounds for States as Well?

The assumption that the economy is closed is not so evident when the regions under consideration are individual states. If they turn out to be open economies, as we have argued earlier our procedure is still valid, provided agricultural TFP improvements increase non-farm employment (an issue we empirically investigate here). However, the bounds we have calculated in Table 1 have to be interpreted as the combined effects of changes in non-farm TFP increases and trade.

When the economy is closed, the theoretical model can be reduced to two equations that determine wages and non-farm employment (using equations (5) and (9)). The exogenous variables in these reduced form equations are the total factor

[11] Foodgrains occupy about two-thirds of crop area.

productivities in the farm and non-farm sectors. When the economy is open, the exogenous variables will also include sectoral total factor productivities of its trading partners since the relative price of the non-farm good depends on these as well.

The econometric exercise is, however, limited by data availability. As wages and non-farm employment data are available only at five yearly intervals starting from 1983, we do not have sufficient observations at the all India level or at the state level. The difficulty is compounded by the absence of non-farm TFP data. Various estimates are available for the organized manufacturing sector but only at the state level (for example, Veeramani and Goldar (2004)). But this leaves out the unorganized manufacturing as well as the entire service sector. It is the service sector expansion that has contributed most to the growth of non-farm employment between 1983 and 1999. Therefore, restricting the measure of non-farm TFP to manufacturing is unlikely to capture the impact of non-farm TFP on non-farm employment and wages.[12]

To resolve the problem of insufficient observations, we estimate a cross-sectional regression at the village level by exploiting the two stage sampling design of the NSS employment surveys in which the village is the primary sampling unit and the households are sampled from the selected villages. The reduced form model can then be written as

(20) $$n_v = \beta_0 + \beta_1 A_v + \beta_2 B_v + \beta_3 E_v + \beta_4 \overline{A}_v + \beta_5 \overline{B}_v + u_v$$

(21) $$w_v = \varphi_0 + \varphi_1 A_v + \varphi_2 B_v + \varphi_3 E_v + \varphi_4 \overline{A}_v + \varphi_5 \overline{B}_v + \varepsilon_v$$

[12] The lack of relevant data means that econometric analysis cannot assess the *relative* contributions of agricultural and non-agricultural TFP in explaining the wage growth of agricultural labour – which is why we undertook the counterfactual analysis in Section 5.

where v indexes the village, n_v and w_v are the log of non-farm employment and wages, respectively, A_v and B_v are the log of total factor productivities in the farm and non-farm sector respectively, E_v controls for differences in village endowments (population, irrigated land, cultivable land) and $\overline{A}_v$, $\overline{B}_v$ are the sectoral productivities of the trading partners of village v.

While the dependent variables of (20) and (21) can be obtained from the NSSO employment and wage surveys, TFP estimates must be sought elsewhere. In the literature, estimates of farm TFP are available only at the state level (Fan, Hazell and Thorat, 1999). One exception is Kumar, Kumar and Mittal (2004) which contains estimates at the district level but they confine their exercise to states in the Indo-Gangetic belt. To overcome this limitation, we combine data on output and inputs from Bhalla and Singh (2001) with cost share information from the cost of cultivation surveys. While the data in Bhalla and Singh is at the district level, we construct TFP estimates at a higher level of aggregation. Over time districts have been subdivided and new districts formed. To ensure comparability across periods, Bhalla and Singh present their data according to the district boundaries in 1961. It is therefore not possible to disaggregate their data so that it maps to district definitions in the more recent NSS data. The sampling design of the NSS uses a larger geographical area called the NSS region. The NSS region consists typically of more than one district and its boundaries are usually those of its constituent districts. Since it is possible to aggregate the Bhalla and Singh data to the NSS region level in a consistent manner, we are able to construct farm TFP estimates at the NSS region level. However, this data set is confined to the crop sector and so are the cost shares from the cost of cultivation surveys. Another limitation is that the Bhalla and

Singh data is not available for the period beyond 1993. Our econometric analysis is therefore limited to 1983 and 1993-94.

The absence of non-farm TFP estimates has already been discussed. As estimates of non-farm output are available only at the state level, it would be beyond any researcher to obtain non-farm TFP measures at a lower level of geographical aggregation. However, state level estimates would probably suffice as non-farm TFP is unlikely to be as narrowly location specific as farm TFP. Economic policies, technology, and infrastructure (the primary determinants of non-farm TFP) are likely to be uniform across a well-defined political and administrative unit such as a state. If so, we could assume that non-farm TFP is invariant within a state and use state-specific fixed effects to control for non-farm TFP. This strategy allows us to consistently estimate the impact of farm TFP on the endogenous variables; however, it cannot give us the impacts of non-farm TFP. The version of (20) and (21) that is estimated, therefore, looks as follows:

(22) $$n_{vrs} = \beta_0 + \beta_1 A_{rs} + \beta_{2s} + \beta_3 E_{vrs} + \beta_4 \overline{A}_{rs} + u_{vrs}$$

(23) $$w_{vrs} = \varphi_0 + \varphi_1 A_{rs} + \varphi_{2s} + \varphi_3 E_{vrs} + \varphi_4 \overline{A}_{rs} + \varepsilon_{vrs}$$

where the variables are now indexed by the level of geographical aggregation. For instance, while n_{vrs} is the log of non-farm employment in village *v* of NSS region *r* and state *s*, A_{rs} is the farm TFP in region r of state *s*. Note that β_{2s} and φ_{2s} are state fixed effects and capture, among other things, the state specific non-farm TFP. A measure of farm TFP in trading partners is obtained by taking the average of farm TFP in other regions of the state. Note that this measure would vary by region but is common to all villages within a region. Since we are assuming that non-farm TFP is uniform within a state and can therefore be controlled by state fixed effects, we do not have to include a measure of non-farm TFP in trading partners.[13]

In the regressions, the dependent variables are the log of mean farm wage in the village and the log of the ratio of non-farm work days to all work days (farm + non-farm). We use the latter variable rather than the number of non-farm work days, in order to control for labor supply response to farm TFP. The control variables are the ratio of population to land, the proportion of cultivable land that is irrigated (both measured at the region level), and dummy variables for the quarter in which the household was surveyed. Variables measuring the age composition and education profile of the village population were insignificant, as were the village level measures of the proportion of irrigated land and the population to land ratio. The descriptive statistics of the variables used in the regressions are displayed in Table 3.

Equations (22) and (23) are estimated for 1983 and 1993/94. The results for 1983 are displayed in Tables 4 and 5. Three variants are considered. The first regression (columns 2 and 3) includes own region farm TFP and other control variables. The second regression (columns 4 and 5) includes also farm TFP of other regions, while the third regression (columns 6 and 7) further includes the log of yield (also at region level) in 1971 as a measure of the unavailable farm TFP in that year as an initial condition. In Table 4 the dependent variable is the log of average village daily wage, and in Table 5 the dependent variable is the proportion of village employment in non-farm activities.

In the wage regressions (Table 4), the elasticity of village wages to own region farm TFP varies between 0.50 and 0.69 and is highly significant. Table 5 shows that own region farm TFP also has a positive impact on non-farm employment (as would be

[13] Note that non-farm TFP impacts of other states cannot be measured because of state fixed effects.

expected in a closed economy). Village wages are also responsive to farm TFP in other regions (Table 4) with an elasticity of around 0.40. Other region farm TFP has a smaller and statistically insignificant impact on non-farm employment (Table 5). This suggests that its impact on wages stems from labour mobility within the state to high wage areas rather than from any specialization due to trade.

Tables 6 and 7 present similar results for 1993/94. The specification of the first two regressions is exactly like in the tables for 1983. The third regression includes an initial condition in the form of farm TFP in 1983 while the fourth regression also includes the log of farm yield in 1971 as another control for initial conditions. The own-region farm TFP impact on wages (Table 6) is now substantially smaller—ranging from 0.15 to 0.25. However, it continues to be statistically significant. The smaller impact of own-region farm TFP impact suggests a movement towards an open economy. This is supported by (a) the lack of impact of own-region farm TFP on non-farm employment (Table 7) and (b) the sizeable impact of other-region farm TFP on both wages (Table 6) and non-farm employment (Table 7) given the initial condition controls.

The 1983 results suggest that even the village economy was closed. Own-region farm TFP has the expected impacts on both wages and employment. Although the TFP of other regions in the state mattered to wages, this seemed to work through migration (within the state) rather than trade because it did not affect non-farm employment.[14] By 1993, however, the results suggest that trade was beginning to be important for the village economy. Wages are driven both by own and other-region TFP, while the latter matters to non-farm employment as well. However, even the 1993 results do not suggest a negative relationship between own-region farm TFP and non-farm employment at the village level. In fact, non-farm employment is highly responsive to the farm TFP in other regions within the state. At the state-level, therefore, farm TFP's impact on non-farm employment will be positive. Hence, it is valid to view the state-level findings of the counterfactual analysis as the upper bound to the contribution of non-farm sector productivity and trade in driving wages.

The importance of initial conditions in Tables 4 through 7 is suggestive of the dynamic impacts of farm TFP on wages. Tables 4 and 5 show that regions with higher TFP in 1983 had higher wages and higher non-farm employment. These regions with higher non-farm employment probably built on this advantage and by 1993 acquired a comparative advantage when inter-regional trade began to play a greater role. Thus, own-region farm TFP had little impact on non-farm employment (Table 7) and a reduced impact on wages (Table 6) in 1993. Both wages and non-farm employment are in fact strongly correlated with the 1983 farm TFP (the initial advantage) and with farm TFP in other regions (due to trade).

Before concluding this section, we emphasize that the agricultural sector over the period 1983 – 1999 considered in the last section also increased the use of factors that raised the productivity of labor—factors such as fertilizers, pumpsets, irrigated land, and tractors. These contribute to the higher wage rate in 1999.[15] We see from the right hand side of equation (19) that a higher 1999 wage rate (that is, w_2) lowers the proportional increase in the wage rate that is attributable to non-farm employment. The regression estimates of the effects of agricultural productivity

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[14] See footnote 4 on the magnitude of inter-state migration.

[15] **A casual comparison of Annexures 1(c) and 1(d) of Bhalla and Singh (2001) quickly reveals the extent of the increase in these inputs between 1983 and 1993. During this period, the use of fertilizers, pumpsets, and tractors went up by 126%, 130%, and 95%, respectively, at the all-India level.**

growth over 1983-1993 in this Section, however, refer strictly to total factor productivity (which excludes the increase in these complementary inputs). So even though the increase in farm TFP appears small (6%, from Table 3), the additional employment of inputs other than labor in agriculture greatly assists in enhancing the farm sector's—and undermining the non-farm sector's—contribution to wage increases.

That said, we must acknowledge the caveat that our cross-sectional regression analysis cannot strictly speak to the issue of time trend. An anonymous referee has pointed out that unobservable variables that are correlated with agricultural productivity and wages may ultimately be responsible for the cross-sectional (within population) estimates. Accounting for such considerations, however, is outside the scope of this paper.

8. Concluding Discussion

Over the last two decades, several countries that liberalized their economies experienced fast growth as a result of a relaxing of the constraints on entrepreneurship and trade. Typically, the growth was driven by manufacturing and service sectors where technology transfer is the easiest. There is ample empirical evidence that growth is correlated with a decline in poverty and it is this fact that makes growth in poor countries so important. However, what this paper points out is that the non-farm sectors that are prone to fast growth on liberalization may be less effective than agriculture in bringing down poverty (raising agricultural wages) in India. It thus supports the findings of Ravallion and Datt (1996) regarding the dynamics of poverty decline in

India. The process through which poverty declines as modeled in this paper is, however, quite generic and in all likelihood our conclusion may apply to other developing countries as well.

Our simple two-sector framework allows us to view the increase in wages to occur through two channels: (i) through an outward movement of the marginal product schedule of labor caused by a growth in agricultural TFP and the use of complementary inputs, and (ii) through the movement of labour out of agriculture into other sectors. The important role played by the growth in farm TFP and complementary agricultural inputs in the wage increase in India over the 16-year period is self-evident. Given that the land to labour ratios decreased in most states over the period due to the slow pace of the movement of labour out of agriculture compared to the population growth rate, it is clear that without any growth of agricultural TFP and of other inputs the wages would have declined in most states. Growth in non-farm sectors can contribute to an increase in wages by drawing labour out of agriculture and thus by increasing the land to labour ratio, in other words through Channel (ii). But since some of the increase in agricultural incomes also spill on to non-farm goods, it is clear that in a closed economy an increase in agricultural productivity also contributes to a wage increase through Channel (ii). Our empirical method of evaluating the role of the non-farm sector (and trade) comprises attributing the entire Channel (ii) effect to the non-farm sector, thus exaggerating its role. Even so, the resulting upper bound is no more than a quarter of the observed wage increase.

Timmer (2005) asks why agriculture is returning to the policy agenda and answers:

"The most important reason is new understanding that economic growth is the main vehicle for reducing poverty and that growth in the agricultural sector plays a major role in that overall growth as well as in connecting the poor to growth."

Lipton (1977) and Mellor (1976, 2000) were the two early proponents of the view that agricultural growth is the most effective instrument to reduce poverty in poor countries. Recently, there is a growing number of papers exploring this issue in the context of different groups of countries. Thirtle, Lin and Piesse (2003) survey many of these papers and cite the finding of Gallup et al (1997) and Bourgignon and Morrison (1998) that agricultural growth has a bigger impact on poverty than does growth in other sectors. Even China—a country whose manufacturing sector has grown at an astonishing rate—may not be different in this respect. Ravallion and Chen (2004) attribute the decline of poverty in China from 53% in 1981 to 8% in 2000 much more to growth in the agricultural sector than to growth in either the secondary or the tertiary sectors. Thirtle, Lin and Piesse (2003) suggest that the impact of agricultural growth on poverty relative to non-agricultural growth declines with development. It is stronger in South Asia and Africa where a large mass of the population under the poverty line are endowed with low human capital and make their living in agriculture than in Latin America. Non-farm growth does create jobs but only a small part of these jobs are open to the unskilled. Agricultural productivity growth, on the other hand, improves their incomes in their current occupation in addition to creating non-farm jobs through spillovers.

It should be emphasized that the policies that were responsible for increasing the growth rate of the non-farm sectors did contribute to the overall poverty decline but in all likelihood not as much as what is commonly believed. In countries such as India where over 50% of the labour force is still in agriculture and where the most of the poor are relatively unskilled, there is no more effective instrument for poverty alleviation than growth in agricultural productivity and the utilization of inputs complementary to labor.

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Figure 1: Real (daily) Wages in Agriculture and Labour-Land Ratio

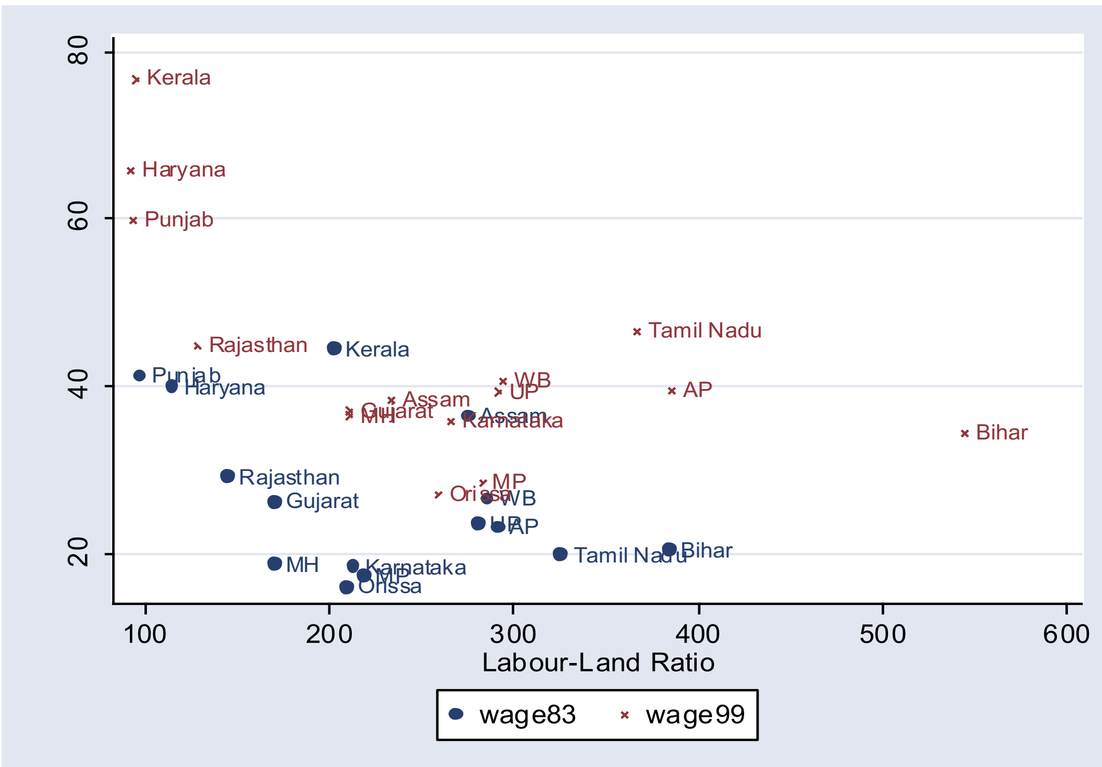

Table 1: The Relative Contribution of the Non-farm Sector to Agricultural Wage Growth

	% change in wages	Change in non-farm employment as proportion of farm employment in 1999	Labour share in value of output in 1999	Proportional change in agricultural wages due to non-farm sector	% Contribution of non-farm sector to change in wages	Standard error (bootstrapped)	t-value
	$\frac{(w_2 - w_1)}{w_1}$	(l / L_{f2})	δ	$\frac{(w_2 - w_2^H)}{w_1}$	$\frac{(w_2 - w_2^H)}{(w_2 - w_1)}$		
All India	0.69	0.25	0.461	0.156	0.23	0.01	21.935
Andhra Pradesh	0.72	0.23	0.516	0.136	0.19	0.024	7.898
Assam	0.06	0.39	0.484	0.127	2.29	114.101	0.02
Bihar	0.69	0.13	0.67	0.061	0.09	0.018	4.895
Gujarat	0.42	0.27	0.568	0.114	0.27	0.066	4.127
Haryana	0.65	0.27	0.321	0.205	0.32	0.156	2.022
Karnataka	0.97	0.17	0.426	0.149	0.16	0.034	4.544
Kerala	0.73	0.80	0.397	0.345	0.47	0.045	10.575
Madhya Pradesh	0.66	0.12	0.473	0.086	0.13	0.026	5.007
Maharashtra	0.96	0.36	0.426	0.248	0.26	0.037	6.912
Orissa	0.70	0.11	0.479	0.082	0.12	0.044	2.687
Punjab	0.46	0.43	0.269	0.255	0.56	0.096	5.791
Rajasthan	0.54	0.23	0.602	0.102	0.19	0.065	2.924
Tamil Nadu	1.36	0.37	0.574	0.230	0.17	0.025	6.671
Uttar Pradesh	0.68	0.25	0.502	0.148	0.22	0.028	7.673
West Bengal	0.54	0.32	0.323	0.212	0.39	0.075	5.224

Table 2: The Relative Importance of Agricultural Trade

Year	% of Net Exports of foodgrains to Production of foodgrains	% of Gross Exports of foodgrains to Production of foodgrains
1990/91	-0.09	0.50
1991/92	0.02	0.61
1992/93	-0.05	0.55
1993/94	1.09	1.44
1994/95	1.44	1.84
1995/96	1.36	2.10
1996/97	0.89	1.92
1997/98	0.50	1.61
1998/99	0.85	1.61
1999/00	0.88	1.60
2000/01	1.99	2.76

Table 3: Descriptive Statistics

Variable	Mean	Std. Dev.
Log of average daily wage in village, 1983	3.06	0.50
Proportion of village employment in non-farm activities, 1983	0.25	0.24
Proportion of observations from April to June, 1983	0.25	0.43
Proportion of observations from July-September, 1983	0.25	0.43
Proportion of observations from October - December, 1983	0.25	0.43
Log of region-level farm TFP, 1983	0.82	0.56
Ratio of population to land (region-level), 1983	0.05	0.03
Proportion of cultivable land irrigated (region-level), 1983	0.37	0.31
Log of average TFP in other regions of the state,1983	0.83	0.54
Log of yield in 1971 (region-level)	1.46	0.88
Log of average daily wage in village, 1993	3.39	0.62
Proportion of village employment in non-farm activities, 1993	0.26	0.23
Proportion of observations from July-September, 1993	0.25	0.43
Proportion of observations from October - December, 1993	0.25	0.43
Proportion of observations from April to June, 1994	0.25	0.43
Log of region-level farm TFP, 1993	0.88	0.60
Ratio of population to land (region-level), 1993	0.06	0.04
Proportion of cultivable land irrigated (region-level), 1993	0.45	0.38
Log of average TFP in other regions of the state, 1993	0.83	0.54

Table 4: Dependent Variable: Log village mean wage in 1983

	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
Ln(farm TFP, 1983)	0.50	12.17	0.67	9.02	0.69	9.22
Ln(Farm TFP in other regions of the state, 1983)	---	---	0.41	2.84	0.42	2.89
ln(value of output per ha in 1971)	---	---	---	---	-0.02	-2.32
Quarter: Apr-Jun	0.03	1.90	0.03	1.87	0.03	1.85
Quarter: Jul-Sep	0.02	1.25	0.02	1.22	0.02	1.21
Quarter: Oct-Nov	0.06	4.13	0.06	4.09	0.06	4.05
Ratio of Population to Cultivable Land, 1983	-0.51	-1.45	-0.69	-1.91	-0.65	-1.81
Proportion of Cultivable land that is irrigated,1983	0.24	5.80	0.23	5.42	0.23	5.46
constant	2.37	54.91	2.12	13.20	2.13	13.24
State Fixed Effects	F(14,5812)=98.8		F(14,5811)=98.7		F(14,5810)=98.9	
# Observations	5833		5833		5833	

Table 5: Dependent Variable: Ratio of Village Non-farm employment to total employment (both in days), 1983

	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
Ln(farm TFP, 1983)	0.05	2.55	0.06	1.67	0.07	1.97
Ln(Farm TFP in other regions of the state, 1983)	---	---	0.02	0.34	0.03	0.42
ln(value of output per ha in 1971)	---	---	---	---	-0.01	-2.80
Quarter: Apr-Jun	-0.01	-1.08	-0.01	-1.08	-0.01	-1.09
Quarter: Jul-Sep	-0.06	-7.67	-0.06	-7.68	-0.06	-7.70
Quarter: Oct-Nov	-0.06	-7.99	-0.06	-7.99	-0.06	-8.04
Ratio of Population to Cultivable Land, 1983	1.16	6.50	1.15	6.31	1.17	6.47
Proportion of Cultivable land that is irrigated,1983	0.00	-0.09	0.00	-0.13	0.00	-0.11
constant	0.18	11.60	0.15	1.88	0.15	1.90
State Fixed Effects	F(14,6808)=12.6		F(14,6807)=12.55		F(14,6806)=13.02	
# Observations	6829		6829		6829	

Table 6: Dependent Variable: Log village mean wage in 1993

	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
Ln(farm TFP, 1993)	0.24	6.44	0.25	6.16	0.15	3.29	0.17	3.78
Ln(Farm TFP in other regions of the state)	---	---	0.14	0.98	1.13	5.41	1.15	5.52
ln(farm TFP,1983)	---	---	---	---	0.76	6.53	0.77	6.60
ln(value of output per ha in 1971)	---	---	---	---	---	---	-0.04	-3.86
Quarter: Apr-Jun	0.07	2.86	0.07	2.86	0.07	2.87	0.06	2.85
Quarter: Jul-Sep	0.08	3.65	0.08	3.64	0.08	3.69	0.08	3.66
Quarter: Oct-Nov	0.12	5.32	0.12	5.32	0.12	5.35	0.12	5.34
Ratio of Population to Cultivable Land	-0.09	-0.15	0.18	0.29	-1.64	-2.39	-1.21	-1.75
Proportion of Cultivable land that is irrigated	0.08	1.87	0.08	1.76	0.09	1.97	0.07	1.68
constant	3.11	71.07	2.97	19.85	1.82	7.84	1.82	7.87
State Fixed Effects	F(14,4981)=34.04		F(14,4980)=34.04		F(14,4979)=33.4		F(14,4978)=33.43	
# Observations	5002		5002		5002		5002	

Table 7: Dependent Variable: Ratio of Village Non-farm employment to total employment (both in days), 1993

	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
Ln(farm TFP, 1993)	0.00	-0.10	0.00	0.33	-0.01	-0.72	-0.01	-0.88
Ln(Farm TFP in other regions of the state)	---	---	0.05	0.91	0.20	2.68	0.19	2.65
ln(farm TFP,1983)	---	---	---	---	0.12	2.81	0.11	2.80
ln(value of output per ha in 1971)	---	---	---	---	---	---	0.005	1.25
Quarter: Apr-Jun	0.01	0.89	0.01	0.89	0.01	0.89	0.01	0.89
Quarter: Jul-Sep	0.04	4.42	0.04	4.41	0.04	4.41	0.04	4.41
Quarter: Oct-Nov	0.04	4.84	0.04	4.84	0.04	4.85	0.04	4.84
Ratio of Population to Cultivable Land	1.14	5.70	1.23	5.54	0.95	3.90	0.90	3.63
Proportion of Cultivable land that is irrigated	-0.05	-3.00	-0.05	-3.09	-0.05	-3.00	-0.05	-2.89
constant	0.19	12.10	0.14	2.70	-0.04	-0.45	-0.04	-0.46
State Fixed Effects	F(14,5891)=12.27		F(14,5890)=12.02		F(14,5889)=11.86		F(14,5888)=11.89	
# Observations	5912		5912		5912		5912	