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Productivity and Size of Firms: Evidence from Indian Manufacturing

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Abstract

This study makes an attempt to analyze the role of firm's size in productivity variation for a large sample of Indian manufacturing firms. For empirical analysis, I utilize a recent survey on the Indian manufacturing, which covers across size, industries and regions of firms. Our results suggest that large size firms have 9-11 percent productivity premia over other sized firms. Also, smaller firms are significantly inferior in terms of productivity performance in comparison to other sized firms. Furthermore, I also find some effects of trade intensity on the productivity of firms, yet, this effect is not found to be quite sizable. Overall, results show a robustness in estimated effects.

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I. Introduction

There are several factors which cause productive differential among firms in the same industry. Theoretical and empirical models have considered several endogenous and exogenous factors which cause productivity growth (e.g. see Craft, 1995). These factors largely vary with the size of firms. For example, R&D, technology transfer, availability of easy and cheap credit is easily accessible to large firms (Van Biesebroeck, 2005). However, some other argue that small firms have the advantage of more flexible management and lower response time to market changes while larger firms have the advantages of economies of scale, political clout and better access to government credits, contracts and licenses, particularly in developing countries (Jovanovic, 1982).

In this context, to understand the productivity performance of firms, it is important to analyze the productivity and size of firms. There are several studies focused on difference in labor productivity (e.g., Baldwin et al., 2002, Van Ark and Monnikhof, 1996) however, barring a few exceptions (e.g., Van Biesebroeck, 2005) evidence for total factor productivity (TFP) is relatively scarce. Therefore, in this study, I make an attempt to analyze the role of firm size in TFP differential of the Indian firms. Analyzing the issue in the Indian context is important as large firms have been criticized for not generating enough employment opportunity for a growing workforce, while micro and small firms have been considered as major growth and employment creators, thus, promoted by government. However, this argument is empirically controversial and needs further investigation.

The rest of the paper proceeds as follows. In the next section, I discuss data and its source. In Section 3, TFP distribution of different categories firms is compared, while Section 4 presents main results. The final section concludes.

2. Data

For empirical analysis in this study, I use a recent published data from Enterprise Surveys (ES) on India. Enterprise Survey is a firm-level survey of a representative sample of an economy's private sector conducted by World Bank. The survey includes several important information related to the firms and business environment. The Indian survey of business owners and top managers in 9,281 firms were interviewed from June, 2013 through December, 2014. It is noteworthy that during the survey period each firm of the sample interview only once. Thus, the sample is considered a cross-section data. I focus only on manufacturing firms which consists 7169 firms. I use some important indicators such as sales, trade, age,

foreign ownership and size of the firm. In the database, information on number of workers is also available for previous periods. I do utilize that information in our empirical model. Details of these variables are presented in Table I. For TFP estimation of firms, I follow the approach of Saliola and Seker (2011), which estimated the TFP of firms for cross-country using the ES data. Specifically, I use value added as a measure of output, while number of workers and capital is used as measures of inputs in a Cobb-Douglas production.

Table I: Data Description

Variable	Definition
LTFP	Log of TFP, estimated by the author
LWorkers	Log of total workers
LCapital	Log to current value of Machinery, vehicles, and equipment
Large	=1 if firm is a large firm (100+ workers), otherwise 0
Medium	=1 if firm is a medium (20-99 workers)firm, otherwise 0
Small	=1 if firm is a small firm (5-19 workers), otherwise 0
Foreign	=1 if firm is a foreign firm (More 10% owned by Private foreign individuals, companies or organizations), otherwise 0
(LLabor) _{t-3}	Log of total workers in t-3 year
LGVAD	Log of value added (sales excluding raw material expenses)
Trade intensity	% of trade (export + import) to total sales
Age	Age of firm

3. TFP of Large firms vis-à-vis Small Firms: Comparing Distributions

3.1. Comparing the Distributions: Kernels Estimates

The prime objective of this paper is to examine whether an association exists between size of firm and productivity levels. For illustration purpose, I use Epanechnikov kernels with optimal bandwidths to smooth the distribution of productivity levels for different size of firms and productivity performance. Specifically, I use a kernel density that estimates the kernel function K, as in

$$\hat{f}_k = \frac{1}{qh} \sum_{i=1}^n w_i K \left(\frac{x - X_i}{h} \right) \quad (1)$$

where $q = \sum_i w_i$ and weights $w_i = 1$, if firm $i = 1, 2, \dots, n$. We use Epanechnikov function as it is the most efficient in minimizing the mean integrated squared error (see Cox, 2005).

I plot in Figure 1 the smoothed distributions of average log TFP levels for large firms vis-à-vis others. The distribution of the large firms is skewed to relatively right to that of other firms, which clearly demonstrates productivity superiority of large firms over others. The figure 2 compares distribution of small vis-à-vis other firms. The distribution of small firms is skewed toward left suggesting smaller firms have lower productivity than other firms.

Figure 1

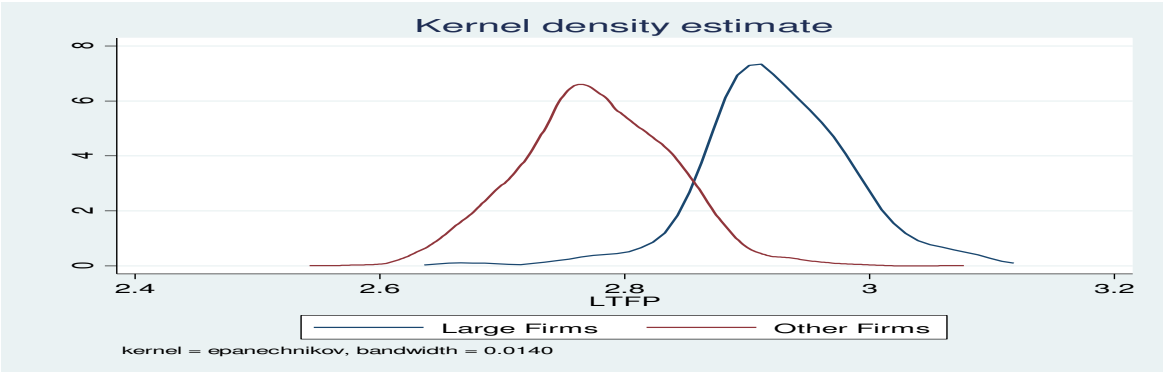
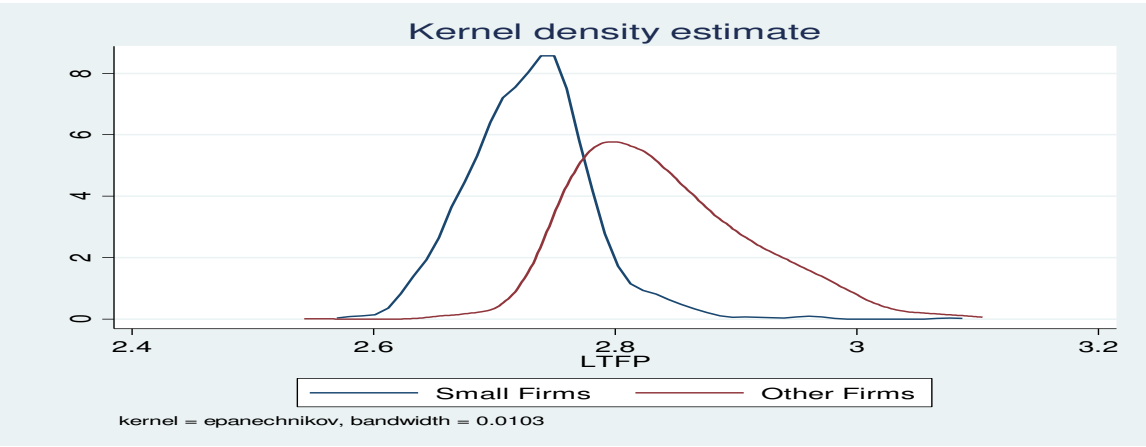


Figure 2



3.2. Comparing the Distributions: Preliminary Regression Results

In order to compare the productivity distribution of large and small firms, in this section, I further attempt to assess the performance differential between the groups. For this purpose, I run the following regression:

$$Z_i = \beta_0 + \beta_1 \text{Large}_i + \beta_2 \text{Small}_i + \varepsilon_i \quad (2)$$

where, Z is TFP of firm i , and other variables are as defined in Table I. The medium size firms are used as reference in the model. Subscript i indexes firms and ε is disturbance. Estimation result of equation (2) is reported in Table 3. These results are although showing simple relations, nevertheless, have the advantage that the estimated coefficients can be interpreted in percentage terms. The results are expected to provide specific percentage differential between large vis-à-vis other firms and small vis-à-vis other firms. The results presented in Table 2 clearly indicate that large firms are superior to medium size firms in terms of productivity. Specifically, in terms of TFP, large firms are estimated to be 11.7% more productivity in the model without industry dummies while, 11.4% more productive with industry dummy. As expected, small firms are estimated to be around 7.8% less productive when industry dummies are not included and with industry control, it is tuned out to be 7.8% less productive. On the whole, these findings confirm the results of kernel distribution and endorse that large firms are more productive while the small firms comprise the least productive group. These findings motivate us to analyze the issue in a comprehensive model.

Table 2: Descriptive regressions results

Dependent Variable: LTFP

	I	2
Large	0.11688** (0.00261)	0.11391** (0.0025)
Small	-0.07802** (0.0021)	-0.07461** (0.0021)
Constant	2.8075** (0.0013)	2.7992** (0.0031)
\bar{R}^2	0.6246	0.6573
Test of Equality (H_0 : Large=Small)	4962.49 (0.00)#	4875.24 (0.00) #
Industry Dummies	No	Yes
Number of obs	2995	2995
Estimator	OLS	OLS

Note: 1. Standard error in brackets. 2.** Significant at 5% critical level.3. Industry dummies are included in all regressions.# P-value

4. Main Results

To analyze the effects of size of firms, I next estimate following model:

$$Z_i = \beta_0 + \beta_1 \text{Large}_i + \beta_2 \text{Small}_i + \beta_3 X_i + \varepsilon_i \quad (3)$$

where, X is a vector of some important variables which affect productivity of firms. The results are presented in column 1 to 3 of Table 3. Column 1 report the results without industry-dummy. As expected, both size dummies - large and small - are estimated to be positive and negative, respectively and statistically significant. Specifically, results suggest that large firms are 9.5% to 11% more productive than others, while small firms are 7.6% to 9% less productive. To test the large firms vis-à-vis small firms' productivity differential, we also employ test of equality, which is found to be significant apparently indicating that their estimated coefficients are significantly differ. This results further confirms that size-wise Indian firms diverge in productivity.

Our analysis also indicate that trade intensity has a significant impact on productivity but its size is comparatively small. This is quite similar to earlier findings of Sharma and Mishra (2011, 2015) and Mitra et al. (2016) for India. Our results also indicate that foreign firms are found to be 0.7% to 2.4% more productive than domestic firms (see Table 3). I include number of labor in t-3 period (see column 3) to control the model. This is also found to be statistically significant and positive.

Finally, random shocks that affect TFP in a firm probably also affect trade activities, therefore, trade intensity may be endogenous in the model that may cause endogeneity biasness in the estimation. To take care this problem, I apply **Two Stage Least Squares (2SLS)** estimator. I instrument trade intensity with education of female employee and it works well. The results of estimation are presented in column 4 of Table 3. These results are not very different from OLS estimator results and further confirm that large firms are around 10% more productivity than others, while small firms are around 7% less productive. Foreign firm dummy that is significant in columns 1 to 3 results, could not clear the statistical barrier in column 4. Trade intensity is estimated to be significant, yet, its effect on productivity is not very sizable.

These findings support the findings of Bartelsman and Doms (2000) which indicated that large firms corresponded to higher levels of productivity and also enjoyed higher growth although their productivity levels are dispersed and highly persistent in developed countries. Results of Van Biesebroeck (2005) also indicated that in developing countries, firms employing 100 or more workers are more productive and more likely to survive. Also, his findings indicated that large firms grow more rapidly and enhance TFP faster. These findings are contrary to the findings of De and Nagaraj (2014) which estimated that small firms in

India are more productive.¹ Nevertheless, it corroborates Sharma (forthcoming) that has recently shown a productivity and innovation premia for large firms.

Table 3: Determinants of TFP

Dependent Variable: LTFP

	1	2	3	4
Large	0.11132** (0.0026)	0.10916** (0.0025)	0.095** (0.0021)	0.0981** (0.0045)
Small	-0.0761** (0.0021)	-0.0733** (0.0021)	-0.089** (0.0015)	-0.0693** 0.0029
Trade Intensity	0.00034** (0.00003)	0.00031** (0.00004)	0.0001** (0.0002)	0.0009** (0.0003)
Foreign	0.02419** (0.0108)	0.0238** (0.0104)	0.0071** (0.0065)	0.0035 (0.0132)
Age	0.0001 (0.0001)	0.0001 (0.0001)	-0.0001 (0.0001)	-0.00001 (0.00001)
(LLabor)t-3			0.0607** (0.0008)	
Constant	2.8066** (0.0013)	2.7989** (0.0031)	2.5891** (0.0034)	2.81366** (0.0016)
\bar{R}^2	0.6371	0.6642	0.8787	0.5747
Test of Equality (H_0 : Large=Small)	4411.61 (0.000) #	4417.91 (0.000) #	443.56 (0.000) #	651.94 (0.000) #
Industry Dummies	No	Yes	Yes	No
Number of obs	2995	2995	2995	2995
Estimator	OLS	OLS	OLS	IV(2SLS)

Note: 1. Standard error in brackets. 2.** Significant at 5% critical level. 3. Industry dummies are included in all regressions. 3. # P-value

5. Conclusion

How does productivity vary across firms? Are large firms more productive than small firms? What other attributes affect firm growth? These are important questions for a country like India trying to boost manufacturing growth. Understanding the relationship between productivity and size is of special interest for India, given the fact that most firms are small and enjoy several exemptions and subsidies. A point of departure in the related literature is the Gibrat's law, which suggests that the performance of firms is insulated to their size. However, our findings in this study indicate that firm's size is an important factor in productivity performance. Large firms are robustly found to have 9-11% more productivity than other size of firms. Also, smaller firms are significantly lower in terms of productivity performance in comparison to other sized firms.

¹De and Nagaraj (2014) have used Prowess database. Their analysis heavily based on enter and exit issues. It is noteworthy that the Prowess does not report entry or exit. A firm can be out of the database but may not be closed down.

More importantly, these results are robust across the alternative analyses. Our findings raise questions on existing industrial policies in the country that aim to encourage small firms. For example, small and medium scale firms enjoy several benefits such as easy and subsidized credit, support for R&D and technology transfer, infrastructure building and support in selling output in domestic and international markets. However, I do not argue for abolition of these incentives but recommend for a better designed and efficient policy that can help the small and medium scale firms in enhancing their use of technology and augmenting the productivity level. Furthermore, large firms have productivity advantage which also help other size of firms also through several spillover channels, therefore, policy makers should also be concerned to their problems. This paper is not free from limitations. A noteworthy limitation is mainly related to the use of cross-section data in the analysis. Unavailability of previous periods information on performance indicators of firms has seriously restricted the flexibility of our models, thus limiting the implication of results. Furthermore, the study utilizes only TFP as a measure of performance, the future studies may also consider some other indicators, such as product and process innovation, capacity utilization and efficiency, for this purpose.

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