Technical Efficiency in the Informal Manufacturing Enterprises: Firm level evidence from an Indian state

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11 November 2007

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In the course of finalizing this paper, the author is benefited from comments and suggestions from a number of scholars including Prof. Malathy Duraisamy, Prof. Kunal Sen, Prof. Jean Pierrie Poullier, Prof. D.Jayaraj, Dr. Suresh Babu and Dr. Mihir Kumar Mahapatra. I would like to record my thanks to all of them.

How technically efficient are enterprises in the unorganised manufacturing sector? Firm level evidence from an Indian state

Abstract

The small and medium enterprise sector plays a pivotal role in the socio-economic development and growth of nations. But there is evidence that the firms in this sector are less efficient than those in the large enterprise sector. Hence it is imperative to examine their efficiency levels in order to identify the factors that contribute inefficiency in these firms and to generate information for designing support policies for them. In this study, level and sources of technical efficiency in the unorganised manufacturing sector in the Indian state of Kerala is examined using translog stochastic frontier production function. The analysis is conducted for five broad industry groups and the sector as a whole using firm level data. The findings show that high levels of technical inefficiency, which reduce their potential levels significantly, characterize the unorganised manufacturing enterprises in Kerala. Regarding the factors contributing to inefficiencies, it is observed that size, ownership, region (location) and nature of seasonality of operation significantly influence technical efficiency level in most of the industry groups. We also find that credit availability and employment of hired labour play an important role in explaining technical efficiency levels.

Key words: Technical Efficiency; Stochastic Frontier Production Function; Unorganised Manufacturing Sector; Kerala
JEL Classification: O14; O17

1. Introduction

The efficiency and potential for development of the small and micro enterprise sector (SMS) in developing economies have been important topics of debate in the development literature. Several studies endorse the need for supporting the SMS as it uses more of what a developing country possesses and less of what it lacks (de Soto 1989; Loveman and Sengenberger 1991; Nugent and Yhee 2001; Liedholm 2001). Unlike enterprises in the formal sector, the enterprises in the SMS create opportunities for unskilled workers and mostly use locally available resources. Others caution that due to the overly abundant use of low skilled and less educated workers and inferior technology, productivity and efficiency levels are very low in the sector. This is reflected in its lower share in income despite enjoying a larger share in employment in developing countries. It has been argued that inefficiency and low productivity make the (participants and) units vulnerable and cause instability in the sector itself. However, not many studies have empirically evaluated the validity of these hypotheses in the Indian context. The empirical evidence is very much important in identifying the factors that threaten the productivity of these firms and in generating information for designing support policies for them.

Although the SMS has been playing a crucial role in the Indian economy in terms of employment and its contribution to National Domestic Product, saving and capital formation, the sector is beset with certain problems. In the first place, there seems to be a bias against the sector in terms of the support provided to them. Limited investment opportunities, marketing problems, lack of access to credit, lack of resources in terms of qualified human capital and fierce competition stand in their way towards development. Over and above that, the rate of technical change has been rather very low. It is very often suggested that technological up-gradation may help in improving the situation in the sector. But this solution may prove costly in the context of developing countries due to scarcity of capital. One way through which the SMS could overcome these problems is to improve internal efficiency. In a liberalized and competitive environment, improving technical efficiency could be an ideal solution for the growth of enterprises in the sector. As the financial constraints faced by the enterprises may further aggravate in these changed circumstances, enhancing the level of production by using more resources becomes increasingly limited and too expensive.

An enterprise can be categorized as technically efficient if it is able to produce maximum output given available resources. It has been acknowledged in the literature that, a gap normally exists between a firm's actual and potential levels of economic performance (Leibenstein 1966). Subsequently, a considerable body of economic literature is currently devoted to the analysis of technical efficiency. Given the current changes in global product and factor markets, raising the internal efficiency of firms is a crucial factor in order to compete in the international markets. In other words, the survival of less efficient firms in the liberalized market environment is highly questionable if they become less competitive. In this context, a study on the performance of SMS has broader implications on trade, fiscal, industrial and monetary policies. Against this backdrop, the aim of this paper is two-fold: first, to estimate the technical efficiency levels of enterprises in SMS. As a useful second step, the paper also makes an attempt to explain firm-level efficiency differentials using firm-specific attributes.

The analysis focuses on the small and micro enterprise sector in the state of Kerala in India. Kerala provides an ideal milieu for estimating the levels and determinants of technical efficiency of enterprises in SMS. This is particularly because the industrial economy of Kerala is dominated by small enterprises. Available evidence shows that the share of small enterprise sector in total manufacturing employment is huge (around 80 per cent) while its contribution in output by industrial sector is substantial and relatively higher than that of all India. It is argued that the relatively slow growth of manufacturing sector in Kerala during the nineties is due to the relatively poor performance of SMS. According to a study by Pillai and Shanta (2005), the contribution by the small enterprise sector in state income during the nineties (1991-92 to 1999-2000) was only 4.07 percent against 9.05 percent contribution from the large enterprise (organized) sector. One of the reasons ascribed to this low performance is the slow rate of technical change or small increase in capital investment due to the resource constraints faced by these firms. As the prospect of improving the financial condition of these enterprises remain murky, the possibility of increasing the level of production by bringing more resources into use becomes very much restricted. As a result, improving the internal efficiency of firms in the sector could act as a panacea to improve the growth performance of the sector in Kerala.

The SMS in this study has been defined by using the employment size criterion and the focus is mainly on the unorganised manufacturing sector. The analysis is based on the firm level data from the National Sample Survey Organization (NSSO) for the period 2000-01 with a sample of 6797 firms in the manufacturing sector. The study employed stochastic production frontier approach to estimate the levels and determinants of technical efficiency in the unorganised manufacturing sector of Kerala. From the policy perspective, empirical evidence on the technical efficiency level of firms in the unorganised manufacturing sector may provide useful insights into resource allocation strategies. A study of this kind would also help us to know whether it is possible to raise productivity by improving firm efficiency or whether it is necessary to develop new technologies to raise productivity. To the best of our knowledge there has not been any study that analysed the levels and determinants of technical efficiency in enterprises in Kerala's unorganised manufacturing sector using the methodology employed in the study.

The rest of the paper is organized as follows. Section 2 presents a brief discussion on the manufacturing sector in Kerala. The database and methodology used in the study are explained in section 3 and 4 respectively. In section 5, we discuss the main results of the study. Finally, section 6 concludes by pointing out the major policy implications.

2. An Overview of Manufacturing Sector in Kerala

Kerala is one of the twenty-eight constituent states of the Indian Union. The state is a tropical land of some 38, 863 sq. km, stretching 580 km in length and 30-130 km in breadth, situated on the southwestern tip of the Indian subcontinent. Although in terms of area, it accounts for only 1.1 percent of India, its population of 31.8 million as per the 2001 census accounts for 3.01 percent of India's population. With a population density of 819 persons per square kilometre, Kerala is one of the most densely populated regions in the country. Moreover, population is spread across the state, and as such, there are no big urban agglomerations.

Kerala holds a unique position in social sector development in comparison with other states in the Indian economy. The state has been the focus of international attention for its success in several key areas of the social sector including literacy, education, health and family planning – a success that is widely reflected in its high Physical Quality Life Index (PQLI) and high Human Development Index (HDI)[1]. As stated by Amartya Sen, 'The distinction of Kerala is particularly striking in the field of gender equality' (Sen 1997). The female-to-male ratio is 1.02:1, in contrast to India's ratio of 0.93:1 (Centre for

Development Studies 2005). However, its poor record of agricultural production[2] and industrial growth[2a] overshadows these achievements in socio-infrastructural facilities.

The services sector occupies a major place in Kerala's economic development. The largest shares of income (55 percent) and employment (40 percent) are generated in the service sector. Kerala is no longer an agrarian economy as the primary sector accounts for only 26 percent of the state income and 32 percent of employment (Centre for Development Studies 2005). On the other hand, the state has a very low representation of large and medium industrial units in its industrial sector. The industrial economy of Kerala is dominated by agro-processing industries such as coir, cashew, wood and edible oil. These industries continue to occupy an important place in the industrial economy of Kerala especially as major employment providers. A small segment of large modern industries based on minerals, chemicals and engineering have also come up, along with an increasing segment of small and medium industries, some based on modern technology and management (Centre for Development Studies 2005).

The contribution of manufacturing sector to state income during 1970-71 to 1999-2000 stood at 14 percent (Pillai and Santha 2005). Like other states, in Kerala too, the manufacturing activity takes place in organized (or registered) as well as unorganised (or unregistered) sectors. The organized sector consists of units that employ more than 10 workers with the aid of power or more than 20 workers without the aid of power. All other units are classified under unorganised manufacturing sector. In the manufacturing sector, the organized sector accounts for the larger share in output by manufacture in Kerala (Table 1). At the same time, it is also important to note that the share of the unorganised sector is substantial and it is even higher than that of all-India[3]. While examining the growth of the sector using the net state domestic product (NSDP), it is observed that the organized sector grew at a faster rate than the unorganised sector in all the three decades from the seventies (Table 2). However, overall manufacturing growth touched a lower figure during the period, 1991-92 to 2004-05. It may be also concluded from the Table 2 that the slow growth rate of NSDP by manufacture in Kerala during the period is due to the relatively poor growth performance of unorganised manufacturing sector.

Using the employment figures provided by the Annual Surveys of Industry (ASI) on the organized sector and surveys of the National Sample Survey Organization (NSSO) on the unorganised sector, an attempt is made to see how the two segments are placed in terms of employment in the manufacturing sector. We find that the unorganised sector occupies a substantial share in employment in the manufacturing sector. Table 3 shows that the sector employs around $4/5^{th}$ of the manufacturing workforce in Kerala. While comparing the growth of employment in both the sectors it is noticed that whenever there was a fall in the growth of employment in organized manufacturing sector, the unorganised sector came to the rescue (Table 4). What is more striking is the performance of the unorganised sector during the late nineties. It has reported the highest growth rate of 7.51 percent during the said period. Despite its larger share in the manufacturing workforce, the unorganised sector contributes relatively lesser share in output. This possibly reflects the low level of technology, low productivity, and low-income characteristics of the enterprises in the unorganised sector.

3. The Data

Given the general lack of time series data on firms in the unorganised manufacturing sector in Kerala, the paper uses cross-sectional data from the survey of unorganised manufacturing enterprises conducted by the National Sample Survey Organization (NSSO) for the period 2000-01. Although 7513 enterprises were originally covered in the survey, some of them were dropped due to incomplete information[4]. The present analysis is confined to a total of 6797 enterprises, of which 3911 are OAMEs, 1981 are NDMEs and the remaining 905 are DMEs. The unorganised manufacturing sector is comprised of three types of enterprises, Own Account Manufacturing Enterprises (OAMEs), Non-Directory Manufacturing Enterprises (NDMEs), and Directory Manufacturing Enterprises (DMEs). OAMEs employ only family labour while NDMEs and DMEs employ hired labour. The number of workers is less than six in case of NDMEs and more than or equal to six in case of DMEs. The break-up of the NSSO survey data is given in Table 5.

The analysis is conducted for five broad industry groups as well as for the sector as a whole. The five broad industry groups are food (includes industry divisions 21 and 22), Textiles (includes industry divisions 23, 24, 25 and 26), Wood (includes industry divisions 27, 28 and 29), Minerals (includes industry divisions 32, 33 and 34) and others (includes industry divisions 30, 31, 35, 36, 37 and 38). This regrouping was necessitated due to the presence of too few firms in certain industry groups. However, care was taken to merge an industry with its related category.

4. Technical Efficiency: definition and measurement using the stochastic production frontier approach

Technical efficiency has received considerable attention in the economic literature in recent years. By definition, a technically efficient production unit is one that produces the maximum level of output achievable given the inputs and technology. Stated differently, a firm is said to be technically efficient if it is producing at the technological frontier. A firm operating below the frontier is considered as technically inefficient because its output falls short of what could have been produced given the input usage. Technical efficiency forms only one of the two components that characterize economic efficiency, the other being allocative efficiency. Allocative efficiency represents the ability of the firm to produce profit-maximizing output by choosing the right mix of inputs given the input prices. However, enterprises will face different prices of inputs, and, therefore, different combination of inputs, depending on the environment in which they operate. For example, firms in the unorganised manufacturing sector may face different input prices as opposed to firms belong to the organized manufacturing sector. Available evidence points to the low cost of labour and much larger cost of capital faced by small firms compared to large firms. In this study, we assume that all firms are allocatively efficient and different input combinations faced by them are justified because different firms face different input prices as they operate in diverse markets[5].

Aigner et al. (1977) and Meeusen and van den Broeck (1977) proposed a single-equation cross-sectional stochastic production frontier model which assumes that establishment i uses the input vector Xi to produce a single output Yi based on the following equation:

$$Y_i = f(X_i, \beta)\exp(\vartheta_i - u_i) \qquad i = 1,2,....,N \qquad \text{------------------- (1)}$$

The error term in the model is comprised of two components, a traditional symmetric random noise component (ϑ_i) and a new one-sided inefficiency component (u_i). The ϑ_i s account for measurement error and other random factors that are beyond the control of firms such as weather, strikes, luck and so on and are independently and identically distributed with mean zero and constant variance, σ_ϑ^2. The u_i that captures technical inefficiency is the combined outcome of non-price and organizational factors that constrains a firm from achieving their maximum possible output from the given set of inputs and technology. The u_is are non-negative and assumed to be independently and identically distributed. Thus, when the firm is fully technically efficient (TE=1), u takes the value of 0 and when the firm faces constraints (0<TE<1) u takes a value less than 0. The magnitude of u specifies the 'efficiency gap'', that is how far a firm's given output is from its potential output. Both the ϑ_i s and u_is are assumed to be independent of the regressors. Here, a firm faces own stochastic frontier ($f(X_i, \beta)\exp(\vartheta_i)$); a deterministic part ($f(X_i, \beta)$) common to all firms and a firm-specific part ($\exp(\vartheta_i)$). Thus, firm-specific Technical Efficiency (TEi) is measured as the ratio of the observed output of the firm to the potential output derived by the frontier function and is outlined as:

$$TE_i = \frac{f(X_i, \beta)\exp(\vartheta_i - u_i)}{f(X_i, \beta)\exp(\vartheta_i)} = \exp(-u_i) \qquad \text{------------------- (2)}$$

TEi measures how close the establishment gets to its maximum achievable output, once external shocks (i.e., noise) are removed. Yi achieves its maximum value of ($f(X_i, \beta)\exp(\vartheta_i)$) and TEi = 1 if $u_i = 0$. Stated differently, $u_i \neq 0$ reports the shortfall of observed output from the maximum potential output. To compute TEi, one needs first to estimate equation (1), and then decompose the residuals into estimates of noise (ϑ_i) and technical inefficiency ($-u_i$).

The crucial issue is regarding the estimation of equation (1) which demands making assumptions about the functional form of the production function and the distribution function for ϑ_i and u_i. While the random fluctuations are assumed to be drawn from a symmetric distribution, the inefficiencies are assumed to be drawn from an asymmetric distribution because they can only decrease the production below frontier levels. As for ϑ_i s, we follow the standard hypothesis in the literature and assume $\vartheta \sim N(0;\sigma_{\vartheta}^{2})$. On the other hand, choosing an appropriate distributional form for the u_is is a difficult task because, in doing so, the researcher is assuming to know quite a lot about the unknown phenomenon under investigation. Green (1993) presents several explicit forms that refer to different assumptions about the distribution of the inefficiency term. Most commonly used one-sided distributions are the half-normal, truncated normal and exponential distributions. The most frequently used form is to assume that u_i is independently and identically distributed and truncated at zero of the normal distribution with mean μ and variance $\sigma^2{}_u$ (i.e., $u \sim \left|N\left(\mu,\sigma^2{}_u\right)\right|$).

Specification and Estimation

To estimate the technical efficiency levels in unorganised manufacturing sector of Kerala, the study used the stochastic frontier production model proposed by Battese and Coelli (1995). Generally two common forms of production function are used in the literature to estimate technical efficiency using stochastic frontier production function namely, Cobb-Douglas and general translog functional forms. Since the Cobb-Douglas specification is nested in the translog model, we used the translog functional specification. The log linear translog production frontier with two inputs labour (L) and capital (K) for firm i is given by:

$$\ln Q_i = \beta_0 + \beta_1 \ln K_i + \beta_2 \ln L_i + \beta_3 \ln K_i^2 + \beta_4 \ln L_i^2 + \beta_5 \ln K_i \ln L_1 + v_i - u_i \text{--------(3)}$$

where ln Q is the log of gross value added; ln K is the log of the value of total capital equipment; ln L is the log of the total number of workers; and βs are the parameters to be estimated.

Understanding that firms are technically inefficient might not be a valuable exercise unless an additional effort to identifying the sources of the inefficiencies is made. Taking cognisance of it, as a useful second step, we investigated the sources of firm-level technical inefficiencies for the sampled firms. Different methods have been employed in the literature to analyse the inter-firm efficiency differences[6]. The present study follows the approach suggested by Battesse and Coelli (1995) to identify the sources of inter-firm efficiency differences. This approach enables us to estimate the parameters of the model as well as sources of technical inefficiencies simultaneously.

The technical efficiency effects are thus defined in terms of modelling the mean of U_i as a function of a host of firm-specific characteristics. Symbolically, the inefficiency model can be specified as:

$$U_i = \delta' z_i + \omega_i \qquad \text{----------- (4)}$$

where z_i is a vector of explanatory variables related to technical inefficiency for the ith firm; δ^1s are the inefficiency parameters to be estimated; and w is an error term that follows a truncated normal distribution. We estimate equations (3) and (4) through Maximum Likelihood techniques (ML) (Battese and Coelli 1995)[7]. The equations are estimated using the FRONTIER version 4.1 computer program developed by Coelli (1994). This computer program provides the ML estimates of the parameters and predicts the technical efficiencies for all the firms included in the study.

5. Empirical Results

In the total sample of 6797 enterprises, 37 percent belong to textiles group, 21 percent are from food industry group, 19 percent are from wood industry group, 9 percent represent metal industry category and the remaining 14 percent are enterprises grouped under others industry category.

Besides the key conventional input variables (see appendix I), some firm-specific factors were expected to affect the technical efficiency level of firms and thus were included in the model. The factors identified for explaining the inter-firm differences in technical efficiency are size, location, ownership, nature of operation, credit availability measured in terms of ratio of borrowed to total capital, share of emoluments to GVA, ratio of hired to total labour and a factor representing the status of the firm as a subcontractor[8]. The descriptive statistics for the sampled enterprises used in the analysis are presented in Table 6.

5.1 Stochastic Production Function and Technical Efficiency Estimates

The maximum likelihood estimates of the parameters of the model obtained from estimating the stochastic frontier production function and the level of technical inefficiencies of the firms are presented and discussed in this section. Six models have been estimated and analysed, one each for the food, textiles, minerals, wood and other industry groups and finally another model for the whole sector. The results are reported in Table 7.

The models estimated by the maximum likelihood method are highly significant as shown by the large likelihood values. It is also evident from the analysis that the stochastic frontier model is an appropriate specification since γ is close to 1 and highly significant in all industry groups. Barring a few exceptions, all the coefficients of the stochastic frontier models have the expected relationship and importance in the sector. The results show that the production in the unorganised manufacturing sector in Kerala is largely labour intensive (Table 7**,** first major row). This is ascertained by comparing the coefficients of capital and labour inputs. With in the whole sector and in the case of textiles and food industry groups, the coefficient of labour is positive and highly significant indicating that labour plays a crucial role in these two industry groups. A similar result though observed in minerals and wood industry groups the coefficients are not significant. But for the 'others' manufacturing group, the elasticity of output with respect to capital has the highest contribution to output. The size of the elasticity of output with respect to labour varies from 0.56 in the all industry category to 1.16 in food industry group while the coefficient of elasticity of output with respect to capital is in the range of 0.25 in textiles industry group to 0.65 in 'others' industry group.

The variance parameter estimate gamma ranges between 0.81 and 0.95 in the six models suggesting that a large portion of the residual variation in the output is explained by technical efficiency. This implies that the average production functions are biased because they assume that all the error term is due to factors beyond the control of the agents. The present analysis based on stochastic frontier approach shows that a significant percent of the random term is due to an inefficient use of the production frontier which can be controlled by the agent. Stated differently, the difference between the actual and the potential output level is primarily due to firm-specific factors and need to be improved and controlled in order to raise technical efficiency. The mean efficiency level for the whole sector is about 48 per cent implying that, on an average, about 52 per cent of the technically potential output level could not be realized due to factors within the jurisdiction of the firms.

The results also indicate that the absolute values of the technical efficiency level vary across industries. The mean technical efficiency level of enterprises varies from a low of 36 per cent in wood industry group to a high of 53 per cent in food and metal industry groups. The mean technical efficiency levels in textiles and others industry groups are 47 and 48 per cent respectively. This implies that firms in these industry groups can increase their production, on an average, between 47 per cent and 64 per cent. In other words, there exists a large scope for expanding output in all the firms by improving the firms' technical efficiency levels using the existing resources and technology. The next section examines the factors that contribute technical inefficiency and its variation among the firms.

5.2 Sources of Technical Efficiency

Having found that there exists wide variation in technical efficiency among the sample firms, it is important and useful to understand the factors that influence inter-firm efficiency differences. The firm-specific characteristics included in the efficiency model are firm size, ownership, location, ratio of borrowed to total capital, availability of contract, ratio of hired to total workers, share of emoluments to GVA and nature of operation. These factors can be broadly classified into ownership/firm characteristics, market/region of operation and the rationale for business existence. The results for this empirical analysis are presented in Table 7 (second major row).

Evidences on the relationship between firm size and technical efficiency are inconclusive and they do not support a strong link between the two in either direction. On the ground of scale economies, it is perceived that the two may be positively linked but it is also suggested that a negative relationship between firm size and technical efficiency cannot be ignored if large firms experience problems of management and supervision. In essence, the relationship could be negative for large firms and positive for small firms. In this study, the number of workers per unit is used as a proxy to represent size which corresponds to enterprise types namely, OAMEs, NDMEs and DMEs. Several studies have used this variable to represent firm size (Batra and Tan 2003; Margono and Sharma 2006; Soderbom and Teal 2004; Nikaido 2004; Badunenko 2006). The size is represented in the equation using a dummy variable, DSi, which is defined as follows: DSi = -1 if an enterprise is OAME, DSi = 0 if an enterprise is NDME, and DSi = 1 if an enterprise is DME. It is observed that the sign of all size coefficients is negative and significant which means that as a firm becomes larger its inefficiency decreases, hence large firms are more efficient than small ones. Several other studies have also obtained a positive relationship between firm size and technical efficiency (Pitt and Lee 1981; Little et al. 1987; Shanmugam and Bhaduri 2002; Kim 2003; Batra and Tan 2003; Margono and Sharma 2006). It may be the case that the smaller-sized firm groups are populated heavily by new firms and therefore, they are expected to have lower average efficiency levels than large and more experienced firms. The large and experienced firms may also have an easier access to cheaper or superior quality of inputs or may enjoy greater economies of scale. Seemingly, this finding supports the notion that the competitiveness of new, small firms initially depends on lower costs. Many small firms survive by paying lower wages or by employing family labour and they may not be competent in operating capital stock when they first enter into an industry but may improve efficiency by learning by doing. On the whole, the effect of firm size on technical efficiency is important for policy purposes. For example, if an industry consists of small firms that are technically inefficient in production, consolidation of these tiny firms may help in raising the efficiency level of the industry as a whole. At the same time, improvements in learning-by-doing processes and managerial practices are also necessary to achieve a rapid improvement in technical efficiency. The empirical result suggests that such policy needs to be pursued for the unorganised manufacturing sector in Kerala.

Ownership is another factor that may explain the technical efficiency level of enterprises in the sector. Different ownership-based classifications have been used by different studies to examine the role of ownership in explaining technical inefficiencies in enterprises. While Onder et al. (2003) and Margono and Sharma (2006) relied on the public-private ownership classification, Saygili et al. (2001) used the state-mixed-private ownership classification[9]. Pitt and Lee (1981) examined the impact of ownership on technical efficiency by dividing the firms into foreign owned and domestically owned. The present study, however, employs a different classification based on which firms are classified into single owner (proprietary firms) and multi-owner (partnership) firms. It is important to note that majority of proprietary firms in the sector are household enterprises employing family labour (OAMEs) and are mostly supervised by females. On the other hand, partnership enterprises are mostly non-household enterprises employing hired labour and include also co-operative societies, firms operated by trusts, public limited companies and so on. This variable can be also perceived as an indicator of size. In the analysis, ownership is measured as a dummy variable with single owner enterprises being the reference category. The coefficients are found to be significant only in the 'all industries' category and 'others' industry group. Though the coefficients reported appropriate sign in all other industry groups, they are found to be insignificant. Within the whole sector, we noticed that partnership enterprises are more efficient than single-owner (proprietary) enterprises. This might point to differences in access to finance and other network advantages for partnership firms. Stated differently, the household sector might have less access to these resources, and therefore their growth may be constrained.

To capture the geographical variations across the state, location is used as a factor (Onder et al., 2003). Location of the firm could influence the performance of the firm as situating in a developed environment could enhance the efficiency through availability of better infrastructure. The industrial map of Kerala is usually divided into two regions:

the south and the north. A dummy variable is used to control for the location of the plant: the variable takes the value 1 if the firm is located in the southern part of the state and 0 otherwise[10]. In our analysis, coefficients of location dummy are found to be positive and significant in all the industry groups and in the whole sector. This implies that firms in the southern region are relatively inefficient when compared to their counterparts in the northern region of the state. Obviously, there has been indeed a significant disparity between southern and northern Kerala as regards the stage of industrial development. But when we compare the level of development of both the regions in terms of per capita income, the northern region stands worse off than the southern region. More over, the south is industrially much more developed than the north. But the result of the study paints a different picture. However, some recent enquiries have also revealed that the extent of industrial sickness is higher in the southern region as compared to the northern region (Mathew, 1999)[11].

Another reason may be the inter-regional cost differential in production. Alarming rise in wages and prices of raw materials in the south compared to the north often forces the producers to rein in their total production, which ultimately prevent them from producing at the optimal level. For example, the most serious problem faced by the coir yarn spinning industry in Kerala, a major employment provider after agriculture and the industry where around 90 per cent of production takes place in the unorganised sector, is the non-availability of raw materials at economic price in adequate quantities. As the coir units are highly concentrated in the southern districts, more raw materials are demanded in the region compared to the northern districts. Consequently, the raw material price has increased significantly in the southern districts. Surprisingly, despite very significant price differential, there has been no appreciable movement of raw material to the scarce areas. Thus it can be concluded that in the case of Kerala's unorganised manufacturing sector, being in a more developed environment does not necessarily make firms more efficient. Perhaps, there are other factors that influence the performance of the sector.

Lack of access to adequate working capital has been recognized as an important deterrent to the development and growth of informal sector. This is the case because deficiency of working capital hampers the ability of informal sector entrepreneurs to invest in much needed capital equipment and labour services. Studies have shown that investment and growth potential are substantially diminished in the presence of credit constraints (Tybout 1983; Nabi 1989). Jalan and Ravallion (1999) claimed that limited credit access compels the entrepreneurs to exhaust their savings and assets which, in turn, could have a detrimental effect on optimal asset accumulation particularly at the household level. A number of empirical studies have reported a strong positive relationship between inefficiency and credit constraints (Alvarez and Crespi 2003; Mukhrejee 2004; Hernandez-Trillo et al 2005). They argue that most microenterprises do not operate at an efficient scale and they do not usually adopt new technology unless they are able to obtain working capital to increase their scale of operation. On the other hand, some studies argue that there is no conclusive evidence that subsidized credit is a crucial factor in SME success. For instance, Hill (2001), while reviewing the performance of SMEs in Indonesia, casts doubts on this assertion.

In this study, we examined the relationship between the availability of credit and technical efficiency level of firms in the unorganised sector. We have used the ratio of borrowed to total capital to proxy credit availability. It is hypothesized that availability of more working capital would allow them to increase the investments in modern capital, human capital of workers and technological innovation, thereby creating a positive impact on productive efficiency. Thus, a firm that has access to adequate amount of working capital is likely to be more efficient as compared to one that lacks access to working capital. The study finds a negative relationship between inefficiency and credit availability for all industry groups and for the whole sector. In other words, the results show that an increase in the ratio of borrowed to total capital is significantly related to firm efficiency implying that provision of working capital can considerably improve the level of technical efficiency in the sector. In view of this finding, efforts should be made to increase and improve the access of small firms to capital markets. But available evidence shows that the financial institutions are not forthcoming in extending credit to the firms in the informal sector since they lack any asset to serve as collateral. For the reason, the microentrepreneurs depend on informal source of credit for working capital. But a draw back of informal source of credit is that the interest rates are quite high, thereby reducing the possibility of using it as a long-term investment strategy. If access to modern financial institutions cannot be made easier, an independent credit institution exclusively for the sector can be established as has been done in the case of small, medium and large enterprises. The *Grameen Bank of Bangladesh* can be cited as a successful example of such an initiative.

The process of industrial restructuring has resulted in greater decentralization of production through subcontracting. The pressure to reduce costs and to find more flexible production methods by the enterprises in the organized sector implies that an increasing number of operations are carried out by subcontractors, many of them are in the informal sector. A positive way of looking at this trend is that it gives greater opportunities for employment and higher incomes in the unorganised sector. It can also be looked upon as means by which technological improvements can be transmitted from the organized to the unorganised sector. It is also regarded as an important source of efficiency and competitiveness for the unorganised sector. Thus it may be hypothesized that subcontracting positively affects technical efficiency level in the sector. The relationship between the two is examined in this study by introducing a dummy variable, which takes the value 1 if the firm is on contract and 0 otherwise. It is found that the coefficients of contract dummy are significant only in wood industry group but have the expected negative sign in most of the industry groups indicating that subcontracting has a positive influence on technical efficiency. However, it needs to be pointed out that subcontracting is relatively less evident in the manufacturing sector in Kerala. This is particularly due to the relative absence of large enterprises in Kerala. Even the firms in the organized manufacturing sector are relatively smaller in size as compared to the organized firms in other industrially advanced states in India.

Unorganised sector is dominated by enterprises employing family labour, i.e., household enterprises. When the economy progresses, the relative size of these enterprises expands and, as a result, generates demand for labour from outside the family. An increase in the number of hired (wage) workers in an enterprise is an indicator of its growth. It is the case that the hired workers are employed strictly for a specific time period and therefore, it can make a positive impact on the performance of these enterprises. This particular aspect is examined by studying the relationship between the use of hired labour and technical efficiency. We used the ratio of hired labour to total labour and examined the relationship. The sign of the coefficient is found to be negative and significant in all industry groups which suggests that as a firm employs more hired labour its inefficiency decreases, hence firms with hired labour are more efficient than household enterprises. In other words, the inefficiency model shows that employing more hired labour has a positive impact on technical efficiency. In our database, proportion of firms employing family workers (OAMEs) is higher than those with hired workers (NDMEs and DMEs). This points to the fact that relatively higher proportion of enterprises in Kerala may be engaged in self-employment types of ventures and hence the development level of manufacturing activities in the sector is low.

A much debated issue in the context of unorganised sector is relating to the low wages prevailing in the sector which has a bearing on worker productivity. The degree of exploitation of workers is certainly higher in the sector as compared to its organized counterpart as far as wage payments and working hours are concerned (Papola, 1981). More importantly, wages paid in the sector is, on an average, almost half of those paid in the organized sector. As we know, the level of wages is of crucial significance for the attainment of full productivity potential of labour. If the worker knows that he will be adequately paid for higher productivity, he will be motivated to put in greater efforts. Notably influence of wages on labour efficiency is more important at the lower levels of income. However, it is found that workers in most industries in the sector do not receive emoluments commensurate with their productivity or the contribution they made in output (Raj and Duraisamy 2004). Hence it is argued that raising the wage level would considerably improve the efficiency level of the sector through impacting labour efficiency. Whether this argument holds true in the context of Kerala? Using the share of emoluments in value added as a variable, this aspect is examined. The coefficient is found to be significant in all the industry groups and the sector as a whole. Where as the coefficient reported an expected sign in the textile industry group, there seem to be a positive relationship between the share of emoluments to gross value added and technical efficiency in other four industry groups and in the whole sector. The result implies that raising wage level in the present production setup considerably erode the efficiency level in the sector. It may be the case that any further rise in the wage level may add up to the cost burden which is already acting as an obstacle to the growth of the sector. On the other side, any further improvement in labour efficiency demands an increase in the wages paid to the workers. Therefore, attempts should be made to revamp the production system considerably, which would help increasing the gap between cost and profit levels of enterprises in the sector while at the same time ensuring reasonable wages to the workers.

It is argued that enterprises that work throughout the year (perennial) are relatively more technically efficient than those enterprises whose activities are confined to a particular season, due to the operation of economies of scale. In the unorganised sector, one could find enterprises belonging to both categories. Hence we examined the relationship between nature of operation and technical efficiency in this exercise by introducing a dummy variable. The variable assumes the value 1 if the enterprise is a perennial enterprise and 0 otherwise. The coefficients of the nature of operation dummies are significant and have negative effect on inefficiencies suggesting that nature of operation positively affects efficiencies. In other words, as argued above, enterprises that operate throughout the year (perennial enterprises) are more efficient than the casual and seasonal enterprises, which form the reference group.

5.3 The Distribution of Technical Efficiencies

This section examines the distribution of technical efficiencies which would help us to understand whether there exists any scope for improvement in the technical efficiencies of enterprises in the sector. The distribution of technical efficiencies for the sample of firms by size and industry are estimated and presented in Figure 1, which once again reinforce our previous conclusion that unorganised manufacturing enterprises in Kerala are technically inefficient relative to their potentials given the existing technology.

The estimated technical efficiency scores for the sampled SMEs range from less than 20 percent to more than 90 percent, with a sample mean technical efficiency level of 48 percent. In food and minerals industry groups, more than 70 percent of the firms are more than 40 per cent technically efficient. In textiles and 'others' industry groups, more than 60 percent of the enterprises are 40 per cent and more efficient. On the other hand, majority of the enterprises (56 percent) in the wood industry group are 40 percent and less efficient. In almost all the industry groups, the percentage of DMEs in the 0 to 40 range of efficiency levels are very low.

The low technical efficiency levels of enterprises in the sector are to be seen against the problems faced by them. Taking cognisance of it, the next subsection discusses the problems faced by the unorganised manufacturing enterprises of Kerala.

5.4 Problems and Needs of the Unorganised Manufacturing Enterprises

Improving the technical efficiency level of enterprises in the sector could not be realized unless and until the problems faced by the enterprises are tackled successfully. The NSSO report on the unorganised manufacturing for the year 2000-01 throws considerable light on the problems faced by the entrepreneurs in the sector. Table 8 presents a summary of the problems faced by the firms of different sizes in the sector[12]. Around 54 percent of firms of all sizes admitted having problems of shortage of capital (32.6 percent), difficulties in marketing of products (25.3 percent), non-availability of raw materials (14.1 percent), competition from large units (21.9 percent) and so on.

Small firms seem to face a serious problem of capital shortage. Their next important problems were marketing of product and competition from larger units. Medium sized firms ranked insufficient working capital, marketing of product and competition from larger units as their first, second and third most important problems just as small firms did. As regards to large firms, frequent power cut emerges as the most important problem followed by marketing of products and competition from large units. The problem of insufficient working capital was found to be less important when compared with small and medium firms.

Among the problems where state policy can directly exercise an important influence, the most important one is infrastructure, especially power. Competition from large units is presumably a major problem that has been lately emerging in the present Indian context. In the past the state had played an important policy role in this area prior to the introduction of reforms through the policy of preferential treatment to small industries in terms of supply of inputs, taxation and grant of reservation to items produced by small scale and unorganised sector units. However, the direct role of the state has been shrinking in the regime of economic reforms. In this changed scenario, the state needs to play a greater role to enhance the competitive strength of the unorganised sector units. Besides other factors, the most important factor that can help raise their technical productive efficiency is improved technology which implies a higher input of capital. For this, increased supply of loans on attractive terms by banks and specialized financial institutions need to be strengthened.

6. Conclusions and Policy Implications

The technical efficiency of unorganised manufacturing sector is crucial to the debate about the role of small and micro enterprises in economic development in India. Given the current global developments and liberalized market conditions, the survival of less efficient firms is highly questionable if they become less competitive. This paper explored the technical efficiency levels in the unorganised manufacturing enterprises in Kerala utilizing a stochastic production frontier approach using firm-level data for the period 2000-01. The econometric analysis is conducted for five broad industry groups and the sector as a whole. The model used in the exercise enables us to estimate the parameters of the model and the sources of technical inefficiencies simultaneously. The empirical results showed that firms in the unorganised manufacturing sector are not using resources and technology efficiently and thus are operating at 48 percent of their potential output level on average. This implies that more output can be obtained by improvement in technical efficiency. If substantial improvements in technical efficiency can be achieved, then this knowledge of using resources and technology efficiently could motivate and set the stage for innovation, thereby leading to technological progress as well.

Regarding the factors contributing to inefficiencies, it is observed that size, ownership, region and nature of operation significantly influence technical efficiency in most of the industry groups. Another policy-relevant lesson from the empirical findings is that credit availability and availability of contract play an important role in explaining technical efficiency levels. Thus, policies that promote a business atmosphere in which unorganised manufacturing enterprises can have easy access to credit and have low cost access to markets may help in increasing efficiency. Similar view is expressed by De Soto (1989), according to whom excessive transaction costs and bureaucracies keep informal sector firms out of the formal economy. Findings of the study also revealed that raising wage level in the present production setup would considerably erode the efficiency level in the sector.

Due to paucity of data, the study is limited to analysing technical efficiency only. Other component of economic efficiency namely, allocative efficiency could not be estimated due to lack of reliable information on prices. Further, the study is based on data from a single production period. It may be important to investigate the time pattern of inefficiencies and also see whether there is a tendency towards convergence in the efficiency levels over time. Such an analysis is demanding in data – long time series unit level data- and hence not attempted here. The use of time invariant technical efficiency model is highly unrealistic if the technology dynamic is strong. Under the assumption that the technology development within the sector is rather low, we could safely argue that even time invariant technical efficiency measures do have important implications and need to be determined. It may be also useful to replicate the studies of the kind undertaken here and extension thereof in the context of other states or sub-sector within each state.

Table 1 Share in Total Manufacturing Output

Period	Registered	Unregistered
1970-71 to 1979-80	47.1	52.9
1980-81 to 1989-90	54.8	45.2
1990-91 to 1999-2000	51.8	48.2
1991-92 to 1999-2000	52.2	47.8
1991-92 to 2004-05	54.7	45.3
1970-71 to 2004-05	52.4	47.6

Source: Computed using NSDP data.

Table 2 Rate of Growth of Registered, Unregistered and Total Manufacturing Sector

Period	Registered	Unregistered	Total
1970-71 to 1979-80	3.95*	1.51*	2.67*
1980-81 to 1989-90	5.23*	-1.25	2.57*
1990-91 to 1999-2000	6.64*	3.78*	5.28*
1991-92 to 1999-2000	6.74*	3.93*	5.42*
1991-92 to 2004-05	4.04*	0.36	2.39*
1970-71 to 2004-05	4.38*	2.89*	3.67*

Note: Growth rates reported are compound growth rates.
* denotes significant at 5 per cent level
Source: Computed using NSDP data.

Table 3 Share of Unorganised Sector in Total Manufacturing Employment

Year	Share
1978-79	81.8
1984-85	86.4
1989-90	83.8
1994-95	67.2
2000-01	78.8

Source: Computed using NSSO and ASI data.

Table 4 Growth of Employment in the Organized and Unorganised Sectors

Year	Rate of Growth	
	Organized	Unorganised
1978-85	-1.90	3.84
1985-90	3.01	-1.06
1990-95	4.95	-12.78
1995-2001	-2.31	7.81

Note: Growth rate reported are simple growth rates
Source: Computed using NSSO and ASI data.

Table 5 Number of Enterprises Surveyed in Kerala

Sector	OAMEs	NDMEs	DMEs	All
Cotton	1617	628	277	2522
Food	904	386	128	1418
Metal	202	235	148	585
Wood	781	403	190	1374
Others	407	329	162	898
Total	3911	1981	905	6797

Table 6 Summary Statistics for variables in the Stochastic Frontier Model

Variable	Sample Mean	Standard Deviation
Output (GVA)	83012.11854	333863.5729
Labour	3.04	4.21
Capital	163230.6678	570720.3615
Emoluments to GVA (including OAMEs)	20	106.5899
Emoluments to GVA (excluding OAMEs)	47	162.9273
Borrowed to total capital	20	32.03531
Hired to total labour	26	32.87259
Percentage of firms with sub-contracting work		21
Percentage of firms in the south		70
Percentage of OAMEs		57.5
Percentage of NDMEs		29.2
Percentage of perennial enterprises		83
Percentage of Proprietary firms		80

Table 7 Maximum Likelihood Estimators for Parameters of the Stochastic Frontier Inefficiency Models

Variables	Textiles		Food		Metal		Wood		Others		All Industries	
	Coeff.	SE	Coeff.	SE	Coeff.	Coeff.	Coeff.	SE	Coeff.	SE	Coeff.	SE
Frontier Function												
Constant	7.2477*	0.6260	7.0696*	0.7065	9.2037*	0.8861	10.3050*	0.3758	5.7135*	0.5236	9.9358*	0.2496
Ln Capital	0.2475*	0.1341	0.2383	0.1522	0.1793	0.1828	0.0484	0.0921	0.6539*	0.1185	0.0569	0.0557
Ln Labour	1.1286*	0.2151	1.1637*	0.2529	0.3061	0.3644	0.3529	0.2251	0.0038	0.3076	0.5569*	0.1210
Ln Capital Squared	0.0067	0.0073	0.0054	0.0080	-0.0022	0.0097	0.0031	0.0054	-0.0177*	0.0066	0.0148*	0.0031
Ln Labour Squared	0.0737*	0.0261	-0.0232	0.0374	-0.0189	0.0483	0.0244	0.0495	0.0279	0.0378	0.0279*	0.0173
Ln Capital × Labour	-0.0664*	0.0230	-0.0163	0.0247	0.0902*	0.0392	0.0295	0.0267	0.0568*	0.0302	0.0026	0.0130
Inefficiency Model												
Constant	1.5513*	0.3179	2.3081*	0.4017	1.9783*	0.4460	2.4396*	0.3852	0.3470	0.7155	2.7405*	0.1557
Ratio of borrowed to total capital	-0.3043*	0.0087	-0.1713*	0.0122	-0.2200*	0.0334	-0.2181*	0.0148	-1.0821*	0.0836	-0.2060*	0.0040
Share of emoluments to GVA	0.4976*	0.1094	-1.4250	1.1471	0.4805*	0.0865	0.5105*	0.0813	0.1838*	0.0293	0.1271*	0.0150
Ratio of hired to total labour	-0.2084*	0.3879	-2.9069*	0.7768	-3.0026*	0.6347	-1.6229*	0.4145	-7.7351*	1.7391	-1.9465*	0.1940
Regional Dummy (1 = south; 0 = north)	0.6378*	0.0828	1.0344*	0.3013	0.7128*	0.1970	0.9014*	0.1277	1.6765*	0.3425	0.5251*	0.0488
Size Dummy (-1 = OAME; 0 = NDME; 1 = DME)	-0.4592*	0.2102	0.0927	0.2480	0.2574	0.2253	-1.1595*	0.2199	0.7941	0.5243	-0.4732*	0.1009
Operation Dummy (1 = perennial; 0 = otherwise)	-1.2190*	0.2266	-2.3344*	0.4770	-1.7678*	0.3677	-2.0339*	0.2379	-2.5372*	0.4921	-1.6208*	0.1258
Ownership Dummy (1 = partnership; 0 = single)	-0.0387	0.2407	-0.4287	0.2495	0.1929	0.2790	-0.2636	0.2597	-2.0087*	0.4878	-0.4795*	0.0458
Contract Dummy (1= Yes; 0 = No)	0.0373	0.0955	-0.0809	0.2674	-0.2058	0.2334	-0.8258*	0.1721	-0.0245	0.1578	0.0880	0.0609
Variance Parameters												
Sigma-squared	1.2101*	0.0664	1.4375*	0.3014	1.0542*	0.1332	1.4772*	0.1124	1.8222*	0.3179	1.1493*	0.0419
Gamma	0.8851*	0.0112	0.7768*	0.0468	0.8192*	0.0219	0.9599*	0.0043	0.8646*	0.0279	0.8463*	0.0086
Number of observations	2522		1418		585		1374		898		6797	
Mean Efficiency	0.47		0.53		0.53		0.36		0.48		0.48	
Log likelihood Function	-3099.40		-1618.80		-588.38		-1597.76		-951.48		-8417.32	
LR test statistics	559.97		285.54		182.53		1111.11		384.44		2223.85	

Note: '*' indicate significant at 5 per cent level or above.
Source: Author's computation.

Table 8 Problems faced by the Enterprises in the Unorganised Manufacturing Sector (in percent)

Sl. No	Nature of Problems Faced	OAME	NDME	DME	Total
1	Non-availability of electricity Connection	2.3	1.7	2.7	2.2
2	Power-cut	3.6	15.0	49.0	13.0
3	Capital Shortage	29.7	44.0	19.8	32.6
4	Non-availability of Raw Materials	15.0	9.8	19.8	14.1
5	Marketing of Product	20.8	28.5	37.4	25.3
6	**Any Other Problems**				
	Competition from large units	19.4	24.9	25.9	21.9
	Fuel non-availability	0.5	0.8	0.6	0.6
	Harassment	0.0	0.0	0.5	0.1
	Labour problem	0.0	0.9	3.0	0.7
	Lack of infrastructure	1.1	1.2	0.9	1.1
	Local Problems	3.0	2.6	2.0	2.7
	No specific Problem	56.0	51.5	47.6	53.6
	Non-availability of labour	1.2	2.0	4.6	1.9
	Non-recovery	4.0	5.9	6.9	4.9
	Other Problems	14.7	10.2	7.9	12.5
Number of Enterprises and share in the total		1775 (44.0)	995 (48.5)	489 (52.4)	3259 (46.4)

Source: Calculated based on the unit level data of the NSS of the unorganised manufacturing sector in Kerala, 2000-01

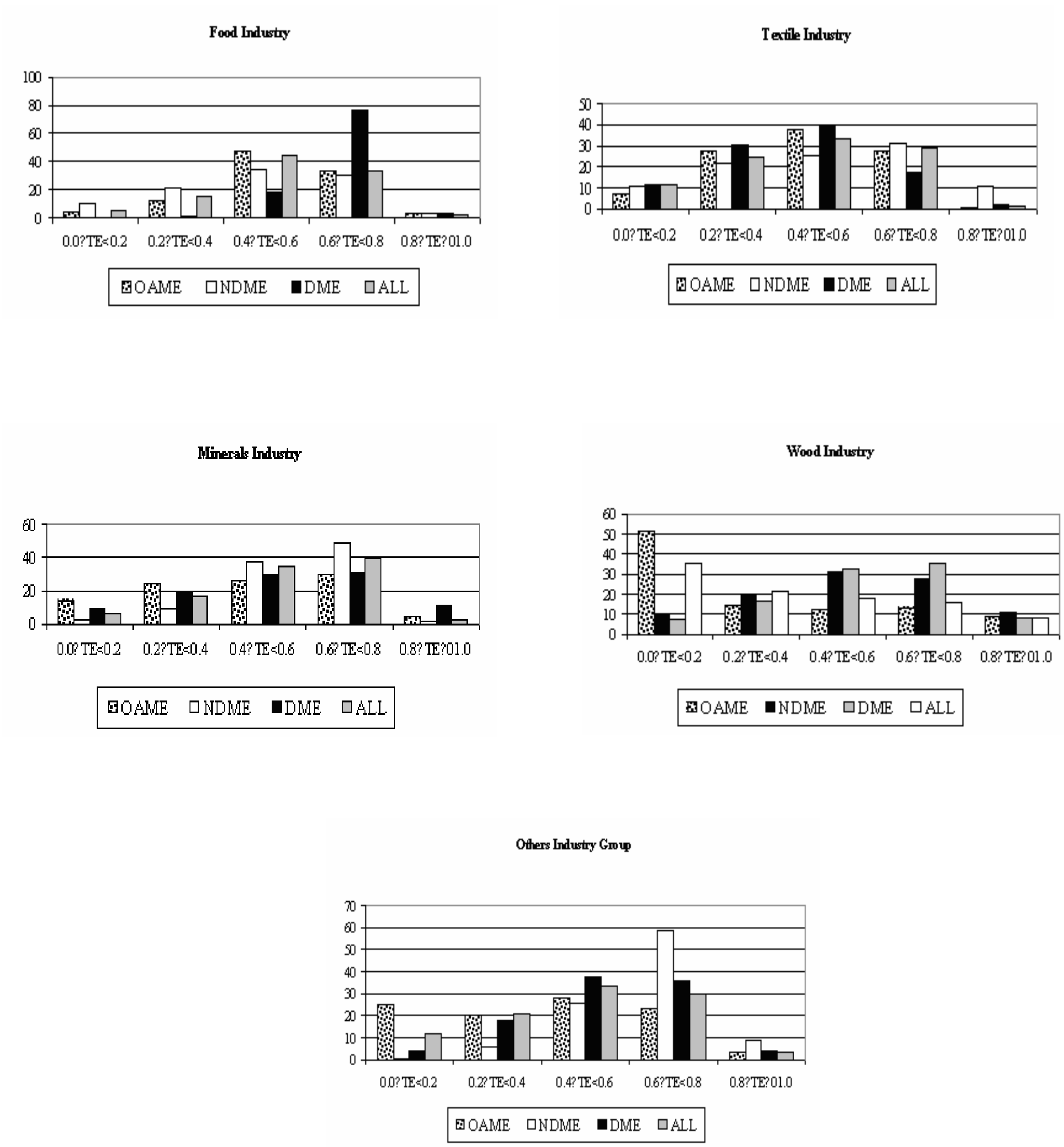

Figure1: Relative Frequency Distribution of Technical Efficiencies

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APPENDIX I

Variables Construction and Elimination Norms

Estimation of stochastic production frontier requires the definition of the variables representing the (scalar) output and the input vector.

As for output, we measure it by gross value added, defined as gross output minus value of intermediate inputs.

Regarding inputs, we confine our attention to labour and capital.

Labour refers to number of workers in the sector including full-time and part-time, hired and other, workers. A worker is defined as one who participates either full time or part time in the activity of the enterprise. If he/she works for more than half of the period of normal working hours of the enterprise on a fairly regular basis, he/she is referred to as a full-time worker. Alternatively, a part-time worker is who works for less than half of the normal working hours of the enterprise on a fairly regular basis. Note that two part-time workers in an enterprise will be counted as 2 and not 1.

This number includes both paid and unpaid workers. The inclusion of unpaid workers – e.g., relatives in family run business not receiving direct monetary, or occasional or volunteer help, possibly remunerated in kind – allows us to measure the contribution of labour better, especially in these small establishments. Note also that due to non-availability of data on total hours worked, it was not possible to use such a measure of labour.

As regards the capital input, we relied on the figures for gross fixed assets reported by the NSSO. Fixed assets are assets held for the purpose of producing or providing goods or services and they are not held for resale during the normal hours of entrepreneurial activities. These cover all goods, new or used that have a normal economic life of more than one year from the date of acquisition. They include the following:

a. assets used for production, transportation, living and other facilities (includes land, building, plant and machinery, transport equipment, tools and so on)
b. assets taken on hire purchase/instalment (whether fully paid or not) excluding interest
c. assets under consideration (e.g., construction of building etc., installation of plant and machinery, preparation of chassis of trucks etc.)
d. addition to fixed assets (as distinct from repair works)

and exclude:

a. assets owned but rented out
b. intangible assets like good will etc.
c. advance payments for fixed assets not yet received

Given the above definitions, the following elimination norms (EN) were applied in selecting observations, when there was:

EN1. Missing or negative value added
EN2. Missing labour measure
EN3: Missing capital value
EN4: Missing values of variables considered as sources of efficiency

These elimination norms (EN 1 to 4) have reduced the sample size from 7513 to 6797 (a 10 per cent reduction).

[1] Kerala has made remarkable achievements in health standards as reflected in the attainment of low infant mortality rate (14 per thousand in 2001), low birth rate (18 per thousand in 2001), low death rate (6.4 per thousand in 2001), high literacy rate (90.9 percent in 2001), high life expectancy (74.6 years in 2000) etc. (Bose 2001; Centre for Development Studies 2005).

[2] The growth rate in agriculture decelerated during the late nineties. In addition, the share of employment in agriculture has come down to less than a fourth. The fragmentation of agricultural holdings and declining family participation in the farm operations with resultant increase in production costs and dominance of perennial crops make the Kerala agriculture more vulnerable (State Planning Board 2002). Above all, the steep fall in the prices of most commercial crops since the mid-nineties till recently affected Kerala's agriculture severely (Joseph 2003).

[2a] The share of Kerala in value added by the factory sector in the country declined from 3.3 per cent in 1980-81 to 2.3 percent in 1999-2000 (Jeromi 2003). Further, Kerala contributed only 2.4 per cent of the manufacturing value added in the country during 1999-2000 (Joseph 2003).

[3] At the all-India level, the unorganised segment accounts for a share of less than 40 percent in the manufacturing sector (Subrahmanian 2003).

[4] A discussion on the variable construction and the norms applied to select the observations is given in the appendix I.

[5] It is also true that in the case of unorganised manufacturing sector reliable information on prices is not available, hence it is not possible to measure allocative efficiency under a behavioural assumption such as cost minimization or profit maximization.

[6] Early empirical studies that investigated the determinants of technical efficiencies among firms employed a two-stage approach where estimates of the stochastic frontier model were obtained in the first stage and then the estimated values of technical inefficiency were regressed on a vector of explanatory variables. This approach has been challenged by Kumbhakar et al. (1991), Reifschneider and Stevenson (1991) and Battesse and Coelli (1995) arguing that firm-specific variables may have a direct effect on the productive efficiency and hence need to be incorporated directly into the estimation of production frontier model.

[7] The variance parameters are estimated as $S^2 = S_v^2 + S_u^2$ and $\delta = S_u^2/(S_v^2+S_u^2)$ (Battese and Corra 1977). The specification for the log likelihood function can be found in Battese and Coelli (1993).

[8] A discussion on these variables is provided in section 5.2 where we present the results on the sources of technical efficiency.

[9] A study by Zheng et al. (1998) in the context of manufacturing sector in China further classified the enterprises in public sector into state-owned enterprises (SOEs), urban collective-owned enterprises (COEs), and township–village enterprises (TVEs).

[10] Another classification would have been to divide the enterprises into those located in rural areas and those located in urban areas. However, such a classification is less meaningful in the context of Kerala as the rural-urban division is rather blurred in the state (Dasgupta 2000). We have followed the classification of districts by NSSO in its recent survey of unorganised manufacturing sector during 2000-01. In this survey, the NSSO had divided the districts into southern districts and northern districts. It can be seen that the southern districts broadly correspond to the erstwhile Travancore and Cochin region while the northern districts correspond to the Malabar region.

[11] People in the southern region tolerate involuntary sickness more than their counterparts in the northern region (Mathew 1999).

[12] The values in the table refer to percentage of firms reporting the problem.