Firm-Level Productivity and Exports: *The Case of Manufacturing Sector in India*

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1 Introduction

Apart from many other features, literature on productivity growth has also focused on the possible link between efficiency and export both at the aggregate and disaggregate levels. The general findings are supported by sets of literature that are related to the significant differences in productivity among firms. Further, it is also observed that these differences persist over time (for example, Griliches and Regev 1995; Tybout 1997 and others). Entry condition of firms is one of the important factors that explain export market participation and export behaviour of firms. Closeness to the efficiency frontier as one of the behaviours of exporting firms is explained in studies such as Aw et al. (2000) and others.[1]

Firm size is considered as one of the important factors in explaining export intensity or propensity at firm level as explained in both empirical and theoretical researches. Yet empirical results on this hypothesis have been mixed based on the type of data in use. For instance, few studies found positive cross-sectional relationship between firm size and export intensity (Perkett 1963), but other studies have found no meaningful relationship (Doyle and Schommer 1976).

[1] Related studies are Aw and Hwang (1995), Bernard and Jensen (1995), Jensen and Wagner (1997), Aw et al. (1997) and Clerides et al. (1998).

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Cavusgil (1976) explains that very small firms tend not to export. Further, he explains that beyond some point of exporting behaviour is not correlated with firm size; however, till the threshold point export behaviour is correlated with firm size. In an attempt using Indian data, Narayanan (1998) studies the effects of deregulation policy of Indian economy that was initiated during the mid-1980s. He studies the impact on technology acquisition and competitiveness in the automobile industries of India. Further, Sahu and Narayanan (2015) focused on the export patterns of automobile sector with an emphasis on the technology and R&D capabilities of automobile firms in Indian economy. This study also uses a parametric approach in determining factors affecting export intensity of sample firms in consideration based on the technological efforts and R&D participation. In general, therefore, to understand the export performance of firms, it is important to analyse the productivity and size of firms. There are several studies focused on difference in labour productivity (Baldwin et al. 2002); however, barring a few exceptions (Van Biesebroeck 2005) evidence for total factor productivity (TFP) is relatively scarce.

The purpose of this work is to estimate total factor productivity (TFP) and measure the TFP differentials for the firms that participate in the export market and the domestic firms. This productivity differentiate is examined for the sample of manufacturing firms in India from 2003 to 2015. This period is after a decade of New Economic Policy of 1991. Hence, this will add in the literature of the policy impact of industrial deregulation and efficiency of firms in export market. This paper will also investigate if export makes difference in productivity differentials. While the research question is related to if exporting has any relation with the TFP, the method used in this paper is different compared most of the works carried out earlier for the Indian context. As against the marginal movements in the TFP, this paper compares the entire distribution of productivity. In particular, we are interested in observing the cumulative distribution function of TFP for firms in different groups such as exporters versus non-exporters and entering to the export market versus continuing exporters. Based on the recent development in quantitative economics, we rank the distributions using stochastic dominance, and their differences using Kolmogorov–Smirnov tests,[2] which are consistent in the direction of general non-parametric alternatives.

Assuming different trajectories between export and domestic markets in case of the productivity growth, we explore the difference between these sets of firms. Our results confirm higher level of productivity for the exporting firms as against the domestic firms. Further, results are in line with the existing literature on learning by exporting; meaning firms with higher productivity level do enter to the export markets as compared to the lesser productive ones, catering only for the domestic market. This validates our hypothesis that there are indeed different trajectories of productivity growth for domestic and the export markets. Having stated the results on the learning-by-exporting hypothesis, we conclude that this hypothesis do exists for

[2]The Kolmogorov–Smirnov test is a non-parametric test of the equality of continuous, one-dimensional probability distribution that can be used to compare a sample with a reference probability distribution. This can be either of one-sample or two-sample test. For more details, see Darling (1957).

the Indian manufacturing firms, however, weak and limited to the younger exporters. In the context of international experiences, our results are in line with works such as Clerides et al. (1998), Bernard and Jensen (1999) and Aw et al. (2000).

The remainder of the paper is as follows. Next section explains review of existing literature from international and domestic experiences. This section also explains the analytical arguments related to the research hypothesis and links productivity distribution and exports for the select sample of firms in manufacturing sector of India. Data and index used in this study are presented in the next section. Section 4 presents results and discussions on the empirical estimation, and Sect. 5 concludes the paper.

2 Literature Review

As reported in the analytical literature, the international markets are exposed to more intensive competition and exporters have high sunk entry cost as compared to the domestic firms. These two arguments are used to indicate why exporters are efficient than the non-exporters. Both explanations above indicate that export market selects the most efficient firms among the domestic firms as entrants to the export market. Hence, the product market competition is greater in the export market and a positive relationship can be established between competition and productivity in general. However, as studies are not unanimously concluded similarly, it will be interesting to see these phenomena in the context of an emerging economy such as India.

The idea of industry dynamics as explained in Jovanovic (1982) and further by Ericson and Pakes (1995) also plays an important role in linking productivity and exports at firm level. In the literature related to industry dynamics, existence of a clear relationship exists between patterns of enter and exit of firms in an economy and productivity. However, Aw et al. (1997) argue that differences in sunk costs can explain productivity differentials between exporters and domestic firms assuming the competitive pressures between the domestic and foreign market are similar. This argument relays on the fact that non-exporter must incur sunk entry cost in order to enter to the export market. In a parallel setup, Roberts and Tybout (1997) explain that previous export status of a firm becomes one of the major factors in explaining future decision to export. This also helps firms favourable to the existence of sunk entry cost in the export market.

In the context of industry dynamics, if higher entry costs for export market are there with respect to the firms that operate in the domestic markets, the productivity growth of the exporting firms has to be much higher. Therefore, enrty and exit patterns of firms are related to productivity growth differentials in the export market. The differences lie between the continuous exporters and the rest in any given economy, and hence it is ideal to assume that the probability distribution of productivity for the continuous exporters should stochastically dominant over the rest. This argument calls for a classification between the continuously exporting firms and for those who are new entrants to the markets and the existing exporters. Therefore, productivity

distributions should be different for continuous exporters and that enter to the export market and exit from the export market. These two arguments can be linked with the hypothesis of selection. Similarly, the other argument can also hold true that exporting as a learning mechanism allows firms to improve productivity over time. This result is highly accepted in the management literature that explains exporting as a learning process due to innovation and better management practices. Based on the above understanding of link between productivity and export behaviour of firms, we suggest the following hypothesis to be tested for the manufacturing firms in India.

1. The productivity distribution of exporting firms, entering exporters and continuing exporters should dominate the productivity distribution of non-exporting firms, and
2. Productivity growth between exporting and non-exporting firms should be statistically different and should increase after a new export firm enter to the market for those firms that are already in the export market.

As stated in the hypothesis above, we have to test the productivity distributions between group of firms identified as exporters and non-exporters, which can be done with the panel structure of firms. The idea of such an exercise is motivated from Delgado et al. (2002).[3] We use a similar approach related to first-order stochastic dominance. This allows us to establish a rank for a comparison purpose.

As explained in Delgado et al. (2002), let F and D denote the cumulative distribution functions of productivity corresponding to multi groups of firms (more than one), then the first-order stochastic dominance of F that is relative to D can be defined either as (1) in case of a two-sided test or (2) in case of one-sided test:

$$H_0 : F(z) - D(z) = 0 \text{ all } z \in \mathbb{R} \quad \text{versus} \quad H_1 : F(z) - D(z) \neq 0 \text{ some } z \in \mathbb{R}, \text{ cannot be rejected} \tag{1}$$

$$H_0 : F(z) - D(z) \leq 0 \text{ all } z \in \mathbb{R} \quad \text{versus} \quad H_1 : F(z) - D(z) > 0 \text{ some } z \in \mathbb{R}, \text{ cannot be rejected} \tag{2}$$

Similarly, one- and two-sided test can be also formulated as

$$H_0 \sup_{z \in \mathbb{R}} |F(z) - D(z)| = 0 \quad \text{versus} \quad H_1 \sup_{z \in \mathbb{R}} |F(z) - D(z)| \neq 0$$

and

$$H_0 \sup_{z \in \mathbb{R}} \{F(z) - D(z)\} = 0 \quad \text{versus} \quad H_1 \sup_{z \in \mathbb{R}} \{F(z) - D(z)\} > 0, \tag{3}$$

respectively.

As presented above, if F and D represent the productivity distributions for the firms that are exporting and the non-exporters, we can compare their respective distribution to validate our assumption of dominance. In case of the two-sided test, we

[3] For a detail methodological review, refer to Degado et al. (2002).

can conclude if both distributions are identical, whereas one-sided test will conclude the dominance characteristics of respective distributions. Hence, if two-sided test is accepted, one-sided test has to be accepted, and hence, the distribution of F has to be on the right of D. This argument implies that the productivity distribution of the exporters stochastically dominates that productivity distribution of the non-exporters. For the one-sided test, the Kolmogorov–Smirnov test statistics can be explained as

$$\delta_N = \sqrt{\frac{n.m}{N}} \max_{1 \le i \le N} |T_N(Z_i)| \quad \text{and} \quad \eta_N = \sqrt{\frac{n.m}{N}} \max_{1 \le i \le N} \{T_N(Z_i)\}, \tag{4}$$

3 Descriptive Statistics, Measurement and Estimation

The data set considered in this study is drawn from the Center for Monitoring Indian Economy Prowess IQ database, an annual survey that refers to a representative sample of Indian manufacturing firms. The base year of the dataset used for this research starts from 2003. We have collected information from 2003 to 2015 annual series for the manufacturing sector in India. We categorized dataset based on firm size, where firm size is defined as a natural log of the net sales. Due to entry and exit of firms in the dataset, our data is unbalanced panel in nature. From 2003 to 2015, we have collected 54,139 firm-year observations that has an average of 4,164 firms. This data set has a maximum observation of 4,817 for 2005 and minimum of 2,053 for 2015.

Observing the export intensity patterns of firms in our sample, the average sample mean is 0.43 with minimum export intensity of zero (no export participation). Therefore, we have classified firms in two sets: (1) small exporting firms and (2) large exporting firms. This classification is based on the average export intensity of firms that are exporting. This gives 650 firms in the category of large exporting firms and rest in the category of small exporting firms. Export intensity of these two groups is found to be statistically different (given the t-test result to be -2.91***). The average turnover of the large exporting firms is smaller than that of the small exporting firms. This may be due to the fact that only 1.3% of sample firms are engaged in export activities.

Few data characteristics can be noted from the descriptive analysis of the sample. First, there is a high turnover rate in terms of entering and exiting from the export market. The computed annual average turnover rate is 26 for the small firms and 21 for the large firms. Second observation from the data set is that the average entry rate is higher than the average exit rate of firms in the export market. Therefore, it can be concluded that the export share of the manufacturing firms in India is due to the net increase in the number of new exporters. In a parallel statistics, we can also see the patterns of the switchers (both entering and exiting in some years) in the data set. 27% of small firms are the switchers, whereas 15% firms are switchers in case of large firms in the sample. Hence, entering and exiting happens for few years more in case of the small firms as compared to the large firms in this sample. This

can also explain partly the productivity differentials of small firms compared to the large firms those are in the export market. Further here, we provide information on the estimation of the production function and the productivity of the sample firms. Total factor productivity is estimated using one of the standard recent methods of parametric estimation of a homogenous production function. The estimate of firm productivity (TFP) is crucial and important as this is the most important indicator that distinguishes between the exporters and non-exporters. Variables of interest in computing TFP are presented in Table 1. As stated earlier, information on the firm-specific variables are collected from the Center for Monitoring Indian Economy's Prowess IQ database. The estimation of TFP will be important to link the export behaviour of firms related to its productivity growth.

There are various methodological approaches to estimate TFP. In this case, we use the residual from the production function at firm level as total factor productivity. Both theoretical and empirical works have pointed out that use of ordinary least squares generates an inconsistent and biased estimator of TFP. Information asymmetry related to firm behaviour other than the factor inputs may create the biasness of the estimator; these can be listed as nature of industry, time, sample, region, etc. Other than the factor inputs, these information asymmetries may influence the estimator and hence create endogeneity in estimating productivity at firm level. In

Table 1 Definition and measurement of variables[a]

Sl. no.	Variable(s)	Definition and measurement
1	Output (Y)	Output at firm level is obtained by adding plus changes in stocks to sales. We deflate nominal output at three-digit industry-level price deflators. Deflation is constructed using Wholesale Price Index (WPI) series from the Office of the Economic Advisor, Ministry of Commerce and Industry, Government of India
2	Labour (L)	Prowess provides data on wages and salaries given to employees. We arrive at firm-level employment figure using emoluments and total persons engaged data from Annual Survey of Industries (ASI), Central Statistics Office, Government of India
3	Capital (K)	Following Banga and Goldar (2007), we use the blanket deflation method
4	Material (M)	The raw material expenses include the value of raw materials consumed. The nominal value of the raw material cost was deflated using raw material price indices. In this case, the base year is taken as 2004–05 = 100
5	Energy (E)	We first calculate the nominal energy input for a firm as the sum of its expenses on power and fuel, in current prices, obtained from Prowess IQ. To construct the energy deflator, we use price indices of coal, petroleum products, natural gas and electricity for industrial use from the official WPI series and other sources

[a]All the variables used to calculate TFP using a production function are of 2004–05 prices. This is obtained by deflating each series reported in current prices with appropriate price indices. These information are collected from 'Index Numbers of Wholesale Prices in India' that is published by the Economic Adviser, Ministry of Commerce and Industry, Government of India

such a scenario, Levinsohn and Petrin (2003) presented an alternative way to estimate a production function using intermediate inputs other than the factor inputs. The intermediate inputs identified are related to energy or electricity use of a firm. This variable helps in addressing the simultaneity problem and keeps the sample size intact. To address the non-convex adjustment cost investment proxy can also be used in this method of estimating productivity. "If adjustment costs lead to kink points in the investment demand function, plants may not entirely respond to some productivity shocks, and correlation between the regressors and error can remain. If it is less costly to adjust the intermediate input, it may respond more fully to the entire productivity term (Levinsohn and Petrin 2003)".

In this study, we use Levinsohn and Petrin (2003) to estimate the production function as in (5).

$$y_t = \alpha + \beta_l l_t + \beta_k k_t + \beta_m m_t + \beta_e e_t + \omega_t + \mu_t \tag{5}$$

where y_t, k_t, l_t, m_t and e_t are logarithm of output, capital stock, labour, raw materials and energy, respectively, ω_t denotes productivity of the firm and μ_t stands for the measurement error in output, which is uncorrelated with input choices. In most of the existing studies, material inputs or energy consumed are used as a proxy to take care of endogeneity problem arising out of unobserved shocks. In this paper, we take energy as a proxy. Given that LP assumes that firm's intermediate inputs demand function, is monotonically increasing in productivity given its capital stock, the unobservable productivity term w_t depends solely on two observed inputs, e_t and k_t. Hence, we can rewrite the Eq. (5) as

$$y_t = \beta_l l_t + \beta_m m_t + \beta_e e_t + \phi(k_t + e_t) + \omega_t + \mu_t \tag{6}$$

where $\phi(k_t, e_t) = \alpha + \beta_k k_t + \beta_e e_t + \omega_t(k_t, e_t) + \mu_t$ and the error term μ_t are not correlated with inputs. From this, we can calculate productivity of the firms as the difference between actual and predicted output using Eq. (7).

$$TFP_{ijt} = y_{ijt} - \beta_k k_t - \beta_l l_t - \beta_m m_t - \beta_e e_t \tag{7}$$

Once the TFP are computed at firm level, the next methodological issue is related to the non-linear estimation of productivity distributions for different groups of firms. As explained in the previous section, we can differentiate the distributions using two-sided and one-sided Kolmogorov–Smirnov tests. To use such a test in the data set, we have the following assumptions. First, the test application requires independence of observations. As the data used in this research is an unbalance panel or large scale firm-year observations and many firms are repeated over years, it will be not possible to arrive at independent or stationary series of the sample. Statistically, the unit-root tests of the panel data also reject the hypothesis that the sample is stationary. Hence, we have applied the test statistics each year separately for each time period. Second, cumulative distribution of productivity at firm level is considered to test the stochastic dominance between group of sub-sample in this case small and large

firms.[4] In a parallel exercise, we also compare exporters and non-exported related to firm size and firm age. Third, it should be noticed that our productivity measure can be interpreted as an estimate of a non-observable measure, where the Kolmogorov–Smirnov test is directly applicable.[5] Fourth, we provide two *P*-values for each of the statistics: one based on the limiting distribution and the other on the bootstrap approximation.[6] These *P*-values can be approximated, as accurately as desired, by Monte Carlo.

4 Empirical Results

We explain the empirical result in this section. This section is followed by the descriptive inference and theoretical argument of the previous section on establishing link between productivity and export behaviour at firm level. As classified earlier, the sample of firms is classified into exporters and non-exporters. First, we examine differences of TFP between these two groups. Further, we establish a possible source of observed differences between firms that are in export market and those are not. Basically, this is to observe the differences between export and non-exporting firms in case of the estimated productivity. To arrive at the differences between the set of firms, we establish two comparisons in terms of ex-ante differences in productivity for firms that are entering in the export market and the non-exporters. The second comparison is carried out between exiting exporting firms with the continuing exporters. Finally, the larger set of firms in terms of domestic and exporting firms is compared in terms of productivity differentials.

For comparison purpose instead of using standard parametric approach, we use non-parametric methods as described in previous section. This is carried out by computing a smooth sample distribution function, instead of a sample distribution function. The reason is that the smooth sample distribution gives a nice and smooth estimate as compared to the sample distribution. Figure 1 presents the distribution function for the full sample that permits us to compare visual comparison of the distribution functions. As noted in the methodology section, exporting firms' distribution of TFP growth is to the left of the non-exporters distribution and presented in Fig. 1. This accepts the hypothesis that exporter smooth distribution stochastically dominates the non-exporters' distribution. Also, as visible from the graphs there is a higher growth rate of TFP for the exporters as against the non-exporters.

[4]Comparisons between distribution functions for the whole population are avoided since this would have required the estimation of a mixture of two distributions.

[5]See Bai (1996) and Delgado and Mora (2000) for a similar argument.

[6]We arrive at good accuracy of asymptotic approximation as the asymptotic and bootstrap *P*-values are fairly close. For detail, see Gine and Zinn (1990).

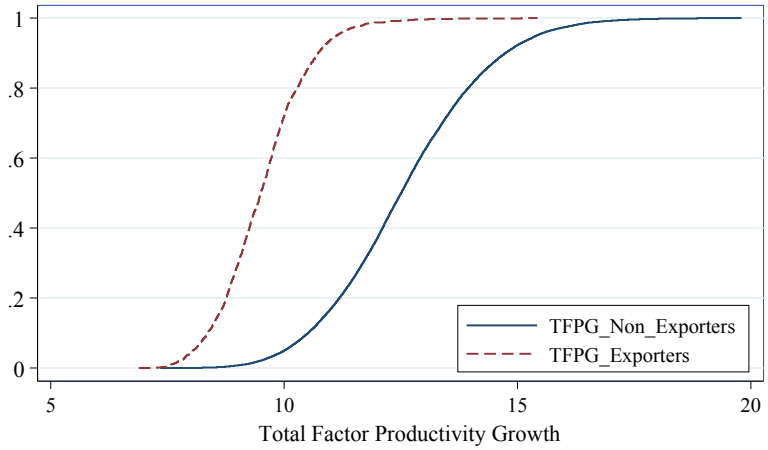

Fig. 1 Smooth distribution function of TFP. *Source* Authors' representation from Prowess IQ database

Next, we present the results from the formal statistical tests for the differences in productivity for firms classified in different groups. The first step in analysis is carried out to see the productivity differences between exporting and non-exporting firms in the sample. We define exporting firms as those participate in export market at period *t*, and non-exporters are the firms that only participate in the domestic market. In both the cases, we have not considered the switchers.[7] The differences in productivity are presented for exporting and non-exporting firms in Fig. 1. The position of the distribution for exporting firms with respect to the distribution of non-exporting firms indicates higher levels of productivity for exporters versus non-exporters.[8]

We present the hypothesis test statistics on productivity differentials between the firms in export market and domestic market. These sets of tests are applied separately for the small and the large exporting firms. First, for the group of exporters and non-exporters, the null hypothesis of equality between both distributions can be rejected at one per cent level for all years (column-1, Table 2). A similar result is drawn for the large exporters and non-exporters for all years. These two results are consistent for the full sample and whole period of study. As accepted the sign of difference is also arrived at as presented in Table 2. A slightly different but interesting result is arrived at between (1) small and non-exporters, and (2) large and small exporters. Except for few years such as 2009, 2013 and 2014, there is no statistical relationship of productivity growth differentials between the small and non-exporters. Interestingly,

[7]Switchers are exporting firm that participate in the export market intermittently, in time intervals that is greater than 1 year.

[8]Productivity distributions are also higher in all quartiles for firms in the export market as compared to the non-exporting firms. The median productivity of the former is 26% higher than the productivity of the latter. Similarly, productivity differences are greater at the lower part of the distribution, 7% in favour of exporting firms at the lower quartile, and smaller in the upper part, 5% in favour of exporting firms at the upper quartile.

Table 2 Productivity differences between exporters and non-exporters

Year	Exporters–non-exporters	Large exporters–non-exporters	Small exporters–non-exporters	Large exporters–small exporters
2003	13.882***	13.724***	−2.037***	0.203
2004	16.913***	16.290***	−4.482***	−1.487
2005	15.706***	15.290***	−3.485***	−0.199
2006	15.591***	14.880***	−4.552***	−0.856
2007	14.734***	14.301***	−3.467***	1.069
2008	15.610***	15.526***	−1.803*	2.328**
2009	14.416***	14.636***	−0.338	4.350***
2010	12.830***	12.636***	−2.662***	2.392**
2011	13.476***	13.094***	−3.361***	2.106**
2012	11.511***	11.068***	−3.396***	2.139***
2013	10.866***	10.866***	−0.765	3.437***
2014	6.034***	6.237***	1.681	2.710***
2015	6.946***	7.050***	−2.037***	1.919**
Full sample	47.951***	3.180***	−9.221***	4.388***

Note Statistically significant of the t-test is presented in table based on limiting the distributions. Significant levels based on the bootstrap approximation (10,000 replications) are presented as *** for 1%, ** for 5% and * for 10%.
Source Authors' calculation from Prowess IQ database

as we can see the productivity growth of non-exporters is better for all other year having a negative sign of the coefficient as against the small exporters. Given the status of activity is restricted to 3 years of export activity, the small exporters may be those who used to be non-exporters and yet to arrive at a higher productivity level due to competition and economics of scale. On the contrary, the difference between the large and small exporters' statistical relationship is not arrived at for observations from 2003 to 2007. However, from 2008 as accepted, the differences between the large and the small exporters are clearly visible as depicted in Table 2.[9] This result is in line with the earlier results of exporters and non-exporters, large exporters and non-exporters.

Conclusions from the above analysis can be classified in two major parts. The first is productivity distribution of firms in export market stochastically dominates the productivity distribution of firms that are in the domestic market. The second conclusion is that the productivity distribution of large exporting firms lies above the productivity of non-exporting firms. Further, we also confirm on the parameters weighing the linear combination to be positive. Hence, we conclude that for the larger sample of firms in the manufacturing sector of India, the productivity of exporters stochastically dominates the productivity of the non-exporters.

[9] *P*-values on limiting the distribution and on bootstrap approximation lead to same results.

Once the conclusion on the differences of exporters and non-exporters are arrived at we now consider the productivity and transition between domestic and the export market. In doing so, we classify firms based on entry of firms in the export market, exit of firms from the export market and firms that are in continuous in the export market. This refers to the selection of firms in either staying/leaving/entering to the export market. On the other hand from this analysis, we can also conclude if the export market considers the most efficient firms as against the inefficient firms in the market. This selection mechanism can work at both enter and exit patterns.[10] On the second discussion on the entry side behaviour of the exporting firms in the sample, we further compare two group of firms as stated earlier; one being the non-exporters and the firms that have newly entered to the export market. The reference case in this case for the non-export-oriented firms being the year, 2003. If a firm has entered any point between 2004 and 2015, they are considered as the entering exporting firms. Rest of firms in the sample are defined as non-exporters.[11] Three years of entry period are considered to enlarge the number of observations. A variation of the selection of year gap is also tried, however; the number of observation drastically falls if we increase the number of years to more than 3. In these cases, however, the behaviour of the sample firms do not change; hence, we allow a larger observation for a best fit for the non-linear analysis to get the differential impacts in case of productivity change for firms in export market and those are not in the export market. Therefore, in this setup, the productivity levels of both groups of firms are compared for the year 2003 before entry for the entering exporters.

Table 3 reports test statistics on the comparison of both productivity distributions. We can observe that individual time effect each year is not statistically established for the full sample in case of enter and exit pattern. However, a decadal effect is quite established (column-1, Table 3, row representing result for the full sample across years). Further, an inconsistency result is arrived at for the differences favourable to entry for the firms in the data set for the Indian economy. For example, if firms have entered in the years either 2003/2004/2009 they have gained productivity growth as compared to the counterparts; for all other years, we are not able to arrive at the statistical relationship of the distribution. Similarly, for existing patterns, if firms exited in the years 2003/2006/2013, they have a higher productivity growth and for all other years, distributional impact is not statistically arrived at. For the continuous exporters, years such as 2004/2008 and 2014 are favourable statistically as compared to other years. However, the decadal effect is quite visible and positively explains the distributional differences for all the categories of firms when taken together.

Now we plot the distributions of small and large exporters and arrive a similar distribution as shown in Fig. 1. For the cohort of 2003–2015, the cumulative distribution functions of productivity of large and small exporters are presented in Fig. 2.

[10] On the entry side, the implication of selection is that only firms with higher productivity should enter the export market. On the exit side, if selection is at work, low productivity exporters should leave the export market.

[11] Switchers are excluded from the comparison.

Table 3 Self-selection to export market and TFP

Year	Equality of distribution		Difference favourable to entering exports		Difference favourable to exiting exports		Difference favourable to continuous exports	
	Full sample	*P*-value	Enter	*P*-value	Exiting	*P*-value	Continuous	*P*-value
2003	0.058	0.945	0.295	0.097*	0.443	0.036**	0.164	0.930
2004	0.052	0.974	0.351	0.011**	0.172	0.644	0.325	0.070**
2005	0.063	0.876	0.216	0.266	0.171	0.692	0.311	0.181
2006	0.053	0.985	0.275	0.135	0.316	0.061**	0.200	0.786
2007	0.066	0.953	0.174	0.742	0.171	0.877	0.231	0.524
2008	0.076	0.825	0.252	0.295	0.196	0.576	0.404	0.015**
2009	0.116	0.465	0.439	0.011**	0.318	0.190	0.505	0.061**
2010	0.094	0.783	0.232	0.527	0.206	0.770	0.319	0.442
2011	0.105	0.716	0.241	0.595	0.236	0.689	0.172	0.931
2012	0.131	0.550	0.307	0.361	0.144	0.995	0.336	0.478
2013	0.165	0.645	0.429	0.423	0.596	0.059**	0.467	0.388
2014	0.115	0.996	0.548	0.287	0.194	0.899	0.800	0.104*
2015	0.125	0.973	0.446	0.446	0.250	0.741	0.568	0.300
Full sample	0.056	0.026***	0.213	0.000***	0.155	0.002***	0.197	0.000***

Note Statistically significant of the t-test is presented in table based on limiting the distributions. Significant levels based on the bootstrap approximation (10,000 replications) are presented as *** for 1%, ** for 5% and * for 10%. *Source* Authors' calculation from Prowess IQ database

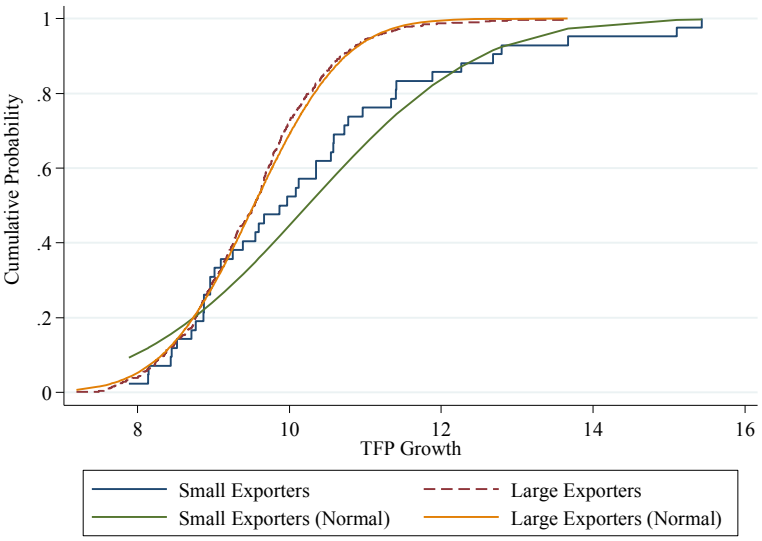

Fig. 2 Cumulative distribution of TFP growth for small and large exporters. *Source* Authors' representation from Prowess IQ database

Table 4 Self-selection to exports market and TFP weighted for firm size

Year	Difference favourable to entering exports		Difference favourable to exiting exports		Difference favourable to continuous exports	
	Enter	*P*-value	Exiting	*P*-value	Continuous	*P*-value
2003	0.540	0.008***	0.183	0.589	0.253	0.179
2004	0.454	0.002***	0.334	0.052*	0.155	0.785
2005	0.361	0.094*	0.308	0.075*	0.216	0.361
2006	0.504	0.003***	0.247	0.461	0.411	0.007***
2007	0.399	0.112	0.416	0.028**	0.383	0.116
2008	0.386	0.018**	0.397	0.013**	0.306	0.108*
2009	0.744	0.000***	0.190	0.830	0.333	0.139
2010	0.583	0.003***	0.519	0.012**	0.548	0.002***
2011	0.510	0.021**	0.394	0.154	0.454	0.046**
2012	0.624	0.002***	0.304	0.472	0.471	0.047**
2013	0.600	0.055*	0.385	0.511	0.707	0.014**
2014	0.400	0.854	0.556	0.360	0.500	0.425
2015	0.917	0.035**	0.464	0.397	0.333	0.819
Full sample	0.394	0.000***	0.217	0.000***	0.237	0.000***

Note Statistically significant of the t-test is presented in table based on limiting the distributions. Significant levels based on the bootstrap approximation (10,000 replications) are presented as *** for 1%, ** for 5% and * for 10%. *Source* Authors' calculation from Prowess IQ database

From the figure, this is evident from the distribution that small exporters have lower productivity growth as compared to the large exporters.

We now present a similar exercise as reported in Table 3; however, in this case, the entry–exit and continuous exporters are weighted with firm size. From the result presented in Table 4, it is quite clear that entering to the export market for the big firms is stochastically different and better as compared to the small exporters. As evidenced from the table, except for 2007 and 2014, entering to export market from the big firms have resulted higher TFP as compared to the small size firm that entered to the export market. The full sample, however, has a similar result of higher TFP for firms that are big in size and entered the export market during 2003–2015. Similarly, we exercised for the exiting and continuous firms. For those who existed either during 2003/2006/2009/2003–2015, statistical significant of TFP distribution is not arrived at; however, for all other years, decision to exit from the export market for the big firms resulted in increase in TFP as compared to the small firms. Firms that are continuing in the export market are having an advantage over time as given in Table 4; however, year-wise analysis shows that those continued even during 2006/2010/2013 have higher TFP compared to others. When we analyse this phenomenon in relation to other results of the same table, we can see that for the year 2006 enter to export market was a good decision to increase TFP, or firms that are efficient self-selected to enter in export market that is in line with the behaviour of the continuous exporters.

However, in the same year 2006 exiting from the market was not favourable. This case continuously happens for other 2 years of study period for both 2010 and 2013. Therefore, those entered in these periods if stayed/continued in the market enjoyed higher TFP. This behaviour can be linked to learning by exporting and increasing TFP at firm level for the big firms. However, the exact channels of increase in TFP growth are difficult to establish.

On a similar exercise, Table 5 presents results with firm age. Firms that are old in export market (not old based on the year of incorporation) have favourable result in increase in TFP only for the entry pattern for years 2005/2007/2010/2011/2013–2015. For other two analyses in case of exiting and continuous exporting, we are not able to arrive at the statistical relationship. However, the sign of the coefficient as reported in Table 5 remains positive and signifies that there is a positive gain for the TFP for the old exporter by not stochastically determined as different from the young exporters. Hence, the young exporter enjoys higher TFP by continuing in the export market along with the old exporters.

Table 5 Self-selection to exports market and TFP weighted for firm age

Year	Difference favourable to entering exports		Difference favourable to exiting exports		Difference favourable to continuous exports	
	Enter	*P*-value	Exiting	*P*-value	Continuous	*P*-value
2003	0.359	0.031**	0.259	0.149	0.159	0.711
2004	0.387	0.003***	0.126	0.839	0.138	0.825
2005	0.214	0.322	0.143	0.774	0.147	0.773
2006	0.341	0.036**	0.187	0.577	0.277	0.124
2007	0.114	0.993	0.232	0.377	0.149	0.881
2008	0.190	0.613	0.210	0.442	0.217	0.422
2009	0.518	0.018**	0.227	0.511	0.118	0.993
2010	0.238	0.537	0.288	0.265	0.286	0.281
2011	0.304	0.305	0.242	0.552	0.185	0.867
2012	0.496	0.092*	0.197	0.912	0.248	0.656
2013	0.208	0.985	0.357	0.658	0.208	0.985
2014	0.528	0.528	0.286	0.955	0.381	0.736
2015	0.227	0.998	0.250	0.974	0.750	0.030***
Full sample	0.204	0.000***	0.063	0.501	0.052	0.738

Note Statistically significant of the t-test is presented in table based on limiting the distributions. Significant levels based on the bootstrap approximation (10,000 replications) are presented as *** for 1%, ** for 5% and * for 10%. *Source* Authors' calculation from Prowess IQ database

5 Conclusions

This paper tries to establish the TFP growth differences between set of exporting and non-exporting firms in the manufacturing sector of India. The sample period of this study is considered to be from 2003 to 2015 drawn from the Prowess IQ corporate database of Center for Monitoring Indian Economy. The underlying hypothesis of this paper is that the exporting firm has higher productivity growth as compared to the firms that are non-exporters. In understanding the productivity differentials, we use a non-linear method of statistical approach instead of a standard linear approach. The possible complementary explanations for greater productivity of exporting firms are linked with either market selection hypothesis or the learning-by-exporting hypothesis. Within the set of exporting and non-exporting firms, our paper differs from the existing research by creating transition patterns between export and non-export firms.

The finding of this paper confirms that there is an identifiable higher level of productivity difference exists between the exporting and non-exporting firms in case of the Indian economy, which is in line of market selection, and learning hypothesis. Hence, we conclude that more efficient firms self-select to the export market in India. Similarly, in case of the entry side argument to the export market, we find evidence in favour of selection. Meaning, firms entering to the export market eventually have higher productivity as compared to the non-exporters in the period prior to their entry. When we look at the exit side of the export market, we see that the ex-ante productivity distribution of continuing exporters stochastically dominates the productivity distribution of the existing firms. Hence, firms that are not able to have higher level of productivity are forced to exit from the export market. Even if we validate the self-selection hypothesis, we are not able to strongly conclude the learning-by-exporting hypothesis in this case. As the productivity growth seems to be similar for exports and non-exporters, we see the entire sample for the sample period of this study. Therefore, the leaning hypothesis is not conclusive for the full sample in this case. Further, weightage based on firm size and firm age are also considered, as firm size and firm age are one of the important variables that explains the export decision and intensity at firm level. This is basically done as a robustness check of the existing empirical result. These results do not explicitly explain the yearly effect, but the aggregate effect is quietly visible from the analysis. The firm size seems to have higher role in export market as against the firm age. The learning from the export market is clearly seen with higher increase in TFP and hence, points out that firms that enter into exports market are more efficient and also bigger in size.

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