14. ECONOMETRIC ANALYSIS OF EFFICIENCY IN THE INDIAN MANUFACTURING SECTOR

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Abstract

Performance in the manufacturing sector, in relation to productivity growth, scale efficiency and technical efficiency in India is dichotomous in nature, depending on whether the firm in question functions in the formal or informal sector. The main differences between these two sectors and the changes over a decade are observed and analyzed, using aggregated data for the entire manufacturing sector in India. Using stochastic frontier approach, and therein the maximum likelihood models, efficiency in the two sectors is compared and verified against factors affecting the levels of efficiency obtained for each major industry category. The results are analyzed against realities on ground-level from a socio-economic perspective.

Keywords: manufacturing, formal, informal, organized, unorganized, returns to scale, technical efficiency, cross-sectional data, maximum likelihood estimation, efficiency gap, India, industries

JEL Classification : C01, C21, C22, D24, D61, E26

1. Introduction

The changing demographics of the developed and developing world are causing a major shift in global manufacturing trends. The ageing population in the developed world is said to be driving the manufacturing jobs to developing countries such as India, which is expected to have the largest percentage of young working age population. In a context where the balance of global manufacturing value added is gradually shifting to developing economies, India needs to tap into this trend at full

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thrust, instead of being left behind by other emerging market economies like China and Brazil. Productivity-related analyses on the impact of Indian economic reforms of 1991 reveal that there has been significant growth in productivity in many of the Indian manufacturing sectors. The dramatic change in the importance of manufacturing in emerging markets has made it critically important to understand how the Indian manufacturing sector is moving into the global economy.

Given this shifting context, the paper provides an econometric perspective on technical efficiency in the manufacturing sector. A special attention is paid to the informal (unorganized) sector, as over 70% of economic activity in the Indian manufacturing sector is classified in this sub-sector. The paper culminates in a rudimentary prognosis of development via efficiency in the manufacturing sector.

2. Classifications

The organized sector refers to those parts of the economy that operate through institutions which feed figures into official statistics. This includes firms organized as companies, payments made via the banking system, incomes reported to the tax authorities, sales reported to the VAT authorities, and employment reported to the National Insurance authorities. These constitute the vast majority of total economic activity in advanced economies. However, they constitute less than 30% of the Indian economic activity.

The unorganized sector holds the key to understanding the economic situation in developing countries such as India. For statistical purposes, economic activity in the unorganized manufacturing sector is categorized as OAME[1], NDME[2] and DME[3]. Most informal manufacturing enterprises are rural and own-account enterprises, followed by own-account enterprises in the urban sector.

The importance of the unorganized sector had been realized by the Indian planners and policy makers in the 1950s; the household-based nonagricultural activities had been covered by the National Sample Survey Organization (NSSO) since 1950. However, the data provided through each subsequent survey were inconsistent, mainly due to the constantly changing and redefined classifications.

In order to undertake comparisons on data gathered that use the two different sets of industry classification codes, broad categories can be drawn out, though with observable lapses. For instance, NIC-98 code 19 is reflected partly in NIC-87 code 29 and partly in NIC-87 code 18. Similarly, NIC-98 code 20 is reflected partly in NIC-87 code 27 and partly in NIC-87 code 36 and many more such instances exist.

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[1] **Own-account manufacturing enterprise** (OAME): An enterprise engaged in manufacturing activities, which is run without any hired worker employed on a fairly regular basis.

[2] **Non-directory manufacturing establishment** (NDME): An establishment engaged in manufacturing activities and employing less than six workers (household and hired workers taken together).

[3] **Directory manufacturing establishment** (DME)**:** An establishment engaged in manufacturing activities which has employed six or more workers (household and hired workers taken together).

Table 1

	Broad Industry Groups	NIC classifications 1987 Used in data for 1994-95	NIC Classifications 1998 Used in data for 2000-01, 2003-04 and 2004-05
1	Food, beverages, tobacco	20, 21, 22	15, 16
2	Textile, apparel	23, 24, 25, 26	17, 18
3	Wood	27	20
4	Paper	28	21
5	Leather	29	19
6	Chemicals	30	24
7	Coke, petrol, rubber, plastic	31	23, 25
8	Non-metallic minerals	32	26
9	Metal (basic and fabricated)	33, 34	27, 28
10	Machinery and equipment	35, 36	29, 30, 31, 32
11	Transport equipment; vehicles	37	34, 35
12	Other	38, 39	33, 36, 37, 22

3. Methodology

The method used here was first developed by Aigner *et al.* (1977) and Meeusen and van den Broeck (1977), who proposed a single-equation cross-sectional stochastic production frontier model which assumes that establishment i uses the input vector X_i to produce a single output Y_i based on the following equation:

$$Y_i = f(X_i , \beta) \exp(\delta_i - u_i) \quad (1)$$

The error term in the model consists of two components, a traditional symmetric random noise component (δ_i) and a new one-sided inefficiency component (u_i). The δ_i accounts for measurement error and other random factors. The u_i that captures technical inefficiency is the combined outcome of non-price and organizational factors that constrains an industry from achieving maximum possible output from the given set of inputs and technology. The u_i is non-negative and assumed to be independently and identically distributed. Thus, when the industry is fully technically efficient (TE=1), u takes the value of 0 and when the industry faces constraints (0<TE<1) u takes a value less than 0.

The magnitude of u specifies the 'efficiency gap', that is how far an industry's given output is from its potential output. Both the δ_i and u_i are assumed to be independent of the regressors. Thus, industry specific Technical Efficiency (TE_i) is measured as the ratio of the observed output of the industry to the potential output derived by the frontier function and is outlined as:

$$TE_i = \exp(-u_i) \quad (2)$$

TE_i measures how close the industry gets to its maximum achievable output, once external shocks (i.e., noise) are removed. Y_i achieves its maximum value of (f (X_i , β) $\exp(\delta_i - u_i)$), and $TE_i = 1$ if $u_i = 0$. Stated differently, $u_i \neq 0$ reports the shortfall of observed output from the maximum potential output. To compute TE_i, one needs first

to estimate equation (1), and then decompose the residuals into estimates of noise (δ_i) and technical inefficiency ($-u_i$).

To estimate the technical efficiency levels in the manufacturing sector of India, 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, the translog functional specification is used. The log linear translog production frontier with two inputs labor (L) and capital (K) for industry i is given by:

$$\log Y = \alpha + \gamma_1 \log K + \gamma_2 \log L + v - u \quad (3)$$

The technical efficiency effects are defined in terms of modeling the mean of u_i as a function of a host of industry-specific characteristics. Symbolically, the inefficiency model can be specified as:

$$u_i = \delta' z_i + w_i \quad (4)$$

where: z_i is a vector of explanatory variables related to technical inefficiency for the ith industry; δ' is the inefficiency parameters to be estimated; and w is an error term that follows a truncated normal distribution.

4. Data and Variables

Given that additional data are available on unorganized manufacturing sector through the NSS rounds for 1994-95 and 2000-01, the econometric analysis for unorganized sector is further qualified than that for the organized sector by including a measure of factors affecting the level of technical efficiency for the respective years, and for some broad industry groups. The industry-specific characteristics included in the efficiency model for the unorganized sector comprises industry size, ownership, location, ratio of borrowed to total capital, ratio of hired to total workers and share of emoluments to GVA. These factors can be broadly classified into ownership characteristics, market/region of operation and the rationale for business existence.

5. Empirical Results and Analyses

5.1. Organized Sector

The regression results for the organized sector are affected by the fact that productive capital was chosen as the variable used to measure capital. As a result of this, one observation had to be dropped as its value of productive capital was negative and therefore could not be used in the translog functional form. From the regression results, it can be concluded that the share of labor and capital in gross value added are 28% and 72% respectively for the organized sector. The figures show an improvement over time in labor's share in gross value added, indicating perhaps an improvement in employee performance, increased labor efficiency and/or better training/qualification of labor in 2004-05 compared to 2003-04. The t-statistic for both variables is significant. (Refer to Annex - Regression results: A.1.1. and A.1.2.).

The technical efficiency measures for 2003-04 in the organized sector, obtained using the maximum likelihood estimator are shown in the table below. Note that shading has been used to create ranges comparable across years and data; ranges have been established separately for each dataset, while the same color scheme is used for all datasets.

Table 2

Maximum Likelihood - Organized Sector Technical Efficiency - 2003-04

Highly Efficient Over 1.3	0.8 – 1.3	0.4 – 0.8	0.1 – 0.4	0.01 – 0.1	Highly Inefficient Under 0.01

NIC code[4]	Industry category	Subcategories					
14	Extraction of salt	1.08322					
15	Food products and beverages	.8036855	.0301158	1.105474	.9675497	.8119298	
16	Tobacco products	.2665215					
17	Textiles	1.102629	.7687681	.7294786			
18	Wearing apparel; dressing and dyeing of fur	.5920065	.3342617				
19	Tanning and dressing of leather; luggage, handbags, etc (leather products)	1.043732	.6358912				
20	Wood and wood products, except furniture	1.236532	1.007652				
21	Paper and paper products	.9268036					
22	Publishing, printing and reproduction of recorded media	.0419123	.6506988	.9355392			
23	Coke, refined petroleum products and nuclear fuel	.6267928					
24	Chemicals and chemical products	.5513083	.1492622	.255801			
25	Rubber and plastic products	.3495883	.8974048				
26	Other non-metallic mineral products	.9568728	1.009052				

[4] *The industry codes used for 2000 – 2005 follow the NIC-1998 industry divisions, which are different from those of the NIC-1987 codes used in data gathered for 1994-95.*

NIC code[4]	Industry category	Subcategories					
27	Basic metals	.3871196	.5686648	.7727759			
28	Fabricated metal products, except machinery and equipment	.2171502	.5971319				
29	Machinery and equipment n.e.c.[5]	.1808241	.3150589	.8456577			
30	Office, accounting and computing machinery	.3785499					
31	Electrical machinery and apparatus n.e.c.	.0319046	.1632002	1.194094	.2795566	.5103726	.5393313
32	Radio, television and communication equipment and apparatus	.3639593	.8296083	.7751457			
33	Medical, precision and optical instruments, watches and clocks	.0957094	.3531782	.4377955			
34	Motor vehicles, trailers and semi-trailers	.1663137	1.131183	.3055288			
35	Other transport equipment	.0406841	.2263249	.1264745			
36	Furniture; manufacture n.e.c.	.6101501	.6181245				
37	Recycling	.7763814	.0079131				
98	Others	.748036					

Shaded chart: (NOTE: for organized sector 2004-05 the ranges are moved higher to accommodate the overall improvement in the scenario)

The table above shows that the level of technical efficiency varies drastically within any given industry category, depending on the sub-group. This is clearly visible, for instance, in the recycling category (code = 37), where the efficiency level of recycling of metal waste and scrap is high, while that of electricity, gas and water supply is low. This can be explained as in the organized sector, recycling of electricity and water are processes requiring the use of latest technologies and there may as well be excess investment in these while the rate of return for such companies are extremely low.

Similar analysis can be conducted for the publishing, printing and reproduction of recorded media (code = 22). In this category, publishing has low efficiency, followed by printing, while reproduction of recorded media has a very high level of efficiency. This can be justified as publishing and printing involve extensive use of capital, while the rate of return can be quite low. However, in the reproduction of recorded media, activity is clearly linked to demand, as only media demanded get reproduced.

[5] *"n.e.c." stands for: "not elsewhere classified"*

The technical efficiency measures for 2004-05 in the organized sector are shown below.

Table 3

Maximum Likelihood - Organized Sector Technical Efficiency - 2004-05

NIC code[6]	Industry category	Subcategories					
14	Extraction of salt	1.199062					
15	Food products and beverages	1.337693	.5999187	1.560854	1.360955	1.50858	
16	Tobacco products	.3687226					
17	Textiles	1.659222	1.304309	1.321788			
18	Wearing apparel; dressing and dyeing of fur	1.063041	1.252128				
19	Tanning and dressing of leather; manufacture of luggage, handbags, etc (leather products)	1.308474	1.294117				
20	Wood and wood products, except furniture	2.224233	1.539529				
21	Paper and paper products	1.47017					
22	Publishing, printing and reproduction of recorded media	.5919031	1.111132	.9684203			
23	Coke, refined petroleum products and nuclear fuel	.3256363					
24	Chemicals and chemical products	.7514657	.6518537	1.097492			
25	Rubber and plastic products	.9195447	1.483317				
26	Other non-metallic mineral products	1.25387	1.31669				
27	Basic metals	.5528659	.5847365	1.116422			
28	Fabricated metal products, except machinery and equipment	.75036	1.069356				
29	Machinery and equipment n.e.c.[7]	.6590368	.746532	1.20772			
30	Office, accounting and computing machinery	1.228205					
31	Electrical machinery and apparatus n.e.c.	.55576	.261514	1.311181	.4933932	1.012488	.7069851

[6] *NIC codes here refer to the 1998 industry classifications*
[7] *"n.e.c." stands for: "not elsewhere classified"*

32	Radio, television and communication equipment and apparatus	.9420847	.6826323	1.26465			
33	Medical, precision and optical instruments, watches and clocks	.5219371	.1275927	1.110485			
34	Motor vehicles, trailers and semi-trailers	**.0805557**	.9399647	.8026085			
35	Other transport equipment	.4943179	.3239527	.1883955	.2907		
36	Furniture; manufacture n.e.c.	1.04764	.9372386				
37	Recycling	.6289288	1.186847				
98	Others	1.421601					

The efficiency coefficients have improved from 2003-04 to 2004-05, indicating implementation of significant reforms in the organized sector manufacturing in Indian industries. The only industry sub-category with a lower level of efficiency than in 2003-04 is that involving the manufacturing of motor vehicles. In the broad industry classification (code = 34), the manufacturing of parts and accessories for motors has shown improvement, however, the manufacturing of motor vehicles has deteriorated in its efficiency ranking. This could be associated to the takeover of small/large Indian car manufacturing firms to international brands, leading to a decline in the average situation of the industry. For instance, Maruti which was a major car manufacturer in India was taken over by Suzuki in late of 2002.

Besides the automobile industry, a couple of other industries have also shown a decline in the rate of transformation of inputs to gross value added. The manufacturers of coke, petroleum and processing of nuclear fuel (industry code 23) have perhaps increased the level of capital investments, with little additional gross value added. This industry group continues to receive increased investments due to its importance in view of national interest, though the efficiency and extraction levels continue to be very low.

The manufacture of electrical devices (industry group 31) has shown consistent improvement due to improved technical efficiency and capabilities. However the manufacture of television and radio transmitters (industry code 32) has declined in efficiency as they are not able to keep up with international brands that have higher investments in R&D, though the manufacturing of television and radio equipment has increased in efficiency.

5.2. Unorganized Sector

The regression result for 1994-95 indicates that the share of capital and labor in GVA is roughly 59% and 36%, respectively. Using 2000-01 data, it is clear that the unorganized sector manufacturing industries continue to be more capital-intensive, in terms of contribution to the gross value added (55% capital and 38% labor). Thus the

overall nature of capital and labor contribution is not significantly different between 1994-95 and 2000-01. However, the overall factor transformation (inputs contributing to gross value added) is lower in 2000-01 than in 1994-95. This may indicate a tendency away from manufacturing to service sector in the unorganized economic activity. (Refer to annexes A.1.3.a and A.1.4.a).

The levels of technical efficiency calculated for each industry in unorganized sector manufacturing for 1994-95 is shown below.

Table 4

Maximum Likelihood - Unorganized Sector Technical Efficiency - 1994-95

NIC Code[8]	Industry Category	Rural			URBAN		
		OAME	NDME	DME	OAME	NDME	DME
20	Food products	.1848255	.1322013	.0172955	.2399956	.3583127	.6042224
21	Food products	.1089965	.4058937	.3848585	.0372216	.1416327	.5296971
22	Beverages, tobacco etc	.3840972	.0990394	.295061	.2400476	.5552636	.4673744
23	Cotton textiles	.18898	.0741457	.0781118	.4066447	.1967036	.5428087
24	Wool, silk and man-made fiber textiles	.1032585	.027759	.2806183	.3083631	.0249013	.1598879
25	Jute and other textiles	.267104	.4234711	.2719346	.2555171	1.06734	.1217629
26	Textile products	.1264607	.4289891	.5431434	.1612812	.336445	.8332416
27	Wood and wood products	.2388893	.2461554	.2125813	.2386695	.8394328	.7512347
28	Paper and paper products	.4479314	.0544661	.8017679	.0717	.2401792	.1070338
29	Leather and leather products	.1513134	1.014795	1.311502	.5376092	.7558657	.8657824
30	Chemical and chemical products	.1969672	.0149223	.1284989	.5946237	.3155838	.5689269
31	Rubber, plastic and petroleum	.8389992	.270583	.2145015	.4309622	.3538114	.0043081
32	Non-metallic mineral products	.083366	.0916027	.7379333	.2245334	.1422812	.1439286
33	Basic metal and alloys industry	.1863705	.4481126	.5717555	.4555346	.3971707	.6166774
34	Metal products and parts	.220173	.3252894	.1804339	.2140294	.4392115	.3173443
35	Machinery and equipment	.0304292	.0637931	.2064654	.0512108	.0593814	.3356191

[8] *The NIC code refers to the 1987 divisions here. These codes do not directly correspond to those in the following or previous efficiency tables.*

NIC Code[8]	Industry Category	Rural			URBAN		
		OAME	NDME	DME	OAME	NDME	DME
36	Machinery and equipment	.1521055	.7085716	.8459789	.0829674	.2822162	.7875177
37	Transport equipment and parts	.0078386	.0705744	.4131559	.2770947	.5075699	.3909456
38	Other manufacturing industries	.1425654	.4525515	.8697926	.4242097	.3974797	.7294394
39	Repair of capital goods	.1231018	.2379581	.3244349	.2890908	.2811247	.9299432
97	Repair services	.4497367	.3861729	.1834985	.5858308	.4343315	.0882612
99	Not recorded cases	.4964229	.4412128	.526106	.6979758	.4644552	.2562553

From the table above, in rural areas, the highest levels of relative efficiency in 1994-95 occur in the leather industry, though there is high efficiency for this industry in urban areas as well. The most alarmingly low relative efficiencies occur in the transport and equipment industry in Rural OAMEs, and in the coke, oil, rubber and plastic industries in Urban DMEs. These figures also correspond to ground-level realities in India during the mid 90s.

The leather industry in India is quite technically efficient, with significant added value relative to input factors. This industry is most successful for NDMEs and DMEs, which are more able to supply the consumer markets for leather than OAMEs (especially not rural OAMEs). On the other hand, rubber industry for instance is best organized at the OAME level, which have strong backward linkages to family-farms (in the case of rubber obtained through sap).

Transport equipment and vehicles industry in unorganized manufacturing may include rickshaws, scooters and three-wheel scooters which are most in use in urban areas. Therefore, once again closeness to market determines the relatively higher efficiency in the urban areas for this industry.

The manufacturing of food products, though considered for 2 separate categories, shows very low levels of efficiency. Similar to the food industry, the textile industry, which is clearly allocated 4 classification categories, exhibits very low levels of technical efficiency.

The categorization of machinery and equipment into two groups, 35 and 36, have different results, indicating the need for more clarification on the classification of these groups.

Both “other manufacturing industries” and “not recorded cases” exhibit much higher overall efficiency than the industries that have been detailed. This shows that these categories should have been further segregated to identify the specific industries that possess such high and positive levels of technical efficiency.

The levels of technical efficiency calculated using 2000-01 data for the unorganized sector is shown in Table 5. The efficiency analysis for 2000-01 shows that there are

some significant outliers. A couple of industries, for instance, paper industry, manufacturing of transport equipment (not including manufacturing of motor vehicles) and the manufacture of basic metals have the frontier levels of efficiency in rural DMEs in the case of both transport equipment and manufacturing of basic metals. This could also be associated to the lack of technological progress in these areas, as they continue to utilize age-old techniques, which are in fact best implemented in the rural areas compared to other industries in the rural areas.

Table 5

ML results Unorganized Sector Technical Efficiency 2000-2001

NIC Code[9]	Industry category	Rural			URBAN		
		OAME	NDME	DME	OAME	NDME	DME
15	Food products and beverages	.1985583	.2443156	.1091332	.0118527	.0261722	.2025919
16	Tobacco products	.0153637	.0703306	.1487336	.376554	.224112	.3307285
17	Textiles	.2858467	.0829792	.0495291	.3870716	.1897154	.1982427
18	Wearing apparel; dressing and dyeing of fur	.148592	.3901153	.0433726	.1003852	.4158869	.4592338
19	Tanning and dressing of leather; manufacture of luggage, handbags, etc (leather products)	.0607462	.3709803	.530673	.0410471	.2630253	.4956789
20	Wood and wood products, except furniture	.1091938	.1885152	.1780605	.1427817	.0247741	.1035457
21	Paper and paper products	.9118605	.75597	.2883105	.7635875	.1158323	.1199951
22	Publishing, printing and reproduction of recorded media	.3387942	.3153195	.4920602	.4111805	.0042181	.0721779
23	Coke, refined petroleum products and nuclear fuel	.1925159	.2572818	.4559216	.4087262	.4596925	.2018127
24	Chemicals and chemical products	.677505	.1372004	.4458375	.5992894	.1241693	.2079396
25	Rubber and plastic products	.4417734	.1925015	.0460229	.2319727	.0605879	.309711
26	Other non-metallic mineral products	.1835504	.4015994	.341362	.2910662	.2140765	.1819105
27	Basic metals	.0170259	.5120606	1.147265	.0453324	.0251536	.1863999
28	Fabricated metal products, except machinery and equipment	.0783091	.201303	.2245874	.0781765	.0814457	.1603837
29	Machinery and equipment n.e.c.[10]	.3952594	.4771538	.2347145	.3239608	.0692663	.1928372
30	Office, accounting and computing machinery	.	.	.	.	.3994069	.2716737
31	Electrical machinery and apparatus n.e.c.	.1726303	.5246739	.0324054	.3584247	.0891466	.6285419
32	Radio, television and	.1246171	.5920267	.0652914	.532331	.3005009	.0901189

[9] NIC Code here uses the 1998 industry classifications
[10] "n.e.c." stands for: "not elsewhere classified"

NIC Code[9]	Industry category	Rural			URBAN		
		OAME	NDME	DME	OAME	NDME	DME
	communication equipment and apparatus						
33	Medical, precision and optical instruments, watches and clocks	.353363	.4708061	.5687785	.1262474	.2555943	.1890221
34	Motor vehicles, trailers and semi-trailers	.2561402	.0539632	.3060446	.3892102	.497272	.1226377
35	Other transport equipment	.1374092	.1509094	2.152476	.7027211	.0562978	.0616531
36	Furniture; manufacture n.e.c.	.0630536	.3976054	.4743094	.0815163	.2677298	.5047598
37	Recycling	.2576532	.0942736	.223175	.4063315	.1636734	.1048188

5.3. Factors Affecting Efficiency in the Unorganized Sector

The frontier method was used to further estimate the factors affecting technical efficiency of Indian manufacturing industries. The regression results for 1994-95 are shown in Annex A.1.3.b. Since the regressions are conducted on industry data and not on firm-level data, the coefficients indicate the effect on mean industry technical efficiency of the ratio of outstanding loan to gross value added (an indicator of credit availability), the ratio of hired labor to total workers, the ratio of emoluments paid to workers as a ratio of gross value added, the type of ownership (OAME, NDME or DME) and the location (rural or urban).

The mean efficiency of the unorganized sector is positively affected by the availability of credit. However, the coefficient has a low value, also indicating that the overall use of credits may be low in order to finance activity in the unorganized sector.

Location has a major impact on the overall efficiency; RU is a dummy variable, which takes a value of 0 if the industry is located in the rural areas and reversely RU = 1 if it is located in urban areas. The overall efficiency of industries is significantly higher in urban areas, regardless of type of ownership.

Ownership on the other hand has a very low t-statistic, indicating that there are industries in which small scale activity (OAME) are more efficient than established enterprises of relatively larger sizes (DME: usually with over 6 employees per firm).

The regression results on factors affecting technical efficiency show a drastic change in scenarios from 1994-95 to 2000-01. In 2000-01, the only significant variables chosen are the ratio of emoluments to GVA and the size variable (indicated by category of industry: OAME, NDME and DME). The efficiency levels are observed to be significantly higher for DMEs over that of NDME, which in turn have higher efficiencies than OAMEs. Therefore, scale efficiencies are becoming more evident and returns to scale are higher in 2000-01 than they were in 1994-95. (Refer to Annex A.1.4.b).

6. Constraints

Variations in data categorization have adversely impacted the analysis that can be done on the manufacturing sector on several levels. Firstly, the categorizations in the two NIC codes – 1987 and 1998 have inherent differences. The 1987 codes are

geared more on primary goods, while the general focus of the manufacturing sector is diversifying and broadening, as it is loosely exhibited in the 1998 NIC codes.

Secondly, data gathered in the NSS rounds vary greatly, preventing a coherent and complete analysis of factors affecting technical efficiency in the informal sector. For instance, proxies were used for many variables: the broad categories of OAME, NDME and DME were used to reflect size, though it must be noted that there is often overlapping sizes between them, as many NDMEs have less than 6 employees (including family) and many DMEs have around 6 employees – thus overlapping NDMEs in size. Information such as type of ownership, nature of activity and sources of credit, which exist for some categories while not for others, would have significantly added value in the analysis of factors affecting technical efficiency.

Finally, it must be noted that the broad categorization within the formal sector may, in fact, be more uniform than in the informal sector as the formal sector often faces similar government support, regulations and external constraints within an industry category than the informal sector, which clearly is starkly heterogeneous with idiosyncratic constraints varying due to regional factors, cultural and social norms, etc. As such, a thorough analysis of the informal sector requires more in-depth data availability in order to undertake the required interventions; but firstly it is needed to conduct basic specification and to identify properly the situation in the informal sector.

7. Conclusions

Comparing all the econometric results of technical efficiency across the organized and unorganized sectors, one notices the expected gap in terms of better average efficiency in the organized sector as well as a clear improvement in average efficiency over time across most industries. In order to make the comparison clear across the different data types (different NIC codes), the efficiency results have been organized below, using the categorizations elaborated in Section 2: Classifications.

Table 6

Efficiency Comparisons

	Organized sector		Unorganized sector	
Broad Industry Groups	2003-04 average efficiency	2004-05 average efficiency	2000-01 average efficiency	1994-95 average efficiency
Food, beverages, tobacco	0.50513623	0.82116137	0.16320386	0.28811313
Textile, apparel	0.66504633	1.29301208	0.22924754	0.30120305
Wood	1.12209200	1.88188100	0.12447850	0.42116050
Paper	0.92680360	1.47017000	0.49259265	0.28717973
Leather	0.83981160	1.30129550	0.29369180	0.77281128
Chemicals	0.31879050	0.83360380	0.36532353	0.30325380
Coke, petrol, rubber, plastic	0.62514468	0.76353358	0.27154334	0.35219423
Non-metallic minerals	0.98296240	1.28528000	0.26892750	0.23727420
Metal (basic and fabricated)	0.49166391	0.83059973	0.22978690	0.36434190
Machinery and equipment	0.48376111	0.94649429	0.30071428	0.30052136
Transport equipment; vehicles	0.33275150	0.46602558	0.40722788	0.27786318
Other	0.46114059	0.84437098	0.27651923	0.43347432

The surprising observation is that average efficiency has in fact declined in many of the broad industry groups for the unorganized sector from 1994-95 to 2000-01. This cannot be explained by considering external factors such as social unrest or political interference as no major negative measures or events took place across the country; though, some of it may be explained through the different data classification between these years. Besides, considering that the data for organized and unorganized sector between 2000 and 2005 have had the same classification structure, the extremely low average efficiencies for 2000-01 in the unorganized sector are indeed a valid comparison. Therefore, it is clear that government intervention is required to improve the productivity and efficiency of the unorganized sector. Thus, measures being taken by the Ministry of Micro, Small and Medium Enterprises (Government of India) and the National Commission for Enterprises in the Unorganized Sector (NCEUS) for bringing about improvement in the productivity of unorganized sector enterprises are well-founded and should be expanded to full-thrust. So, such measures should at the same time aim to maintain the advantages that come along with the unorganized sector activity (for instance, economies where such unorganized sectors exist do not feel the full blow of economic downturns as it was visible in the current global economic crisis).

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ANNEX

Regression Results

A. 1.1.

ML frontier regression organized sector 2003-04

Number of groups: 25 Number of obs: 60

logvad	Coef.	Std. Err.	[95% Conf.	Interval]
loglab	.2772659	.0858449	.1090129	.4455188
logcap	.7259951	.0736672	.58161	.8703801
_cons	-.331754	.9953814	-2.28266	1.619157
sigma_u2	.0153112	.0707331		.1539454
sigma_v2	.1323363	.0334422		.1978818

A. 1.2.

ML regression organized sector 2004-05

Number of groups: 25 Number of obs: 61

logvad	Coef.	Std. Err.	[95% Conf.	Interval]
loglab	.3538913	.0811844	.1947728	.5130098
logcap	.6963819	.0725952	.5540979	.8386659
_cons	.1083705	1.292045	-2.423992	2.640733
sigma_u2	.1032186	.0487278	.0077139	.1987233
sigma_v2	.1276742	.0296995	.0694642	.1858842

A. 1.3.a

ML regression unorganized sector 1994-95

Number of groups: 22 Number of obs: 132

logvad	Coef.	Std. Err.	[95% Conf.	Interval]
loglab	.3616218	.0446923	.2740266	.4492171
logcap	.5929573	.0428845	.5089053	.6770092
-cons	5.040645	12.54064	-19.53856	29.61985
sigma-u2	.0246619	.0151357	-.0050035	.0543273
sigma-v2	.1263795	.0172716	.0925279	.1602311

A. 1.4.a

ML regression unorganized sector 2000-01

Number of groups: 23 Number of obs: 134

logvad	Coef.	Std. Err.	[95%Conf.	Interval]
loglab	.3801554	.040866	.3000595	.4602512
logcap	.5531959	.0386764	.4773917	.6290002
-cons	5.320912	.4591395	4.421015	6.220809
sigma_u2	.0296885	.0674741	-.1025583	.1619353
sigma_v2	.1298697	.0175328	.095506	.1642334

A. 1.3.b

ML regression unorganized sector factors affecting technical efficiency 1994-95

Number of groups: 22 Number of obs: 132

meanU	Coef.	Std.	[95% Conf.	Interval]
loanratio	.0027129	.0010091	.000735	.0046907
hireratio	.0037688	.0024966	-.001124	.008662
emolratio	-.005818	.0029415	-.011584	-.0000538
OND	.0436106	.0793608	-.111933	.199155
RU	.0752629	.0375798	.0016079	.1489179
_cons	.7254116	32.67096	63.30849	64.75932
sigma_u2		.0053695	-.001305	.0197427
sigma_v2		.0062134	.0336095	.09655

A.1.4.b

ML regression unorganized sector factors affecting technical efficiency 2000-01

Number of groups: 23 Number of obs: 134

ErrU	Coef.	Std. Err.	[95% Conf.	Interval]
loanratio	.0014779	.0011877	-.0008499	.0038057
hireratio	.0000679	.000633	-.0011728	.0013086
emolratio	-1.45022	.3805797	-2.19615	-.7043051
OND	.2796526	.0467741	.1879769	.3713282
RU	-.026418	.0578362	-.1397751	.0869386
_cons	.8375763	.1643307	.515494	1.159659
sigma_u2		.0399711	-.0359455	.1207383
sigma_v2		.0109844	.0602679	.103326