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ARTICLES

Rural-Urban Growth Linkages in India

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I

INTRODUCTION

The rural non-farm economy accounts for 20 per cent of all full-time employment in rural India and for nearly one-third of rural income. It is the backbone of the economy of numerous small towns scattered throughout the countryside as well as the primary source of income and employment for many of India's poor. Seen in this light, the rural non-farm economy will play a key role in determining future prospects for employment growth and poverty alleviation in India.

The rural non-farm economy is intimately linked to agriculture. A substantial share of rural manufacturing involves agro-processing and the production, repair and supply of farm inputs. Moreover, the dominant sectors in the rural non-farm economy consist of trade and service establishments that cater largely to rural consumer demand.

The prospects for growth in the rural non-farm economy will, therefore, hinge on future agricultural performance. Increases in farm income stimulate demand for consumer goods and services (Mellor, 1976). Likewise, a growing agriculture demands production inputs and supplies raw materials to transport, processing and marketing firms (Johnston and Kilby, 1975). In addition to stimulating national economic growth, these production and consumption linkages affect poverty and spatial growth patterns. Because most of the resultant growth in non-farm activity is located in rural areas and small towns, it can contribute to the containment of excessive rural-to-urban migration. Moreover, when agricultural growth is focused on small and medium-sized farms, the resulting demand patterns typically favour products produced by small, labour-intensive enterprises whose growth can contribute to increased employment opportunities for the poor (Johnston and Kilby, 1975; Mellor, 1976).

This paper examines the importance of these rural-urban growth linkages in India. Because growing land scarcity raises concerns about prospects for rural labour absorption, the paper highlights the impact of agricultural growth on rural non-farm incomes and employment. Methodologically, the paper innovates by estimating agricultural growth multipliers econometrically rather than by the conventional input-output models.

II

DESCRIPTIVE PROFILE OF NON-FARM ACTIVITY

Non-farm enterprises account for about 20 per cent of full-time employment in rural India and for roughly 75 per cent in rural towns (Table I). In addition, one must consider the part-time and seasonal employment that undoubtedly increases the importance of non-farm activity. Indeed, 20 to 50 per cent of rural manufacturing enterprises operate only

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The views expressed in the paper are the authors' and should not be attributed to the World Bank.

TABLE I. NON-FARM SHARE OF TOTAL EMPLOYMENT IN INDIA, 1961, 1971 AND 1981
(per cent of total full-time workers)

Year	Rural areas plus rural towns			Large urban[b]	Total national
	Rural areas	Rural towns	Total		
(1)	(2)	(3)	(4)	(5)	(6)
1961	18.0	79.4	22.8	96.2	27.7
1971	15.2	76.5	20.4	95.4	27.9
1981	18.9	77.4	24.3	95.8	33.3

Source: Population Census of 1961, 1971 and 1981. See Government of India (1961 *a-d*, 1971 *a-b* and 1981 *b*).
a. Rural towns are defined as urban areas under 100,000 in population. They are settlements of between 5,000 and 100,000 people.
b. Large urban settlements are all those with population exceeding 100,000. Total urban figures reported in the censuses equal the sum of what have been partitioned here into rural towns and large urban settlements.

part-time or seasonally (NSSO, 1976). Even so, measured secondary employment appears very small in the aggregate. According to the 1981 population census, only 2.4 per cent of India's economically active population finds secondary employment in non-farm sectors (Government of India, 1988). This holds true in both rural and urban areas. The National Sample Survey (NSS) data place the rural figure even lower (NSSO, 1961). Of course, standard labour force definitions, because of their emphasis on usual employment and inability to fully capture female participation, may obscure the extent of seasonality and part-time non-farm employment, as the following income figures suggest.

Income data reveal larger role for non-farm activity. In rural areas, excluding rural towns, non-agricultural activity normally contributes 25 to 35 per cent of total income in contrast with its 20 per cent share of employment. Moreover, the non-farm income share appears to be growing substantially over time (Table II).

TABLE II. NON-FARM SHARE OF RURAL AND URBAN INCOME, INDIA, 1967-68 TO 1981-82

Source of income	Rural						Urban
	1967-68	1968-69	1969-70	1970-71	1975-76	1981-82	1975-76
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Agriculture							
Own farm	62.8	54.9	61.2	60.5	55.8	53.3	4.7
Wage labour[b]	(11.7)	19.9	17.7	17.4	13.7	(16.5-11.9)	0.5
Total agriculture	(74.5)	74.8	78.9	77.9	69.5	(69.8-65.2)	(5.2)
Non-farm							
Self-employment	10.3	8.4	7.6	9.0	8.1	-	26.4
Wage labour[b]	(2.0)	3.4	2.1	3.0	8.6	(2.9-7.5)	10.6
Salary	10.5	8.0	5.9	5.8	9.8	-	49.1
Rent and dividends	2.7	5.4	5.5	4.3	4.0	-	5.6
Total non-farm	(25.5)	25.2	21.1	22.1	30.5	(30.2-34.8)	--
Total income	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source:- National Council of Applied Economic Research (NCAER) (1972, 1975, 1980, 1986 *a*).
a. Excludes transfer income from 1967-68 and 1975-76 to make income definition comparable with other years.
b. In some years, published results fail to disaggregate farm and non-farm wages. Figures in parentheses partition wages based on farm and non-farm shares prevailing in other years. For 1967-68, the estimated wages breakdown takes non-farm share of total wages at 15 per cent, the level prevailing in 1968-69 to 1970-71. Since non-farm share of wages appears to have risen over time, the 1981-82 estimate offers a range. The lower bound takes non-farm wage share at 15 per cent, the upper bound puts it at 38.7 per cent, the level prevailing in 1975-76.
-- Not applicable. Wages disaggregated in those years.
- Breakdown not available

Many labour-intensive non-farm activities provide work opportunities for the very poor, especially the landless (Table III). Moreover, the recent National Council of Applied Economic Research (NCAER) panel study of rural households indicates that over time the smallest rural land holders, like all rural households, have become increasingly dependent on non-farm earnings (NCAER, 1986 *a, b*).

TABLE III. INCOME DISTRIBUTION BY FARM SIZE, RURAL INDIA

(per cent)

Cropped area (ha/household)	Household income (Rs./ household)	Share of total income, by source			
		Crops	Farm wages	Non-farm and livestock	Total
(1)	(2)	(3)	(4)	(5)	(6)
(*i*) Poor crop year (1968-69)					
Zero	1,734	0	40.5	59.5	100
0 - 1.0	1,618	37.6	32.3	30.0	100
1.1 - 4.5	2,519	72.4	10.1	17.6	100
4.6 -10.5	4,763	85.5	1.8	12.6	100
More than 10.6	7,228	78.0	0.9	21.1	100
(*ii*) Good crop year (1970-71)					
Zero	1,865	0	37.7	62.3	100
0 - 1.0	1,630	38.7	26.9	34.4	100
1.1 - 4.5	2,889	69.3	9.9	20.8	100
4.6 -10.5	5,271	86.2	2.5	11.3	100
More than 10.6	11,082	96.4	0.2	3.4	100

Source: NCAER (1975).

Not surprisingly, the density of non-farm activity increases dramatically in urban areas and with town size. Currently, about 20 per cent of India's non-farm employment is based in rural towns, defined in this paper as localities between 5,000 and 100,000 in population.[1] A further 35 per cent reside in large cities over 100,000, while rural areas house the remaining 45 per cent.

The composition of non-farm activity differs considerably across locality sizes. In rural areas, services and household manufacturing dominate non-agricultural pursuits (Table IV). But in the move to rural towns, commerce and services lead the dramatic surge in non-farm activity. Similarly, factory manufacturing and transport increase substantially. Even the prevalence of household manufacturing increases in rural towns, although it declines in importance in large urban centres. In the largest urban localities, factory manufacturing emerges as the dominant non-farm activity.[2]

These differences, at least as measured by employment statistics, reflect almost exclusively changes in the level and composition of male employment. Measured female participation[3] remains minor in all locality sizes and activities and increases perceptibly only in services in rural towns.

The years since 1961 have witnessed several changes in the Indian non-farm economy. As Table I indicates, the decade of the seventies represents a key turning point. Until 1970, India's agricultural share of national employment remained constant, constant for a century or more according to some (see Vyas and Mathai, 1978; Deshpande and Deshpande, 1985; Sinha, 1982). Not until the 1981 census did the first evidence emerge of an increase in the national share of non-farm employment; it rose from 28 per cent in 1971 to 33 per cent in

1981. The income profiles tracked by NCAER researchers likewise identify the first substantial boost in rural non-farm incomes during the seventies (Table II). This coincides with the widespread adoption of green revolution wheat and rice varieties and provides at least circumstantial evidence linking the big spurt in agricultural growth with the enlargement of the non-farm economy.

TABLE IV. COMPOSITION OF NON-FARM ACTIVITY BY SIZE OF LOCALITY, INDIA, 1971

Size of locality	Agriculture	Non-agriculture								Total (2+3)
		Total	Mining	House hold mftr.	Non-household mftr.	Construction	Commerce	Transport	Other services	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Total employment										
Rural	287	51	1	11	8	2	8	3	18	338
Rural towns[a]	68	220	4	19	43	10	56	23	65	287
Large urban[b]	14	284	2	11	86	10	61	34	79	298
Males										
Rural	230	45	1	9	7	2	8	3	16	274
Rural towns	54	198	4	15	39	9	54	22	55	252
Large urban	12	260	2	9	82	10	58	33	66	271
Females										
Rural	57	7	0	2	1	0	1	0	2	64
Rural towns	14	22	0	4	3	1	2	1	10	36
Large urban	2	25	0	2	4	1	3	1	13	27

Source: India (1971 *a*, 1971 *b*).
a. Rural towns are all urban areas under 100,000 in population.
b. Large urban areas are all urban areas above 100,000.

Urbanisation has accompanied the rising prominence of non-farm activity. The non-farm employment densities have remained constant in rural areas, rural towns and in large urban centres (Table I). This, coupled with the rising national share of non-farm in total employment, can only be possible if rural towns and large cities increase in relative size, as indeed they have.

III

FACTORS AFFECTING CHANGE IN THE RURAL NON-FARM ECONOMY

Why does non-farm activity vary over time and across regions? Certainly resource endowments, location, ethnicity, historical happenstance, and government policy play a role. Yet agriculture, because of its size, must be added to the list of key suspects.

Agriculture can influence non-farm activity in at least three ways: through production, consumption and labour market linkages. On the production side, a growing agriculture requires inputs - of fertiliser, seeds, herbicides, pumps, sprayers, equipment and repair services - either produced or distributed by non-farm enterprises. Moreover, increased agricultural output stimulates forward production linkages by providing raw materials that require milling, processing and distribution by non-farm firms. Consumption linkages arise when growing farmer incomes boost demand for basic consumer goods; these typically increase over time as rising per capita income induces diversification of consumption spending into non-foods. Much of the overall increase in demand - for inputs, services, distribution and many basic consumer goods - can be serviced by firms in rural areas and

rural towns. Yet the heavy production inputs and consumer durables are more likely to be produced in large cities or abroad.

Although production and consumption linkages have attracted most of the initial interest in agricultural growth linkages (Mellor and Lele, 1973; Johnston and Kilby, 1975), more recent investigations highlight a third important link, the labour market interactions. In rural areas, in particular, rising agricultural wages raise the opportunity cost of labour in non-farm activities. This induces a shift in the composition of non-farm activity out of very labour-intensive, low-return activities and into more skilled, higher investment, high-return activities (Hossain, 1988; Ahmed and Hossain, 1990). Thus rising agricultural productivity may be instrumental in inducing a structural transformation of the rural non-farm economy.

Not all analysts have expressed confidence in the prospects for agriculture-led growth. In a provocative and often-cited review, Vyas and Mathai (1978) argue that agricultural growth has not in fact stimulated development of the rural non-farm economy. Using the population census data reproduced in Table I, they point out that the non-farm share of rural and urban employment remained unchanged between 1961 and 1971. In their view, skewed income gains in agriculture limited consumption linkages, while inadequate rural infrastructure limited the ability of rural firms to supply the modest increases in input and consumer demands.

Yet most subsequent analyses - based on longer time-series or disaggregated at the state or district level - dispute Vyas and Mathai's pessimistic conclusion.[4] Time-series evidence from fast-growing agricultural states document the strongest connections between agriculture and the non-farm economy (Chadha, 1986 *a*). Studies of the Punjab (Chadha, 1986 *b*; Bhalla *et al.*, 1989) and Haryana (Bhalla, 1981) all highlight the importance of rising demand for consumer goods and agricultural inputs as a result of increased agricultural production. Chadha, in particular, emphasises the importance of farm machinery and other input supply in the Punjab.

These studies likewise corroborate Ahmed and Hossain's (1990) initial evidence on labour market linkages. In Haryana and the Punjab, increased demand for agricultural labour has resulted in the highest farm wages in India. By raising the opportunity cost of labour in non-farm pursuits, this has led to a decline in very low-return household manufacturing and a parallel rise in higher-return modern small factories and services.

Other time-series evidence comes from the moderately prosperous agricultural region of North Arcot. Using a simulation model for the region, Hazell and Ramasamy (1991) have estimated demand multipliers emanating from agricultural growth over the seventies. They estimate that, as a result of production and consumption linkages every Rs. 100 increase in agricultural income induced an additional Rs. 87 in income in other sectors of the rural economy. Production linkages accounted for about half of the increase and consumption linkages the other half.

To date, cross-section comparisons across districts and states have produced similar, although less robust, correlations between agriculture and non-farm activity. In part, this arises because so many important factors other than agriculture vary across areas, and they also influence the level of non-farm activity. Raw material availability varies across regions; consequently leather-working industries predominate in Rajasthan, while wood processing is largest in well-forested states like Bihar (Papola, 1985). Moreover, tradition, caste, historical accident and India's elaborate system of subsidies and policy protection for small

and village industries complicate cross-section comparisons.

Even so, Radhakrishna *et al.* (1988), who compared three advanced agricultural districts in Uttar Pradesh with three laggards, found a higher non-farm employment share in the agriculturally prosperous areas. Papola (1985), comparing two different districts in the same state, found no correlation. But since he covered only a portion of rural non-farm activity - and the least buoyant at that, household manufacturing - the lack of association cannot be considered persuasive.

Khandker (1988) has used pooled time-series, cross-section district data to examine the relationships among rural employment, wages, agriculture and infrastructure. He finds both agricultural output and non-farm employment higher in regions with higher agro-climatic potential, but he does not attempt to measure the direct connection between the two.

The labour market links between agricultural and rural non-farm activity seem consistently robust in the cross-section studies. All comparisons to date have confirmed the positive relationship between earnings in agriculture and earnings in rural non-farm activity (see Papola, 1985; Chadha, 1986 *a, b*; Radhakrishna *et al.*, 1988).

IV

AN ECONOMETRIC ANALYSIS OF AGRICULTURAL GROWTH MULTIPLIERS

A. The Model

Since many factors other than agriculture affect the growth of the non-farm economy, attempts to quantify the magnitude of the growth multipliers require formal modelling approaches. Agricultural growth multipliers are typically estimated with the aid of economic base or input-output type models. But these models over-estimate multipliers because they assume perfectly elastic supply of non-farm goods and services (see Haggblade *et al.*, 1991, for a recent review). This section takes a different approach. It uses cross-section district data to estimate econometrically the indirect rural employment and income generated by agricultural growth. A principal advantage of this approach is that it accommodates upward-sloping non-farm supply curves and thus should result in lower, more realistic, multipliers than do the standard methods.

The following econometric model builds on the economic base model developed by regional scientists (Richardson, 1985). It assumes that agricultural output is constrained by technology, land and agro-climate, but that rural non-farm activity is constrained by demand. Improved agricultural technology increases farm output and hence the demand for non-farm inputs and consumer goods. Since agricultural output varies across regions, the following relationship allows a rough estimate of the growth multiplier:

$$RNFY = a + b\,AGY \qquad \ldots (1)$$

where RNFY is rural non-farm income, AGY is agricultural income and b = dNFY/dAGY is the agricultural income multiplier.

Of course, other factors, besides the level of agricultural income, vary across districts and states, and they too may affect the size of the non-farm economy. Different types of agriculture may generate different linkages since input intensity and processing requirements vary across cropping systems. Outside of agriculture, analysts generally single out infrastructure, population density and per capita income as variables most likely to increase

growth multipliers. Infrastructure facilitates communication, transport and credit flows and should improve the responsiveness of the non-farm economy to demand increases from agriculture. Likewise population density, especially in rural areas, may reduce the geographic catchment area necessary to achieve minimum efficient scales of production, reduce transport costs and thereby improve prospects for rural responses. And higher agricultural income per capita should lead farm families to diversify their consumption into non-foods, thus increasing their incremental expenditure on non-foods.

To take account of these other influences on the growth linkages, consider the following elaboration of (1):

$$RNFY = a + b\,AGY + c\,AGY*INFR + d\,AGY*POPDEN + e\,AGY*AGYCAP + f\,AGY*IRRIG \quad \ldots. (2)$$

where INFR refers to infrastructure, POPDEN to rural population density, AGYCAP to agricultural income per agricultural population and IRRIG to the share of irrigation in total cropped area. Irrigation is used as a proxy for intensity of input use across agricultural zones. The four ancillary variables are included as multiplicative interaction terms because in this form the income multiplier becomes:

$$d\,RNFY/d\,AGY = b + c\,INFR + d\,POPDEN + 2\,e\,AGYCAP + f\,IRRIG \quad \ldots. (3)$$

That is, infrastructure, population density, per capita agricultural income and input intensity of agriculture affect the multiplier itself (the slope) rather than merely the level of non-farm activity (the y-intercept).

Note that other factors influencing the level of non-farm activity are captured in the error term. Raw material availability, historical accident, location, ethnicity and differential policies all undoubtedly influence the non-farm activity to some extent. But they are difficult to measure and it seems reasonable to model them as varying randomly across districts.

A missing element in this simple model is the possible feedback effect of growth in the rural non-farm economy on agriculture itself. The urban growth pole literature has stressed the role of rural towns in stimulating agricultural growth. This may result from more readily available, or cheaper, supplies of inputs, from easier access to markets, or more readily available credit. Moreover, rural towns may stimulate demand for perishable horticultural and livestock products, thereby promoting agricultural expansion in non-foodgrains (Haggblade and Hazell, 1989). To capture these effects, we expand the model to include a structural equation for agricultural output:

$$AGY = \alpha + \beta\,RNFY + \gamma;X \quad \ldots. (4)$$

where X is a vector of farm input and agro-climatic variables.

When allowance is made for the feedback effect of RNFY on agriculture, the income multiplier becomes more complex than the one defined in equation (3). Solving equations (2) and (4), and noting that since AGY is now endogenous to the model, the multiplier must be defined with respect to a shift in the intercept (α) of the agricultural income equation (4), the revised multiplier is obtained as:

$$\frac{d\,RNFY}{d\alpha} = \frac{B}{1-\beta B} \quad \ldots. (5)$$

where $B = b + c*INFR + d*POPDEN + e*AGYCAP + f*IRRIG$ is the derivative of equation (2) with respect to α.[5]

Incorporating this feedback increases the size of the multiplier. Since both B and β are both likely to be positive, equation (5) should give a larger multiplier than equation (3) - the right-hand side of which equals B.

The data for our analysis is the same 85-district sample used by Binswanger and Khandker (1988) and Khandker (1988). It is a representative, India-wide sample including districts from Andhra Pradesh, Bihar, Gujarat, Haryana, Jammu and Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh. Because income data are not available at the district level, we have estimated both farm and non-farm income from employment, wage and wage share data.[6]

We estimated the RNFY equation separately for rural areas (RNFY), rural towns (RTNFY), and the expanded rural region (RRTNFY) encompassing both. This provides a useful indication of the spatial dispersion of the rural demand linkages. In estimating equations (2) and (4), it was necessary to correct for endogeneity problems both because of the simultaneous relation between AGY and RNFY and because of possible endogeneity problems with some of the other right-hand side variables. For example, it could be argued that population and infrastructure are concentrated in regions with higher agricultural potential, leading to selectivity bias problems (Binswanger and Khandker, 1988). To purge the model of any biases from these effects, we used two-stage least squares. In the first round, we used agro-climatic instruments for fitting reduced-form equations for AGY and other endogenous variables. Then we regressed the fitted values of these variables on RNFY and AGY in the second round. The estimation was also repeated using the Prais-Houthaker adjustment for heteroscedasticity.

B. Results

The econometric estimates for the RNFY equation are reported in Table V. Because of multicollinearity problems, the irrigation variable was never significant, hence we dropped it from the final runs. As expected, the Breuch-Pagan test revealed heteroscedasticity in the district data. Consequently, all regressions were run using the Prais-Houthaker adjustment in an attempt to correct the problem.

The regression for agricultural income (equation 4) was satisfactory, and we were able to include variables for each district measuring fertiliser use, the size of the agricultural labour force, irrigation potential, total cropped area, annual rainfall, length of the rainy season, soil moisture capacity index, number of months of excess rain, number of cold months and the area liable to flooding (these variables are defined in Binswanger and Khandker, 1988). To save space, we do not report the full results here. The key parameter for our multiplier calculations is β, and this has an estimated value of 0.336. However, with a t-statistic of only 0.5, the feedback effect of RNFY on AGY is not statistically significant.

The income multipliers derived from these regressions are reported in Table VI. In addition to the national multipliers, we have also evaluated the multipliers for high, medium and low income states to show how differences in local infrastructure, population density and per capita agricultural income affect the multiplier.

TABLE V. REGRESSION RESULTS FOR RURAL NON-FARM INCOME, INDIA, DISTRICT DATA, 1981

Particulars (1)	AGY (2)	AR (3)	AP (4)	AU (5)	AY (6)	$\bar{R}^2$ (7)	F (8)	X^2 (9)
Rural areas								
2SLS[a]	-0.245 (3.2)	0.025 (6.2)	0.005 (0.5)	0.005 (0.3)	0.033 (3.2)	0.88	121.7	84.0
2SLS-PH[b]	-0.072 (1.5)	0.012 (3.2)	0.001 (0.2)	0.006 (1.1)	0.019 (2.6)	0.55	21.3	12.6
Rural towns								
2SLS	-0.013 (0.2)	-0.002 (0.8)	0.002 (0.2)	0.005 (0.5)	0.016 (2.1)	0.34	9.4	70.0
2SLS-PH	-0.124 (2.6)	0.016 (5.0)	0.006 (0.9)	0.007 (0.9)	0.017 (1.6)	0.51	17.8	43.6
Rural areas plus rural towns								
2SLS	-0.258 (2.8)	0.022 (4.6)	0.007 (0.5)	0.010 (0.6)	0.049 (3.9)	0.87	108.8	42.4
2SLS-PH	-0.099 (2.1)	0.014 (3.9)	0.002 (0.4)	0.006 (0.9)	0.020 (2.4)	-0.05	0.3	13.0

a. Two-stage least squares estimate.
b. Two-stage least squares with the Prais-Houthaker adjustment for heteroscedasticity.
Notes:-
AGY = agricultural income in each district.
AR = AGY. road density (km. roads per square kilometre of area).
AP = AGY. population density (people per square kilometre).
AU = AGY. urban distance (kilometres to one of 8 major urban centres).
AY = AGY. daily agricultural wage rate (used as an alternative to agricultural income per agricultural population).
RNFY = rural non-farm income.
n = 83 observations.
The absolute value of the t-ratios are listed in parentheses under regression parameters.

TABLE VI. RURAL NON-FARM INCOME MULTIPLIERS ACROSS STATES WITH DIFFERING AGRICULTURAL INCOME

State	Rural areas	Rural towns	Rural areas plus rural towns[c]	
	2SLS-PH[a]	2SLS[b]	Sum 1+2	Pooled regression 2SLS-PH
(1)	(2)	(3)	(4)	(5)
All-India average (Rs. 1,100)[d]				
No feedback	1.21	1.16	1.37	1.53
With feedback	1.32	1.22	1.54	1.91
Punjab/Haryana (Rs. 2,560)				
No feedback	1.34	1.24	1.58	1.83
With feedback	1.54	1.36	1.90	2.65
Karnataka/Gujarat (Rs. 1,130)				
No feedback	1.19	1.16	1.34	1.50
With feedback	1.28	1.23	1.51	1.84
Madhya Pradesh/Bihar (Rs. 730)				
No feedback	1.12	1.11	1.22	1.33
With feedback	1.17	1.16	1.33	1.53

a. Two-stage least squares with the Prais-Houthaker adjustment for heteroscedacity.
b. Two-stage least squares.
c. Rural towns are localities between 5,000 and 100,000 in population.
d. Figures in parentheses are 1982-83 agricultural income per agricultural population.
Note:- The multipliers are calculated using the same national regression coefficients, but using the sample means of the explanatory variables for each of the geographic regions indicated.

These income multipliers are calculated by adding together those for rural areas with the rural towns. Because the Prais-Houthaker adjustment successfully corrects for heteroscedasticity in rural areas, we use the 2SLS-PH regressions there. But for rural towns, we use the uncorrected 2SLS since Prais-Houthaker does not offer signifcant improvement.

The results suggest five major conclusions. First, on an average, a one hundred rupee increase in agricultural income will generate between 37 and 54 additional rupees in rural non-farm income, the difference depending on the strength of the feedback effect of rural non-farm activity on agricultural income.[7] The absence of a statistically significant coefficient suggests some caution in accepting the higher multiplier figure.

Second, these econometric estimates indeed project lower indirect effects than those obtained through semi-input-output modelling. Without feedbacks, the econometric estimates of indirect effects range between Rs. 37 and Rs.53 compared to Rs. 80, more typical in semi-input-output modelling of similar economies (Hazell and Ramasamy, 1991; Bell *et al.*, 1982). This suggests that realised multipliers may lie in the range of 45 to 65 per cent of the levels predicted by the fixed-price, input-output-type models (see also Haggblade *et al.*, 1991).

Third, the multiplier effect is stronger in rural areas than in rural towns, by a ratio of about 2 to 1.

Fourth, all of the ancillary factors - infrastructure, population density and per capita agricultural income - increase the agricultural growth multiplier. Take roads, as an example, since policy makers can most easily influence infrastructure. Given our estimated paramters for the model, without feedback, a 20 per cent increase in road density will increase the indirect increment of rural plus rural town income by 3 per cent, resulting in a multiplier of 1.38.[8]

Fifth, because the infrastructure, population density and per capita agricultural income differ so markedly across states, the multipliers are far stronger in some states than in others. While one hundred rupees of agricultural income will generate Rs. 58 in rural (including rural towns) non-farm income in the Punjab and Haryana, it will only support Rs. 22 of non-farm income in Bihar and Madhya Pradesh. Higher consumption linkages and higher input intensity in agriculture account for the substantially higher linkages in the high-productivity agricultural states.

C. Employment Projections

The estimated regression parameters provide a basis for forecasting the non-farm income and employment that might materialise under different agricultural growth scenarios. Given assumed growth rates for agricultural income, population and road density, the district-level regressions in Table V are used to project the changes in the income multiplier each year between 1981 and 2020. The product of the multiplier and the projected agricultural income growth for each year then provides a forecast of incremental rural non-farm income. Non-farm employment is then projected by dividing the forecasted rural non-farm income by per capita earnings. This latter is projected each year from the assumed growth in agricultural income and population.[9]

Projections are reported in Table VII for a variety of agricultural growth rates. The non-farm projections comprise an aggregate of rural areas plus rural towns, and they are based on the regressions in Table V and the corresponding multiplier in Table VI. All the projections assume an unchanging density of rural roads.

TABLE VII. PROJECTED EMPLOYMENT GROWTH RATES IN RURAL AREAS PLUS RURAL TOWNS UNDER ALTERNATIVE AGRICULTURAL GROWTH SCENARIOS, INDIA, 1981-2020

(compound annual growth rates, 1981-2020)

Agricultural output	Non-farm		Agricultural employment			Total employment, rural area plus rural towns		
	Income	Emp-loyment	Scenario I Rainfed	Scenario II Mixed	Scenario III Irrigated	Scenario I Rainfed	Scenario II Mixed	Scenario III Irrigated
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Without feedback loop								
1.0	0.74	2.00	0.60	0.75	0.88	1.01	1.11	1.20
2.4	2.29	2.09	1.44	1.80	2.11	1.61	1.87	2.11
3.25	3.44	2.37	1.95	2.44	2.86	2.06	2.42	2.75
4.0	4.57	2.72	2.40	3.00	3.52	2.48	2.94	5.35
6.0	7.91	3.96	3.60	4.50	5.28	3.69	4.38	5.01
With feedback loop								
1.0	0.79	1.93	0.67	0.84	0.98	1.04	1.15	1.25
2.4	2.39	1.94	1.62	2.03	2.38	1.70	2.01	2.28
3.25	3.63	2.10	2.22	2.78	3.26	2.20	2.63	3.03
4.0	4.86	2.24	2.79	3.48	4.09	2.66	3.23	3.74
6.0	8.60	1.40	4.63	5.78	6.78	4.13	5.19	6.14

Scenario I assumes agricultural growth will be predominantly focused in rainfed areas; Scenario II assumes the same pattern of agricultural growth that occurred during 1968-69-1970-71 to 1976-77-1978-79; Scenario III assumes an irrigation intensive growth strategy.

Assumptions: Growth rates - agricultural income same as agricultural output; roads 0 per cent; population 2.2 per cent. Agricultural employment elasticities - Scenario I, 0.60; Scenario II, 0.75; Scenario III, 0.88.

The table also includes projections for agricultural employment. These are obtained by multiplying the projected growth in agricultural output by an agricultural employment elasticity each period. Three alternative elasticities are used, corresponding to different scenarios for agricultural growth.

Scenario I: Rainfed agriculture assumes that future growth will depend on rainfed agriculture, with a shift away from sorghum and millets to oilseeds, sugarcane and less traditional crops. In the absence of any estimated employment elasticities for most of these crops, we simply assume that the growth will be predominantly yield driven and use Tyagi's (1981) aggregate yield employment elasticity of 0.6.

Scenario II: The status quo assumes that the pattern of growth - in terms of the crop-mix, irrigated versus rainfed, and area versus yield growth - will be the same as observed in the period 1968-69 - 1970-71 to 1976-77 - 1978-79. For this scenario, we use Tyagi's (1981) estimate of the agricultural employment elasticity of 0.75.

Scenario III: Irrigation assumes that future agricultural growth will arise from greater emphasis on irrigation, a concomitant shift towards more paddy and wheat, and a modest increase in per hectare yields. Specifically, we assume that 50 per cent of future agricultural growth will arise from increases in the gross cropped area, 20 per cent from increases in the crop-mix in favour of rice and wheat and 30 per cent from higher yields. Then, using relevant employment elasticities reported by Tyagi (1981), each one per cent growth in agricultural

output will lead to: 1.0[(1.05)(0.5) + (0.76)(0.2) + (0.66)(0.3)] = 0.88 per cent growth in agricultural employment.

Non-farm income will grow faster than agricultural income under each of the agricultural growth rates assumed in Table VII. So will non-farm employment, although it will not grow as fast as non-farm income. This difference arises because, as earnings rise in agriculture, they pull up rural non-farm earnings in tandem. Consequently, a given non-farm income increment will represent fewer jobs at a high wage than at a low wage. Even so, non-farm employment will grow faster than agricultural employment under all scenarios.

If agricultural output only grows by one per cent per annum, then total employment will grow at between 1.01 and 1.20 per cent depending on whether the agricultural growth is oriented towards rainfed or irrigated areas. This would be less than the estimated growth in the rural plus rural town labour force, which is currently increasing at around 2.2 per cent per annum.

An agricultural growth rate of 2.4 per cent per year (a continuation of the past trend) would enable the growth in total employment to keep pace with the labour force, if the agricultural growth is irrigation-led and if feedbacks achieve their full potential. However, growth in rainfed agriculture cannot generate adequate growth in total employment unless agricultural output grows by at least 3.25 per cent per annum.

Note that growth in non-farm employment contributes relatively more to the increase in total employment when agricultural growth is low and/or has a low employment elasticity. It will be particularly important in helping to absorb projected increases in the rural labour force if agriculture grows at less than 2.4 per cent, especially if future growth is focused on rainfed agriculture.

For high rates of agricultural growth, Table VII suggests that total employment would quickly outstrip the growth in the total rural plus rural town labour force. The surplus labour demand would clearly have to be resolved through higher wage rates or urban-rural migration, neither of which is adequately captured in our model.

Caution: The above projections pertain only to the growth in non-farm income and employment that might arise as a consequence of the indirect effects of agricultural growth. Additional growth in non-farm income and employment will undoubtedly arise from increasing export opportunities from rural areas, both to large urban areas within India and to overseas markets. But these sources of growth are likely to continue to provide a relatively small share of the total market for rural non-farm activity.

V

CONCLUSIONS

This paper has highlighted the importance of the rural non-farm economy in determining current and future incomes and employment in India's rural areas and rural towns. It is a particularly crucial sector for the welfare of the poor and, unless agricultural growth increases sharply, it will be instrumental in creating sufficient productive employment to absorb projected increases in the rural labour force in the decades ahead.

The growth of the rural non-farm sector is driven primarily by agricultural growth. We estimate that each rupee of value added created in agriculture leads to Re.0.37 of direct

additional value added in non-farm activities in India's rural areas plus rural towns. With feedback effects from non-farm activity back to agriculture, the total indirect income increment becomes Re. 0.54.

But the multipliers are not invariant. They increase with agricultural development. Thus the direct multiplier is Re. 0.58 in the Punjab and Haryana but it stands at only Re. 0.22 in Madhya Pradesh and Bihar. And all evidence suggests that the multipliers will increase over time. Both production and consumption linkages have grown substantially, buoyed by the rising input-intensity of agriculture and the growing incomes which stimulate consumer diversification of spending into non-foods.

Moreover, the magnitude of the growth linkages can be increased through appropriate governmental policies and investments. Our analysis, as well as Khandker's (1988), has identified the importance of rural infrastructure (roads, electrification, banking services, etc.) in enhancing the size of the multipliers. Irrigated agriculture also has larger multipliers than rainfed agriculture. And, as shown by Hazell and Roell (1983), Mellor and Lele (1973), Haggblade and Hazell (1989) amongst others, the multipliers are bigger for small to medium-sized farms than for very large farms. Appropriate regional and farm targeting of agricultural technology and investments, supported by adequate investments in rural infrastructure, may, therefore, significantly enhance the size of the indirect benefits emanating from agricultural growth.

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NOTES

1. The remaining urban settlements, those over 100,000, are referred to as large cities.
2. The data in Table IV are for the year 1971 because the 1981 breakdown for rural towns is not yet available.
3. See World Bank (1989) for a good discussion of how dramatically conventional labour force definitions undercount female participation.
4. The most direct rebuttal, based on longer time-series, comes from Deshpande and Deshpande (1985).
5. In this feedback model, the shift in α also has a multiplier effect on agricultural output itself, and the full regional income multiplier is:

$$\frac{dY}{d\alpha} = \frac{d\,RNFY}{d\alpha} + \frac{d\,AGY}{d\alpha}$$

$$= \frac{B}{1-\beta B} + \frac{1}{1-\beta B}$$

$$= \frac{1+B}{1-\beta B}.$$

6. Specifically, we estimate income (Y) as a function of employment (L), the wage rate (W) and wage share of income (S_w) as follows: $Y = L \cdot W/S_w$. We take wage rates as equal in agriculture and rural non-farm activities. From Hazell and Ramasamy (1991), we estimate S_w as 0.58 in agriculture and 0.70 in non-farm pursuits.
7. Note that the pooled rural plus rural town estimates are even higher, generating indirect increments of Rs.53 to Rs. 91. Because an F-test suggested the rural areas and rural town regressions were structurally different, we have opted to estimate them separately and add them together to estimate the aggregate effect. This choice results in more conservative estimates of the growth multipliers.

8. Unfortunately for policy makers, this does not mean that building more roads will guarantee higher non-farm growth linkages. Since all infrastructure variables are highly correlated (with a correlation coefficient of 0.8), it is not possible to separate out the individual effects of roads from banks, electricity, or telephones - at least not with these cross-sectional data. Re-running the model using bank density rather than roads, for example, produces virtually identical parameters. So to achieve the 3 per cent increase in multipliers, it will probably be necessary to develop infrastructure across the board by 20 per cent. Khandker (1988) is more successful in isolating the separate contributions of different kinds of rural infrastructure, but he has access to pooled time-series, cross-section data for the same districts.

9. We take per capita non-farm income as equal to agricultural income in rural areas but double that in rural towns.

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