Is Small Beautiful? Size-Productivity Relationship in Indian Manufacturing

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ABSTRACT

We study the size-productivity relationship of manufacturing firms in India. Like other developing countries, India has been characterized by large size heterogeneity of firms within the same industry. In the context of growing liberalization of trade, licensing and monopoly policies since 1991 and growing incentives to small and medium scale firms, productivity implications of size heterogeneity has become more important. We find that smaller firms that are in the lowest quintile of the asset distribution are more productive than their larger counterparts. For identification, we exploit the panel nature of the data and use production-function estimation technique as developed by Levinsohn and Petrin (2003) to estimate the total factor productivity and Arellano and Bond (1991) type of dynamic estimation to control for potential endogeneity arising out of the persistence of productivity.

INTRODUCTION

Growth literature has long documented the importance of productivity enhancement in raising income, particularly in developing economies. Historically, manufacturing sector has been the principal component of income growth and has been subject to intense research in the past decade in search of explanations of productivity variation. One among many peculiar characteristics of manufacturing sectors in developing countries is the size-heterogeneity of firms. Industries within the manufacturing sectors in developing countries have been characterized by coexistence of firms of such heterogeneous sizes that Tybout (2000) calls this phenomenon a form of 'dualism'. However, productivity implications of such heterogeneity are not clear. While big firms have scale advantage and often have better access to capital and other resources through political and economic channels, small firms are likely to have leaner management and more flexibility in resource allocation. This polemic has become particularly important in the last decade or so for at least two reasons. A number of economies have liberalized their trade and licensing regimes to allow easy entry of firms and to reduce monopolies of either big state enterprises, or big private firms. Second, much richer micro-datasets are increasingly being available to empirically assess the dynamic changes in productivity.

In this paper we investigate whether small firms are likely to be more productive. Size-productivity relationship in the manufacturing sectors of developing countries is an important question in its own right for the following reasons: First, theoretical literature has not been conclusive. Therefore, there is value in estimating a reduced form relationship rather than estimating some specific structural model. Second,

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empirical evidence of size-productivity relationship is scant, particularly for developing countries. Finally, as discussed in the next section, India has been pursuing a policy of providing incentives to small firms over the last decade or so. Similar trends in policy can also be found in the other parts of the developing world also. Without empirical evidence, we cannot evaluate such a policy.

SMALL SCALE SECTOR IN INDIA

Being labor intensive, small enterprises promote employment, especially of unskilled labor. They play an important role in economic growth by contributing to the GDP (Beck et al, 2005). Among the Asian countries, India has been unique in terms of its focus on the development of small and medium enterprises since Independence. Over the decades, the policies governing the small scale industries changed from promotion to protection. Financial incentives and reservations for the small scale sector emerged as the policy instruments in the 1960's. By 2003-2004, the Small Scale Industry units accounted for more than 40 percent of gross value of output in manufacturing sector and about 34 percent of total exports of the country. It is the highest employment-providing sector after agricultural sector. Though 87 percent of the SSI units are unregistered, the registered units account for 72 percent of the total SSI production and 87 percent of total SSI exports. (Source: Development Commission (SSI), Third Census).

There are a number of ways in which the ministry helps the small firms - from directing credit, easing collateral requirement for loans, providing easy credit for technology improvement, providing training for entrepreneurs and providing technical training to tax concessions. Though the Government has now undertaken a number of policy initiatives in this direction, promoting SMEs might not be in the best interest of the economy if the SMEs are not more productive than their larger counterparts. Therefore, empirical findings on size-productivity relation will have bearing on the impact of policies promoting small and medium scale enterprises. This is true for not only India, but other countries too.

THEORETICAL PRIORS AND RELATED LITERATURE

While one would expect big firms to reap the traditional benefits of economies of scale, and in case of developing countries, where institutions are typically weak, other benefits such as access to license, finance and government contracts, we have not found a theoretical approach that succinctly models it. Idson and Oi (1999) argue that workers in large firms reap the benefits of increasing returns (brought in by big volumes) by having less idled time and producing more. This provides an explanation for higher productivity in larger firms. Tybout (2000) also attributes the (potential) higher productivity of large firms in developing countries to variables like increasing returns and lobbying power. One of the earliest of such attempts was made by Williamson (1967). In a model of hierarchical control, he showed that benefits of increasing returns from growing in size are countervailed by the increasing cost of managerial complexity. The models that followed, built on this advantage of small firms – leaner and more flexible management. Further, small firms can be more receptive and adaptive to the new technology. One advantage of having a smaller scale is that the production process is less deeply entrenched in existing technology. Finally,

analyzing manufacturing firms in nine African countries, Van Biesebroeck (2005) found that large firms are more productive and have higher growth rates. However, Bigsten and Gebreeyesus (2007) find in Ethiopia that small firms actually grow faster than the larger ones. In the United States, Dhawan (2001) finds that smaller firms are more productive.

DATA AND SIZE DISTRIBUTION OF FIRMS IN INDIAN MANUFACTURING

The data used is taken from Centre for Monitoring Indian Economy (henceforth, CMIIE)'s PROWESS database. CMIE compiles this data from the audited financial results of listed and unlisted firms. The firms in Prowess accounts for almost 75 per cent of all corporate taxes and over 95 per cent of excise duty collected by the government of India.

We use an unbalanced panel data of manufacturing firms for the period 1994 to 2008. The choice of time period has been dictated by the intention to keep the most recent data and avoid having a lopsided sample. Number of firms covered in the PROWESS database has jumped steeply in 1994. The effects of the economic reform of 1991 were evinced gradually by 1993. The data has detailed information on financial variables including break up of assets, liabilities, income and expenses. All variables have been deflated by the wholesale price index. Since the database contains information on only the wage bill and not on employment, we infer the amount of labor by deflating the wage bill by average industry wages. The data on wage per worker has been taken from Central Statistical Organization's (CSO)'s Annual Survey of Industries (ASI) database. The PROWESS data has firms from 22 NIC-2 digit industries.

Table 1 shows the distribution of assets in terms of mean and median over five quintiles. We can make several key observations from this table. First, there is substantial heterogeneity in terms of firm size. The mean size in the highest quintile is more than 100 times bigger than the mean size in the lowest quintile. Second, the average size in the highest quintile has been steadily rising over the years, signifying an increasing concentration at the top. Third, as the higher up we go in quintiles, more skewed the size distribution becomes, as reflected by the wedge between mean and median.[1]

Table 1: Distribution of Assets among Indian Manufacturing Firms (in INR Million)

year	Quintile1		Quintile2		Quintile3		Quintile4		Quintile5	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
1994	34	34	93	92	179	175	404	381	4210	1440
1995	34	35	90	89	179	176	403	378	4090	1430
1996	40	42	102	100	205	199	480	456	4790	1770
1997	43	45	108	106	217	211	519	489	5320	1970
1998	41	44	106	104	220	218	525	498	5650	2010
1999	37	39	98	94	207	203	496	465	5320	1900
2000	34	35	95	94	199	192	478	448	5020	1810
2001	34	35	94	91	202	194	493	459	4970	1830
2002	32	33	91	90	196	191	485	450	5200	1870
2003	27	28	85	85	179	172	429	406	4950	1700
2004	23	24	79	77	177	170	446	424	5170	1770
2005	21	21	77	76	186	178	488	454	5840	1980
2006	23	23	89	86	223	215	590	556	7040	2270
2007	28	27	108	105	293	288	812	769	9380	3230
2008	40	38	185	171	519	510	1360	1270	14700	5530

Note: Within every industry and year, firms have been divided into five quintiles according to the size of its assets

EMPIRICAL STRATEGY

In order to estimate the effects of a firm's size on its productivity, we start with the following reduced form baseline specification:

$$TFP_{ijt} = \beta_0 + \beta_s SMALL_{ijt} + \beta_m imports_{ijt} + \beta_x exports_{ijt} + \beta_r rnd_{ijt} + \beta_o Ownership_{ijt} + \beta_h BusinessHouse_{ijt} + age_{it} + agesq._{it} + \lambda_i + \lambda_j + \lambda_t + \eta_{ijt} \ldots\ldots\ldots\ldots (1)$$

The dependent variable is the Total Factor Productivity of a firm i, in industry j and period t. SMALL is an indicator of the size of the firm by assets within the industry it belongs to. For each industry and year, firms have been categorized into five quintiles according to their asset sizes. The variable is therefore comparable across industries and across years. The indicator small here refers to the lowest quintile, that is, the lowest 20 percent of the firms by asset size. β_s is our coefficient of interest. The rest of the control variables in equation (1) have been chosen to ameliorate the omitted variable bias. The choice of variables is driven mostly by either previous literature or theoretical prediction.

In what follows, we will estimate a variety of this baseline specification. We will start with the random effects model where the firm-specific time-invariant unobserved heterogeneity λ_i is assumed to be uncorrelated with η_{ijt}. The second set of estimates is calculated under the alternative assumptions of fixed effects model. Finally, we dynamize this model by including the lagged dependent variable in the right hand side and by using the lagged values of exports and R&D as instruments of themselves as

proposed in Arellano and Bond (1991), and Arellano and Bover (1995) and applied in TFP estimation by Fernandez (2007) and Khandelwal and Topalova (2010) among others.

CALCULATION OF TFP

The estimation of total factor productivity using the traditional method of Ordinary Least Square leads to simultaneity issues. With a positive shock to productivity, the use of inputs also increases. The residual will therefore be a biased estimate of productivity. To overcome this simultaneity issue, we use the method pioneered by Levinsohn and Petrin (2003) by using intermediate inputs (such as material and fuel) as a proxy in place of investment. Conditional on capital, profit-maximizing behavior leads more productive firms to use more intermediate inputs.

IDENTIFICATION AND ENDOGENEITY CONCERNS

Our estimation captures the relationship between firm size and productivity. There are two threats to the claim that any correlation is causal. First, there may be omitted firm characteristics (either unobserved, or lacking in our data) that may affect both firm size (and growth) and productivity. The second concern is that the causality may run in the reverse direction to our claim – firms experiencing higher productivity may acquire new assets and grow in size.

We take a variety of measures to deal with these potential endogeneity concerns. First, we include firm fixed effects. This controls for the unobserved time-invariant firm characteristics such as managerial ability and spatial characteristics. Second, we also include year fixed effects that control for across-the-economy policy changes in a particular year and industry fixed effects that control for industry specific heterogeneities. Together, they control for industry specific changes in regulations over time.

However, while these measures ameliorate the endogeneity concerns in a static model, the endogeneity might arise due to the time-dependency of TFP.(Syverson,2010). Hence we also consider dynamic models developed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). These models further improve upon our specification in the following ways. First, in the absence of exogenous instruments, ABB estimators use lagged values of the control variables as instruments. This makes the endogenous variables pre-determined and, therefore, not correlated with the error term in equation (1). Secondly, the first-differenced GMM estimator naturally removes time-invariant firm characteristics, thus preserving the benefits of using a fixed effects model. Moreover, if TFP is indeed correlated with its past values, then the static model produces inconsistent estimates because the regressor(s) will be mechanically correlated with the error term. ABB-style system GMM controls for this by using past values as instruments. Finally, as Roodman (2006) notes, for a short time (T), long units (N) panel, there is less likelihood that correlation of the lagged dependent variable with the error term will decline over time to be rendered eventually insignificant. ABB estimators are particularly relevant for these cases.

MAIN RESULTS

Table 2 summarizes the main results of the paper. Columns of Table 2 present results from estimation of six variations of equation 1. We start from estimating the simplest relationship between size and productivity with no controls (column (1)). We see that there is a strong positive correlation between belonging to the lowest asset quintile and productivity. Column (2) introduces year and industry fixed effects to control for unobserved industry and time variability. Then column (3) and column (4) present results from the random effects (generalized least square) models. For all four columns, we see that being small means more productive and significantly so. Coefficient estimates go down slightly when we introduce controls to our estimation. Next, we include firm fixed effects in equation (1). Being small is still significant with slightly lower coefficient estimate (column 5, row 1). Finally, we present estimates from the dynamic model *a la* Arellano and Bond (2001). In this case, two lags of the dependent variable TFP are included as regressors and the estimation is performed as a system generalized method of moments procedure.

As column (6) shows, the dynamic model gives us the best fit. All regressors are significant. The first and second lags of the dependent variable TFP are significant and less than unity.[2] Even in this case, small firms turn out to be significantly more productive, though both coefficient estimate and standard errors are less in the case of dynamic model. Therefore, the overwhelming evidence from Table 2 tells us that small firms are more productive than their larger counterparts, after controlling for the unobserved variables at the level of the firm, industry and time and for the dynamism in TFP.

ROBUSTNESS CHECKS WITH BALANCED PANEL

Table 2 reports estimation results of equation (1) with an unbalanced panel of firms. Firms enter and leave industries all the time. However, as discussed in the earlier section, some exit behavior may bias the sample towards firms with higher productivity. Therefore, we restrict the sample to firms who stayed on throughout the sample period of 1994-2007 to form a balanced panel of firms. The results from estimating the same set of models (except for single regressor regressions to avoid clutter) are presented in Table 3.

Except for the first two columns, Table 3 is organized in the same way as Table 2. Evidence in this table also confirms the earlier evidence from unbalanced panel of firms that small firms are significantly more productive than their larger counterparts. The sign and significance pattern of the other control variables confirm that entry and exit of firms do not seem to affect the results in any particular way.

Table 2: Size-Productivity Relationship – Regression Results for UNBALANCED PANEL (Dependent Variable: Total Factor Productivity at firm-level)

	(1) RE	(2) RE	(3) RE	(4) RE	(5) FE	(6) AB
SMALL (Firms in the lowest 20% in asset size)	0.0748***	0.0745***	0.0695***	0.0694***	0.0524***	0.0422***
	(0.0075)	(0.0071)	(0.0072)	(0.0071)	(0.0089)	(0.0064)
L.TFP						0.1168***
						(0.0036)
L2.TFP						0.2320***
						(0.0031)
Industrial Group Dummy			-0.0861	-0.0843	0.0000	0.5426***
			(0.1132)	(0.1145)	(0.0000)	(0.1051)
Ownership Indian Private			-0.0204	-0.0136	0.0000	0.7221***
			(0.1127)	(0.1142)	(0.0000)	(0.1012)
Ownership Foreign Private			-0.0975	-0.1064	0.0000	0.5232***
			(0.1130)	(0.1134)	(0.0000)	(0.1124)
Observations	39886	39886	39822	39822	39822	26424
Year Fixed Effects		yes	yes	yes	yes	
Industry Fixed Effects		yes		yes		
Firm Fixed Effects					yes	yes

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Notes:

I. All regressions include firm demographics such as age and age squared and exports, imports and R&D as percentage of sales.

II. Ownership is a categorical variable with categories “Indian private ownership”, “foreign private ownership” “Indian government ownership” respectively. The third one is the base category in regression.

Table 3: Size-Productivity Relationship – Regression Results for BALANCED PANEL (Dependent Variable: Total Factor Productivity at firm-level)

	(1) RE	(2) RE	(3) FE	(4) AB
SMALL (Firms in the lowest 20% in asset size)	0.0875***	0.0876***	0.0497***	0.0236**
	(0.0101)	(0.0098)	(0.0126)	(0.0100)
L.TFP				0.3987***
				(0.0092)
L2.TFP				0.2221***
				(0.0071)
Industrial Group Dummy	-0.0669***	-0.0727***	0.0000	0.1356***
	(0.0154)	(0.0266)	(0.0000)	(0.0235)
Ownership Indian Private	0.1036***	0.1257***	0.0000	0.3205***
	(0.0132)	(0.0165)	(0.0000)	(0.1157)
Ownership Foreign Private	0.0657***	0.0655***	0.0000	0.5393***
	(0.0123)	(0.0131)	(0.0000)	(0.1155)
Observations	13496	13496	13496	11466
Year Fixed Effects	yes	yes	yes	
Industry Fixed Effects		yes		
Firm Fixed Effects			yes	yes
Robust standard errors in brackets				
*** p<0.01, ** p<0.05, * p<0.1				

Notes:

I. All regressions include firm demographics such as age and age squared and exports, imports and R&D as percentage of sales.

II. Ownership is a categorical variable with categories “Indian private ownership”, “foreign private ownership” “Indian government ownership” respectively. The third one is the base category in regression.

SUMMARY AND POLICY IMPLICATIONS

In this paper, we have used firm level panel data to estimate the differences in the productivity of large and small firms in the manufacturing sector in India. Such exercise has been motivated by several stylized, theoretical, empirical and policy observations. Firm size heterogeneity is widespread among developing countries. Mammoth firms coexist with smaller firms and continue to produce similar products. However, theoretically both small and large firms have productivity advantages and disadvantages such as scale economies vs. smaller and more flexible management structure. Empirical evidence from the US and the rest of the world has been piecemeal and mixed. Finally, several countries including India have been pursuing policies to promote small and medium scale enterprises. With availability of new firm-level micro data, new evaluation of size-productivity relationship contribute to both researchers’ and

policymakers' understanding of the implications of firm size heterogeneity for productivity and growth in the economy.

We combine several strategies for identification. We calculate total factor productivity by using Levinsohn-Petrin method to control for simultaneity between input choice and productivity shocks. In estimating our main specification, we exploit the panel nature of the data to remove unobserved time-invariant firm heterogeneities. We also use dynamic panel data technique to control for -persistence of total factor productivity.

As far as policy implications are concerned, our findings buttress the case for encouraging small firms. However, this does not mean that large firms need to be broken up or firm growth should be stifled or firms should be stopped from being merged or acquired. A deeper understating of size-productivity relationship is required, particularly of the channels through which such productivity benefits accrue to smaller firms.

ENDNOTES

1. Note that these are sector-wide numbers that aggregate *all* industries. It may be improper to compare firms in, say, textile industry to heavy industries like steel and automobile. However, listing all industries will lead to unmanageable clutter. Such results, along with a longer version of the paper are available upon request.
2. When regress TFP on its first lag, we get a coefficient of 0.58 – similar to the range of 0.6 - 0.8 found by, for e.g., Ábrahám and White (2007) and Foster, Haltiwanger, and Syverson (2008).

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