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Impact of Rural Small and Medium Enterprises on Agriculture: A Sectoral Approach

by

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Abstract

We investigate the sectoral relationship between the rural Small and Medium Enterprises (SMEs) and agriculture. The supply of the SME-produced manufactured goods, M, is thought to be capital-constrained. Following Hymer and Resnick [1969], we set up a theoretical model to incorporate the production linkage between M-goods and agriculture which coexists in the same rural sector. An increase in the availability of M-goods in equilibrium would increase the productivity in agriculture through an improvement in the quality of variable inputs such as land and labour and cause a shift in the production-possibility frontier. This theoretical result is verified using time-series data for India, where we incorporate the SME-variable in the agricultural production function. We show that a relaxation of the capital constraint through an increase in credit allocation to the SME sector produces a positive and significant impact on agricultural production.

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1 Introduction

This paper deals with the effect of the development of rural Small and Medium Enterprises (SMEs) on agriculture. The analysis of the rural non-agricultural sector had been one of the neglected areas of study in the field of development economics. Contrary to the general perception, the rural sector in a developing economy is characterised by a plethora of activities, agriculture being the major one. Apart from agriculture, there is a wide range of traditional goods and modern small and medium scale manufacturing activities that take place in the rural sector as well. It might well be that the gap in the traditional development literature regarding rural non-agricultural activities is the product of the sector's great heterogeneity. However, recent work by Liedholm and Kilby [1989], Haggblade, Hazell and Brown [1989], Reardon,et.al.[1994], Lanjouw and Lanjouw [1995] and many others have put the focus of discussion on the rural SME sector.

The analysis of the impact of SMEs in the rural areas has broadly concentrated on them acting as an alternative source of employment for the population engaged in agriculture. In less-developed countries, agriculture is typically a seasonal activity, even though with the advent of modern methods of cultivation and irrigation, double or triple cropping is common in a lot of areas, in India for example. However, in a labor-surplus agricultural sector, there is always the possibility of the existence of disguised unemployment [Lewis,1954]. Rural SME activity helps in providing gainful employment opportunities to workers out of employment in the agricultural sector. However, these studies concentrate on the microeconomic aspect, focusing on specific country cases in Africa (Sierra Leone, Nigeria), Asia (Taiwan, India) and South America [Lanjouw,1999].

The micro-level studies give us a clue as to the characteristics of the non-farm sector, such as their productivity and their impact on inequality and poverty alleviation in the rural sector. However, one common thread that runs through most studies is the realization of the dynamic potential of the SME-sector in the rural economy. This is due to the fact that growth in the farm sector can induce upstream (input supply) and downstream (processing and distribution) linkages between the agricultural and the non-farm sectors. Similar linkages arise due to consumption and investment relations between the two sectors, which in turn has the possibility of promoting a virtuous cycle of growth. Our objective in this paper is to investigate the mechanism through which the development of the rural SME impacts on the inputs used in agriculture, thereby raising productivity in the farm sector. This is verified empirically by estimating a production function using time-series data for the agricultural sector in India over the last two decades.

The organisation of the paper is as follows. In Section 2, we investigate the structure of the intersectoral linkages as discussed in the literature. In Section 3, we construct a theoretical model to look at the impact of rural SME production on agriculture from a certain degree of abstraction. Empirical formulation and analysis of the model is given in Section 4, in which we use a time series from India to verify our hypothesis. Section 5 concludes the paper with a reflection on the significance of our analysis, both theoretical and empirical.

2 Structure of Intersectoral Linkages

The formalisation of the sectoral analysis was undertaken in the late sixties by Hymer and Resnick [1969]. They considered the utility of the rural agricultural sector to be determined by the consumption of food produced by the sector as well as the consumption of traditional Z-goods and the consumption of manufactured goods produced in the urban areas. They showed that if the Z-goods are inferior, then by the mechanism of an improvement in the terms of trade of agriculture, the urban manufacturing sector replaces the rural traditional industries, thus leading to de-industrialization in the rural areas. This might have been the process during the colonial rule in many countries of the world, a majority of which are the so-called developing countries of today.

Ranis and Stewart [1993] extended this model by dividing the Z-goods sector into two parts. One part of the sector is engaged in the production of traditional goods and services in households and villages, and the other is made up of more modern manufacturing activities more often located in the semi-urban areas. The development of urban industrial sector, the U-goods sector, consisting of large-scale industries with capital-using technology has been the cornerstone of the economic development strategy for many countries in the developing world. However, the U-goods have the potential of undermining the rural non-agricultural sector goods, Z_M, thus acting as a deterrent for rural industrial development. This, according to Ranis and Stewart,1993:81-3, is the 'unfavorable post-colonial archetype ', Philippines being one of them. In the 'favorable post-colonial archetype '[83-5], the Z-goods sector as a whole increases in importance, with Z_M acting as complimentary to the U-goods, thus becoming a dynamic element in industrial development with a high rate of capital accumulation, technological change and employment expansion. This in turn acts as a stimulant to agricultural growth as a result of non-agriculture to agriculture linkage. This path has been followed by Taiwan in the post-war development.

Taiwan carried out an integrated policy of agricultural as well as rural non-agricultural development, infrastructure (including social infrastructure like education and health), and heavy industries. Table 1 shows the increase in the number of units of selected categories of rural industries. The pattern of development of small and medium enterprises (henceforth SMEs) in Taiwan shows a declining trend in those rural industries directly linked to agriculture like food. Instead, there is a movement towards the establishment of manufactured industrial products used by consumers in both rural as well as the urban markets. Also, there is a tendency for development of industries which are either labor intensive like leather and non-metallic minerals, or those with high value-added like machinery, rubber and plastic etc. A major portion of the output of SMEs in Taiwan are export oriented. Since they are based in the rural areas, these units reap the benefits of lower setup and operating costs and hence are more competitive in the export market. The genesis of this development was the grising rural consumption demand, which triggered the early development of SMEs, laying the foundation for a fast-learning, highly adaptive dynamic sectorh[Park and Johnston,1996:189]. There was another important connection between rural spending and the composition of demand for inputs to agricultural production in Taiwan. 'Large-scale farms often purchase capital intensive machinery and equipment. In Taiwan, this led to the demand for simple agricultural tools and inputs easily produced by labor-intensive small-scale rural enterprises '[188].

The most recent phenomenon of the growth of rural SMEs is the proliferation of the township and village enterprises (TVEs) in many parts of China. Rural industries has recently been singled out as the most dynamic sector in China today [Findlay, Watson and Wu, 1994]. Official statistics [Peng, Darby and Zucker,1997:1] have shown that from 1984 to 1993, the average annual growth rate of rural industrial output was about 27 percent. Comparatively, the annual GDP growth rate was 9.5 percent in the same period. From 1980, at the initial stages of the reform process, to 1986, the share of industry in Rural Gross Social Product rose from 19.5 percent to 31.5 percent, while that of agriculture dropped from 49.3 percent to 33.1 percent [Byrd and Lin, 1989]. By 1987, the share of rural industries in the rural economy surpassed that of agriculture. Thus, a structural change in the economic organisation in the rural areas took place, which was the by-product of the rise of the dynamic SME sector in China in the last two decades.

Parikh and Thorbecke,1996 report that the setting up of a medium-scale factory near a predominantly agricultural village in rural western India had several interesting effects on this village as compared with another which is wholly agricultural. Using Social Accounting Matrix (SAM) approach, they show that the total household income is higher in the first as compared to the second village due to dual employment opportunities. A higher level of education is also observed, since infrastructure facilities such as schools and roads are better near the former. The productivity of farm labor is also observed to be better in the village located near the factory due to two reasons, better knowledge of modern farming techniques like hybrid seed and fertilizer and also better quality of implements for agricultural work due to higher income from non-farm sources. This would imply that there are close interlinkages between non-agricultural SME and agricultural production. This may not only be due to income augmentation but also in the availability of rural manufactured M-goods which are used in agriculture.

It was stated in the mid-1970s by John Mellor and others [Mellor and Lele, 1972; Johnston and Kilby, 1975] that as a result of emerging green revolution technologies, there would be multiple linkages between the farm sector and the rural SMEs. Production linkages would be both forward via the need to process many agricultural goods as well as backward linkages via the demand of agriculturists for inputs such as plows, engines and tools,etc. The increase in the availability of both consumption and capital goods (the heterogenous M-goods in our model) would favorably affect the productivity in agriculture by improving the quality of labor and capital used in farm production, lower input costs, profits invested back into agriculture and technological change.

In this scenario, a lack of supply of the rurally produced good is viewed as the crucial issue. If there is a binding constraint on the supply of the M-goods, then even with rising agricultural incomes arising from higher productivity in the farm sector, there would be a leakage from the rural sector of the surplus in the form of consumption of urban goods at higher prices, thus reducing the availability of the funds for reinvestment, as well as foregoing of employment opportunities in the non-farm sector. In the following section, we try to model the case of a rural economy with M-goods and show that in the event of an increase in supply of such goods, there will be a positive effect on agricultural production through the price mechanism.

3 Theoretical Model

We start with the stylised version of an economy with two sectors: the rural and the urban sector. The rural sector coexists with the urban with characteristics different from each other. In our simple economy, the rural sector is regarded as spatially and economically distinct from the urban sector, which can be conceptually thought of as being caused by poor communication links between them, such as transportation and modern telecommunications. In such an economy, the rural sector can be analysed separately from the urban one.

We assume that the rural sector is engaged in three broad types of production activities. First, the primary activity is the production of food items, F, which includes both foodgrains as well as cash crops native to that area; second, producing traditionally manufactured articles, T, such as coarse cloth, handicrafts and other such items which are generally for self-consumption; and third, the small and medium scale activities, M, producing manufactured items using modern technology which are used both for consumption as well as for agricultural production either directly or indirectly. Examples of the last type of activity can be production of spare parts for machines used in agricultural production, such as tractors and threshers, as well as consumption items such as processed food, rubber shoes, bicycle parts and so on. The F and T-sector production will be carried out by the agricultural sector, while the M-goods production will be carried out independently of the agricultural sector of the rural economy.

The rural agricultural sector consumes part of its production of food and traditional goods as well as M-goods. Following the Hymer-Resnick framework, we assume that the rural agricultural sector has as set of community indifference curves denoted by the utility function:

$$U = U(F^d, T^d, M^d), \tag{1}$$

where F^d, T^d and M^d are the demand of the rural sector for food, traditional goods and M-goods respectively.

Let p_f,p_t and p_m be respectively the prices of F,T and M-goods. If the total production of food and traditional goods are F and T, then the rural sector's budget constraint can be written as:

$$p_f F^d + p_t T^d + p_m M^d = p_f F + p_t T$$

or alternatively,

$$p_f(F - F^d) + p_t(T - T^d) = p_m M^d, \tag{2}$$

where $(F - F^d)$ and $(T - T^d)$ denote the marketed surplus of F and T production respectively which are used to buy the M-goods.

The rural sector's utility maximisation exercise requires maximisation of (1) subject to the budget constraint (2). Forming the Lagrangian for the problem, we have,

$$\pounds = U(F^d, T^d, M^d) + \lambda[p_f(F - F^d) + p_t(T - T^d) - p_m M^d], \tag{3}$$

where $\lambda > 0$.

Differentiating (3) with respect to F^d, T^d, M^d and λ, we get the following first order conditions:

$$\frac{\partial \pounds}{\partial T^d} = \lambda p_t \tag{4}$$

$$\frac{\partial \pounds}{\partial M^d} = \lambda p_m \tag{5}$$

$$\frac{\partial \pounds}{\partial F^d} = \lambda p_f \tag{6}$$

$$\frac{\partial \pounds}{\partial \lambda} = p_f(F - F^d) + p_t(T - T^d) - p_m M^d = 0 \tag{7}$$

The first order conditions (4) to (7) determine the demand functions of F^d, T^d and M^d as functions of the prices and the levels of output of F and T. Thus, from the solution of the utility maximisation (3), we get the following demand functions:

$$F^d = F^d(p_f, p_t, p_m; F, T) \tag{8}$$

$$T^d = T^d(p_f, p_t, p_m; F, T) \tag{9}$$

$$M^d = M^d(p_f, p_t, p_m; F, T) \tag{10}$$

Now we come to the supply side of the agricultural sector. We assume that the agricultural sector produces two goods, F and T. In our economy, we assume that the capital is constrained and that agricultural labor is employed fully in the production of the two goods. The constraint of supply of M-goods is reflected in the quality of capital used in the production of F and T. As a concrete example, it is observed in many underdeveloped rural areas in developing countries, the choice of capital equipment such as tractors or pumpsets is determined as much by their prices as by the availability of spares in the vicinity or technical support services in the area. The use of implements used in agriculture is also contingent upon the skills of the blacksmiths of the area as observed by Lieldholm and Kilby(1989). Thus, F and T-sectors have respective stocks of labor and capital where their productivities depend on the amount of M-goods used.

We assume that the food sector has a production function of the form

$$F = \Phi(L_F(M_F), \overline{K}_F(M_F)) \tag{11}$$

where L_F is the labor and $\overline{K}_F$ is the fixed amount of capital used in the production of F, the efficiency of which depends on the amount of M-goods used for F-production. Similarly, the traditional goods sector produces according to the production function

$$T = \Gamma(L_T(M_T), \overline{K}_T(M_T)) \tag{12}$$

where L_T is the labor and $\overline{K}_T$ is the given quantity of capital used in the production of T, depending on the level of M-goods. $\overline{K}_F$ and $\overline{K}_T$ represent the constraint of capital posed by the lack of M-goods in the rural economy. As observed earlier, the quality of labor and capital stocks in the agricultural sector for F and T production is contingent upon the availability of non-agricultural goods and services in the rural areas. As such, the labor and capital inputs used in F and T-goods production can be described as a function of the amount of M-goods used in each sector and we denote this by writing $L_i(M_i)$ and $\overline{K}_i(M_i)$, where $i = F, T$. This kind of a formulation is similar to standard neo-classical production functions of the type $Q(L, K; M) = A(M)[f(L(M), K(M)]$ where the M-goods act as a type of technological parameter, determining the level of output for a given level of availability of the M-goods. This formulation will be adapted for the empirical analysis below.

The problem of maximisation on the production side by the rural sector entails the maximisation of profits of the F and T subsectors, taking into account their cost of production. The two profit maximisation problems for the F and T-sectors respectively can be written as:

$$Max \quad p_f F - \overline{w} L_F - \overline{r}\overline{K}_F - p_f M_F^d \tag{13}$$

$$Max \quad p_t T - \overline{w} L_T - \overline{r}\overline{K}_T - p_f M_T^d \tag{14}$$

where $\overline{w}$ and $\overline{r}$ are the fixed prices of labor and capital for the production of both F and T-outputs; $\overline{K}_i$, $i = L, K$, denote the level of capital in both the sectors and M_i^d, $i = L, K$, signify the amounts of M-goods used in the production process. From the individual profit maximisations, we would get the supply functions F^s and T^s as well as the demand functions for M from the two set of productions in the rural sector as functions of the prices p_f, p_t and p_m.

Now, assuming full employment of labor in the agricultural sector, that is,

$L_F + L_T = \overline{L}$, then the transformation function between F and T for a given level of non-agricultural M-goods available to the agricultural sector is given by:

$$\Psi_M(F,T) = 0 \tag{15}$$

The food and traditional goods producing sectors thus solve independent profit maximisation exercises. Given the amount of M-goods in the rural economy, $\overline{M}$, (15) gives the full employment (both L and K) locus of possible outputs for the agricultural sector. Hence it is seen that the profit maximisation problem that the sector as a whole solves can be written as:

$$\begin{aligned} &Max \quad p_f F + p_t T \\ &s.t. \Psi_{\bar{M}}(F,T) = 0 \end{aligned} \tag{16}$$

The position of the production possibility locus would depend on the amount of M-goods available to the rural sector. Now, given p_f, p_t and the given level of M-goods, the choice for the agricultural sector is to produce a combination of T and F-goods that would maximise the profits of the sector as a whole.

From the first order condition of (13) and (14), we obtain the supply functions for F and T as:

$$F^s = F^s(p_f, p_m) \tag{17}$$

$$T^s = T^s(p_t, p_m) \tag{18}$$

In equilibrium, the market clearing prices for F, T and M, p_f^*,p_t^* and p_m^* respectively, are determined simultaneously by equating the demand and supply conditions for F,T and M-goods respectively, given by:

$$\begin{aligned} F^d &= F^s \\ T^d &= T^s \\ M_c^d + M_F^d + M_T^d &= \overline{M} \end{aligned} \tag{19}$$

where $\overline{M}$ is the exogenously given supply of M-goods.

At equilibrium, the restriction on the supply of M-goods determines p_m^*. The real problem in the rural sector faced by the F and T-goods producers might be the high prices of the M-goods in the market, which arises as a result of the lack of adequate provision of rural non-agricultural goods and services. Thus at equilibrium, any increase in the supply of the SME goods will have both a labor and capital improving effect on the production of F and T as well as a reduction in p_m, and hence the production function for these two goods will shift upwards. Consequently, there will be an outward shift in the production possibilities frontier between F and T as depicted by Fig.1 below.

Given the equilibrium prices p_f^* and p_t^*, there will be a positive effect on the supply of both the goods in the agricultural sector in the first round.

4 SME-Agriculture Linkage: Empirical Investigation

4.1 The Indian Case

Among the developing countries, India was one of the first ones to have embraced the Green Revolution. It led to a rapid increase in agricultural production and yield over the last three decades. Although initially confined to the mainly wheat producing northern Indian states of Punjab, Haryana and Uttar Pradesh, modern farming technologies and extension activities have now spread to nearly the whole of India. The index of agricultural production, IAP (base: 1980-81) rose from 82.3 in 1970 to 174.5 in 1995 at an annual compounded rate of 2.93 percent. At the same time, the index of yield with base 1969-70 rose to 191 in 1995 at a rate of 3.4 percent, while the index of area Inc erased only slightly. This can be seen from Figure 2. Although the increase in agricultural production has been largely due to an increase in yield, the data also seems to suggest that Indian agriculture went through a period of modernization aided mostly by improvements in factor inputs, including labor and capital equipment. This can be seen more clearly from Table 2 below if we compare the early period from 1958-75 with the latter from 1976-94. As seen from Table 2, the latter period shows a marked improvement in yield and output per head of the rural population as well as the real agricultural wage rate, while the net sown area per person in the rural areas decreased at a faster rate.

The SME sector in India enjoyed a high degree of protection from imported goods, and formed a major part of the industrial production. However, the overall thrust of industrial policy was import substitution and the setting up of large capital-intensive projects in core sectors, such as iron and steel, cement etc. At the same time, there has been a shift in the structural composition of the SME sector in the rural areas regarding the composition of the output of this sector as seen from Table 3. The share of the modern SMEs in the rural areas has increase progressively from nearly 53 percent in the mid 1970s to nearly 82 percent in 1990-91. On the other hand, the share of traditional industries in total rural SME output has decreased from 16 percent to 10.7 percent in the same period. This may be related to the high growth in the agricultural sector during this period. Hazell and Haggblade,1990 report on the basis of state and district-level data for India that as one moves from lesser to higher agriculturally developed regions, services and cottage industries that dominate non-farm activities in rural areas in the former give way to commerce and factory manufacturing as the major non-farm activities in the latter. This suggests that there is a strong linkage between the increase in productivity in agriculture and the setting up of rural industries. Evidence from micro-studies from the Philippines as stated by Ranis, et.al,1990 suggests that the presence of modern (although not traditional) non-farm enterprises has a positive influence on agricultural productivity. Further evidence of this SME to agriculture linkage is provided by Vogel,1994. On the basis of evidence from a cross-section study of 27 countries, he suggests that at very low levels of development, the strongest linkage is through consumption. The backward production linkages via agricultural inputs become stronger with development as agriculture becomes more capital intensive. Vogel,1994 concludes that the forward linkages, via agricultural processing, are never very strong and decline as processing becomes less important in the overall economy.

Thus, our objective in the following empirical exercise is to determine on the basis of time series data for India whether there exists production linkages between SME-sector and agriculture. We would also be able to determine whether the large number of micro-level studies is borne out at the macro-level as well.

4.2 Empirical analysis

4.2.1 Estimation Model

We use a standard Cobb-Douglas type of production function for the estimating equation. We use two alternative specifications of this functional form:

$$lnY = lnA + \Sigma\alpha_i lnX_i + \gamma lnM \tag{20}$$

and

$$lnY = lnA + \Sigma\alpha_i lnX_i + \eta M \tag{21}$$

where Y is the agricultural output, X_i's are the conventional variable inputs and M is the variable of rural small and medium enterprises. The coefficients of X_i's have the usual interpretation of the production elasticities of the variable inputs:

$$\alpha_i = \frac{\partial lnY}{\partial lnX_i} = \frac{\partial Y}{\partial X_i}.\frac{X_i}{Y}$$

$$\gamma = \frac{\partial lnY}{\partial lnM} = \frac{\partial Y}{\partial M}.\frac{M}{Y}$$

$$\eta = \frac{\partial lnY}{\partial M} = \frac{\partial Y}{\partial M}.\frac{1}{Y}$$

Hence γ denotes the elasticity of output with respect to the non-conventional input M while η is the percentage change in the output response to a unit change in M at the margin, the other conventional inputs remaining constant. Thus, the values of γ and η with determine the effect of the non-conventional input on the production of the agricultural sector as a whole.

The general form (20) follows Kawagoe, Hayami and Ruttan,1985 which estimated an intercountry production function for agriculture for 43 countries using a Cobb-Douglas type of production function. The estimation equation (21) follows Jamison and Lau,1982 which used the flexible form to measure the impact of education on agricultural productivity in Thailand, Korea and Malaysia. The explicit form of the estimating production function are as given by (22) and (23), with the X_i's replaced by the land, labor and fertilizer as the conventional variables, while M is the variable of rural SME production.

$$lnQ_t = const. + \alpha lnB_t + \beta lnL_t + \mu lnK_t + \gamma ln(SME) + \epsilon_t \quad (22)$$

$$lnQ_t = const. + \alpha lnB_t + \beta lnL_t + \mu lnK_t + \eta(SME) + \epsilon_t \quad (23)$$

where Q_t is the output of the agricultural sector, B_t is the input of land at time t, the labor and fertilizer inputs at time t are denoted by L_t and K_t and SME denotes the output of rural small and medium enterprises. Kawagoe,et.al,1985 used five conventional variables: land, labor, fertilizer, livestock and machinery, and two non-conventional inputs, namely general and technical education [117-122]. However, their estimates are based on data for 1960, 1970 and 1980, i.e., they are point estimates and not time series observations. We tried the regression using livestock and machinery variables, but they do not seem to fit the data. The coefficients were insignificant in both the estimating equations, along with the fact that the coefficient of land variable becomes insignificant with their inclusion. This observation is consistent with Kawagoe,et.al,1985 where they observe that the coefficient of the land variable is considerably better if the principal component analysis is used. This is due to the high correlation between land and livestock. We argue that land and livestock represent a long-term capital formation embodying inputs supplied mainly from within the agricultural sector itself and as such, they represent internal resource accumulation. In our formulation, this effect would be captured by the land variable alone and we expect its coefficient to be positive and significant.

In the same vein fertilizer and machinery are inputs supplied to agriculture from the heavy industrial sector. They therefore can proxy the whole range of modern mechanical and biological technology inputs used in the agricultural sector. However, as was the case with land and livestock, in a time series data set, there is considerable difficulty in including both machinery and fertilizer together in the estimation equation because of the problem of multicollinearity. Hence, we use only the direct fertilizer input as an explanatory variable. Since the use of fertilizers is a decision variable of the farmer who determines the amount of use considering the type of crop he produces, we would expect the effect of this input to be positive and significant.

The time period of the present study is from 1980 to 1995. As pointed out in the discussion above, the Green Revolution was extended to most of the country by the mid-1970s. This resulted in an increase in both the volume of agricultural output and the use of modern inputs in the production process. Also, this is the time period when the rural SMEs gained in importance in the development policy in India. There was a thrust towards an integrated development of the rural areas, including agriculture and SMEs based in the rural areas. A structural shift in the composition of the rural SME output also took place in the last two decades, with higher proportion of the output coming from manufacturing rather than cottage and village industries. This makes the analysis of the interaction of this sector with that of agriculture from the early 1980s to the mid-1990s an interesting period to study.

4.3 Data and Analysis

The independent variable, agricultural output, is measured by the index of agricultural production, IAP; labor by the agricultural population for the corresponding years; fertilizer by the total of nitrogen, phosphorous and potash (NPK) used in agriculture. The details regarding the sources of data are given in the Appendix. We have taken care not to use derived variables in our regression since it may be confusing and sometimes difficult to draw implications. The choice of the SME variable is difficult because direct measures such as the share of rural SMEs in GDP or the employment growth of that sector are either not available or involve substantial extrapolation. This fact has been acknowledged by Datt and Ravallion (1998) in their effort to incorporate a time series of rural non-agricultural variable in the poverty index regression. However, as an indirect measure, it seems feasible to use the amount of credit extended by the scheduled commercial banks towards the rural SMEs as priority sector lending. In India, most of the banks are state-owned, and hence are used to direct credit at priority sectors, which includes agriculture and rural SMEs (Reserve Bank of India Annual Report, various years). This formal sector credit can be used as a measure of actual disbursements by the scheduled commercial banks for setting up of SMEs in the rural areas as these loans are expressly granted for specific projects and cannot be used for consumption purposes.

Kawagoe,et.al,1985 found evidence of constant returns to scale for variable inputs in agriculture in the less developed countries in their sample. In our case as well, a test of returns to scale cannot reject the hypothesis of constant returns in the variable inputs. We perform the ordinary least squares (OLS) regression on the transformed variables with Index of Labor Productivity in agriculture as the independent variable. The dependent variables include Index of Area per worker in agriculture, fertilizer consumption per worker in agriculture, and the SME variable. The results are given in Table 4.

Among the conventional inputs, the coefficients of Index of Agricultural Land per worker and the fertilizer use per worker are positive and highly significant, coefficients α and μ indicate that the elasticity of the land variable is around 0.43 while the fertilizer variable is about 0.27. From the assumption of constant returns to scale, the estimated elasticity of labor is around 0.30. Comparing with the findings of Kawagoe et.al.(1985), we find that the estimate for the labor variable is lower while that of the land variable is higher in our study. However, regarding our main hypothesis of the impact of rural SMEs in agricultural productivity, we note that a one billion rupee increase in credit advanced to the SME sector would entail a 0.08 percent increase in the Index of Agricultural Production from our formulation in Model 2. From Model 1, the elasticity of the production of the agricultural sector with respect to the SME variable is of the order of 22 percent. However, in this model, the fertilizer variable becomes insignificant. This may be due to a high degree of correlation between the fertilizer variable and SME in the form used in Model.

If we have the data for the real output of the rural SMEs, we can quantify better the direct effect of an increase in production of the rural SMEs on agriculture. However, as long as a strong correlation exists between credit advancement and the increase in output of the rural SME sector, we can conclude that the time series data for the Indian economy shows that a positive and significant effect of rural SME sector on the agricultural sector exists, confirming the village-level findings of Parikh and Thorbecke (1996).

5 Conclusion

Our main objective was to investigate from both a theoretical and an empirical point of view whether there exists a sectoral linkage between agriculture and SMEs in the rural areas. This linkage has been the focus of a series of studies starting with the Hymer-Resnick (1969) model, extended by Ranis and Stewart,1993 and micro-level studies across countries by Vogel,1994, Ranis et.al.,1990 for the Philippines, Parikh and Thorbecke,1996 and Hazell and Haggblade,1990 for India. We assume a supply constraint in the availability of manufactured rural SME goods, M, and show that an increase in the supply of such goods will have backward linkages with agriculture through the price mechanism at equilibrium. The M-goods can be theoretically thought of as a parameter that acts on both the capital and the labor variables by improving their respective productivities. This in turn results in a shift in the production function upwards. We verify this by considering a time series for India which includes agricultural output and variable inputs such as land, labor and fertilizer, as well as M-goods. In two alternative formulations following Kawagoe et.al.,1995 and Jamison and Lau,1982, we show that the SME variable has a positive and significant effect on labor productivity in agriculture. The shift parameter is estimated to be around 0.08 percent with respect to the Index of Agricultural Production.

Our analysis indicates that the encouragement of rural-based manufacturing activities can have important implications for agriculture in many countries of the developing world with surplus workforce in agriculture. As has been studied extensively in the literature, the rural SMEs have a direct influence on off-farm work opportunities for peasants and the consequent contribution to income of the rural household which has been put at nearly 32 percent in Asia and around 40 percent in Africa in various micro-level studies in the two regions. This additional income is thought to generate funds for investment in agriculture. However, our study has shown that another important linkage exists between non-farm M-goods and the farm sector. An increased availability of M-goods would improve the quality of labor and capital by providing both consumption as well as investment goods for the peasants, and thus act as a source of backward linkage with agriculture. The gradual but significant improvement in productivity would increase the incomes of the farmers as well as that of the entrepreneurs of the rural SMEs, and thus can produce a virtuous cycle in the rural sector as a whole. Further research in this field might concentrate on the impact of rural SMEs on wages in both the sectors as well as its effect on reducing migration from the rural to the urban sectors.

Appendix: Data Sources and Explanation

Production:

The production variable is measured by the Index of Agricultural Production. This is a Laspeyres index of the output of all the crops produced in India. To overcome the problem of aggregation, the Ministry of Agriculture of the Government of India publishes annual data on the Index, in the annual Economic Survey. The weights are given according to the relative importance of each crop in overall production. This Index is being used widely in the research on the agricultural sector in India. (See Datt and Ravallion,1998)

Area:

The land variable used is the Index of Area Sown. This is a weighted Laspeyres index taking into account the different types of land in total area sown, such as arid, semi-arid, fertile etc. The source of the data is the Economic Survey, published by the Government of India annually.

Labor:

The labor variable used, agricultural workers, is a headcount of the number of workers in agriculture published annually by the FAO in the World Agricultural Statistics Yearbook. This is the only data on yearly estimates and has been used extensively for time series regressions. The other way that we can get a time series of agricultural workers is to extrapolate from the decennial Census data by taking the yearly average increase over the ten year period. This does not take into account estimates of yearly fluctuations and so is avoided for this analysis.

Fertilizer:

The fertilizer variable is taken to be the amount of NPK fertilizer used in agriculture, obtained from the Economic Survey of the Government of India.

Credit to Small and Medium Enterprises:

We use the Reserve Bank of India data for the amount of credit disbursed as priority sector lending to small and medium enterprises (SMEs). This data is published in the Annual Report of the Reserve Bank of India various years.

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Table 1: Number of rural SMEs in Taiwan

	1954	*1981*
Food	12200	8697
Textiles and apparel	7043	8943
Leather	202	1053
Paper and printing	955	6426
Rubber and plastic	395	8672
Non-metallic minerals	1935	3712
Electrical and electronic products	729	4818
Machinery	3007	19430
Metal and metal products	1112	10473

(source: Park and Johnston, 1996)

Table1: Selected growth rates of the agricultural sector

	Average annual rate of growth (%)	
	1958-75	*1976-94*
Real agricultural wage rate	0.33	2.84
Agricultural output per acre of net sown area	1.51	2.91
Net sown area per person in rural areas	-1.53	-1.76
Agricultural output per head of rural pop.	-0.01	1.15

Source: Datt and Ravallion (1998)

Table 3: Composition of output of Small Scale Industries

Industry	1973-74	1979-80	1984-85	1989-90	1991-92
A. Traditional Industries					
Khadi	0.44	0.27	0.26	0.18	0.14
Village Industries	0.90	1.04	1.17	0.96	1.10
Handlooms	6.20	5.19	4.45	2.95	2.08
Sericulture	0.45	0.39	0.49	0.43	0.51
Handicrafts	7.83	6.11	5.41	6.18	6.79
Coir	0.44	0.26	0.15	0.11	0.09
Subtotal of A	16.10	13.26	11.45	10.82	10.71
B. Modern SSIs					
Small Scale Ind.	52.94	64.51	78.12	80.55	81.93
Powerlooms	14.56	9.69	9.93	8.63	7.36
Subtotal of B	67.50	74.20	88.05	89.18	89.29
C. Others	16.40	12.54	0.5	0	0
Total (A+B+C)	100	100	100	100	100

Source: Planning Commission, India

Table 4: Estimated Models of Production: dependent variable Index of Labor Productivity *(Ordinary Least Squares)*

Variables	model 1	model 2
Constant	-0.8409**	-0.6843**
	(-4.4051)	(-3.1578)
$Log(B_t/L_t)$	0.8821**	0.4336**
	(3.1758)	(2.5493)
$Log(K_t/L_t)$	0.0029	0.2734**
	(0.0163)	(3.2581)
Log(SME)	0.2253**	
	(5.656)	
SME		0.000772**
		(3.0251)
Implicit coefficient for labor	0.115	0.293
Durbin - Watson	2.304	2.375
Adjusted R-square	0.896	0.903

Note: t-statistics are in parentheses
**, * indicate significance level of 1% and 5% respectively

Figure 1: Production-possibility frontier for T and F in the presence of M-goods

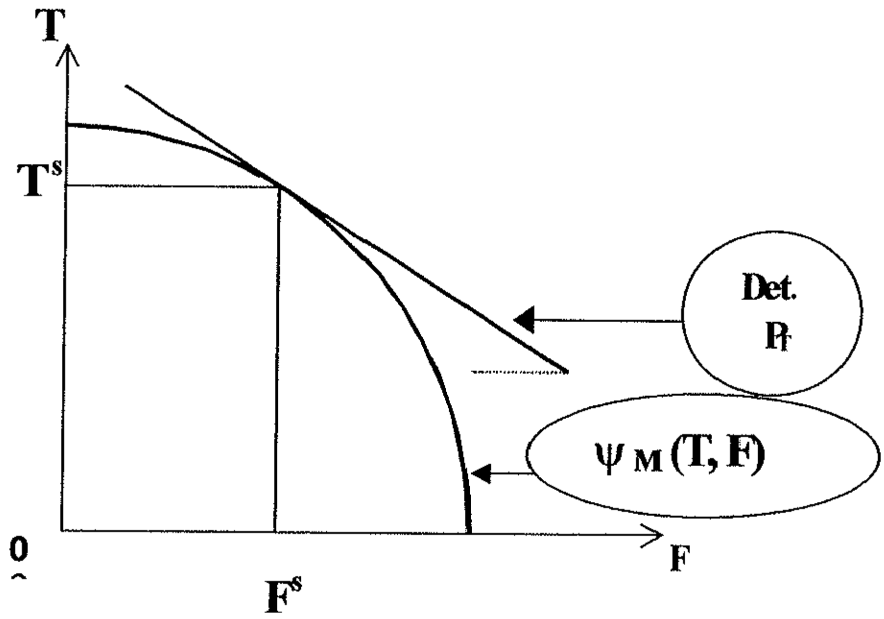

Figure 2: Area, Production and Yield Indices in Indian Agriculture