Productivity heterogeneity and firm level exports: case of Indian manufacturing industry

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Abstract

The study is an attempt to understand the nature of productivity heterogeneity and firm level export market particpation in the Indian manufacturing industry. This include testing of two alternative hypothesis *first*, self selection of most productive firms into the export market and *second*, learning by exporting, where firms become more productive once they enter the export market. The study employs firm level data obtained from Centre for Monitoring Indian Economy (CMIE) for the period 1990-2009 for analysis. Firm level Total factor productivity is estimated using Levinsohn and Petrin(2003) method. The initial findings indicate that exporting firms are more productive than the non exporting firms in the Indian industry. However, the magnitude of this productivity difference is not very large compared to other countries. Study reports self selection of firms into the export market for the period from 1990 to1999. Continued participation in the export market and the intensity of exporting is associated with growth in productivity, indicating the presence of learning by exporting for the period from 2000 to 2009.

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1. Introduction

Exports play a major role in sustaining economic growth in economies. Among different channels that connect a country with others, export to foreign markets attracts most attention in the literature studying the sources for productivity growth in an economy. Recent studies indicate that the exporting may result in reallocation of scarce resource towards industries which have comparative advantage, popularly known as trade induced reallocation of resources[1]. However, a large number of scholars provide explanation of reallocation as trade-induced within-firm productivity improvements. Because the firms engage in international trade are heterogeneous in terms of productivity and size (Melitz 2003). Studies based on this context reveal superior firm performance of exporting firms as compared to the non-exporting ones. The premise of such argument is based on the hypothesis that exporters at the outset tend to be more productive than the non-exporting firms. Two explanations for this phenomenon have been proposed. First, *self selection* of most productive firms to the export market Second, *learning by exporting* where firms become more productive once they starts export[2].

Further, the said differences in export performance may be attributed to the progressive trade and product market liberalization adopted by various countries (Helpman et al. 2004). Product market or trade liberalization, induces important reallocations between heterogeneous producers in a sector: the smallest or least productive producers are forced to exit, and market shares are further reallocated between less productive producers (who do not export) towards larger, more productive exporters (Melitz 2003). Although, there exist a number of studies pertaining to various economies, attempt to address the issue in the context of India is rare. Some of the recent studies indicate that the effects and nature of trade and FDI liberalization in India brought significant changes in firm level productivity[3]. Hence, a detailed analysis on productivity heterogeneity and firm level export market participation in the context of liberalized regime is necessary to understand the linkages. In addition to this, the nature of variables

[1] See Melitz(2003), Bernard et al (2003)

[2]Roberts and Tybout (1997) shows that firms the entry decision of a firm into the export market largely depends on the ability to cover the sunk cost of exporting. In the case of learning by exporting, one view is that exporters acquire knowledge of new production methods, inputs, and product designs from their international contacts, and this learning induces higher productivity for exporters relative to their more insulated domestic counterparts. See Clerides, *et al*. (1998) for more discussion on this.

[3] See Topalova(2011) and Sivadasan (2009) for detailed discussion

pertaining to capture industrial structure, technical change and policy environment are different in the case of different sub-sectors of the manufacturing sector in India. Hence, a detailed empirical analysis of the manufacturing sector which underwent these changes would provide valuable insights about the dynamics of firm level export market participation in an emerging economy like India.

Based on this the major objective of this study is *firs*t, to estimate productivity at the firm level for the Indian manufacturing industry and *second*, test the alternative hypothesis of self selection of more productive firms into the export market vis a vis learning by exporting(Whether firms boost their productivity once they enter the export market). The paper is organized as follows: the next two sections provide an overview of the theoretical and empirical literature on exporting and firm productivity. Section 4 outlines the empirical model. Section 5 describes data and enlists the preliminary analysis. Section 6 studies the performance of exporters vs non exporters, section 7 and 8 tests self selection and learning by exporting. Section 9 concludes the findings.

2. Motivation and background

Primary motivation for this study on India is the progressive external sector liberalization adopted by the country since early 1990 and the associated productivity reallocation within the narrowly defined manufacturing industries[4]. Product market liberalization has been carried out through two simultaneous routes *first*, the reduction of trade barriers by liberalizing tariff rates and *second*, increasing FDI inflow into the country by liberalizing the foreign capital requirements. As a part of trade liberalization, tariff rates fell from 87 percent points to 34 percentage in 1996 with similar drop in standard deviation of tariff. FDI liberalization eased the entry of foreign firms in the domestic market. As an immediate response to these measures exports as a percentage to GDP increased from 7 to 13 percentage from 1990-2000 with drastic changes in the direction and composition of trade from the country. Studies carried in the context of Indian manufacturing sector document for reallocation of market share, changes in the availability of intermediate inputs and an increase in the product mix produced by firms in different sub sectors[5].

[4] See Sivadasan (2009), Topalova(2011), Harrison for detailed discussion on the trade liberalization in India

[5] See Goldberg et. al.(2009)

Based on these evidences and on account of liberalization episodes in other countries it is evident that trade liberalization is a potential policy tool which can provide better export performance in terms of reach to different markets and number of products exported. One reason for this phenomenon is that trade liberalization increases the competition firms face by reducing market access cost to foreign firms[6]. As a result domestic firms must become more productive in order to survive the new import competition. Studies carried out on Indian manufacturing sector (aggregate and firm level) highlight the extent of productivity difference and the nature of reallocation of productivity across firms within and between industries after 1990 due to trade liberalization. On the other side of the argument liberalization can make existing inputs cheaper for both foreign and domestic firms and can provide access to previously unavailable inputs (Goldberg et. al. 2009). The imported intermediate inputs would help in the production of export goods. Trade liberalization also resulted in the growth of extensive product margin at the firm level (Goldberg et. al. 2010). This may be due to the declining trade cost due to trade liberalization as postulated by the theoretical models of multi product firms. Hence, it is clear that the trade liberalization induced widening of heterogeneity across firms in the form of reallocation of productivity, availability of intermediate inputs for production and an increase in the product mix produced by firms in different between sectors.

However, some of the issues remains relatively unexplored in the Indian context that F*irst*, whether the liberalization induced the reallocation of productivity between export and non-exporting firms *Second,* the linkage between productivity and exports i.e., whether the productivity improvements helps firms to self-select into the export market (self-selection effect) or export market participation leads to productivity improvement once the firm starts exporting (learning by exporting effect). The export responsiveness of firms to trade liberalization may be also different depends on the intensity of exports with these firms (less export intensive and most export oriented firms). Evidences on other countries highlight that pre-entering firms became more export oriented due to liberalization[7]. Further, in the context of India most of the studies were being carried out using the aggregate data. Therefore, in order to analyse the dynamics of firms response to product market liberalization micro level foundations of exporting and productivity needs to be analysed. Hence the present study is an attempt to fill the gap in the

[6] Which is in fact discussed in the trade literature as import effect. Topalova(2011)
[7] See Bernard and Jensen(1999)

literature by investigating in detail the firm level export market participation and the link between productivity in the context of emerging country- India.

3. Theory and empirical evidence

The earliest study analyzing the causal relationship between exporting and productivity at the firm-level in the recent literature was on the U.S. economy (Bernard et al. 1995, 1999). Study found strong self selection effect and very little evidence of any learning-by-exporting effect. Based on this Melitz (2003) pioneered a model linking heterogeneous firms and industry productivity, with firm level exporting behavior. He created a dynamic industry model in a general equilibrium frame work and incorporated firm level heterogeneity into the model propounded by Krugman (1979). The major difference is on the cost of exporting. Firms face fixed cost to export. However they differ from each other in terms of productivity. Every firm has to make a productivity choice from an exogenous distribution which in turn determines whether they do actually produce and export and endogenously determined productivity threshold which determine who does and does participate in the export market[8]. The interaction of these raises industry productivity. There are two effects due to to increased export market participation *first,* there is a rationalisation effect. Exporting increases expected profit, which in turn increases the entry of firms in the market results in augmenting the productivity threshold for survival and causes the least efficient firms to exit. *Second*, exporting allows the most productive firms to expand into more market and causes less productive firms to contract.

Bernard and Jensen (1999) find no evidence of strong self selection of firms in the case of USA for the period 1984-92. Study employed a linear probability framework with plant fixed effects and also finds substantial sunk costs in export entry. Export experience in the previous year increases the probability of exporting by 40 percent, although the entry advantage depreciates very quickly. Study identifies that least productive firms exit from the export market. However the benefits of exporting for firms are unclear from this study. Clerides, *et al*. (1998) highlight the importance of self selection in international trade. The model shows that more productive firms with lower marginal costs earn higher gross profits from producing, but not all firms export. Only those with sufficiently high profits to cover the sunk costs of entering export markets do so. They find strong evidence for self -selection and learning by exporting. Aw,

[8] See Melitz(2003) for detailed discussion

Chung and Roberts (2000) used micro data collected from the manufacturing censuses in South Korea(1983-93) and Taiwan(1981-91) to study the linkages between producers total factor productivity and choice to participate in the export market. Study identified differences between the countries in terms of importance of selection and learning by exporting. In Taiwan, the participation of plants in the export market are due to the productivity as predicted by self-selection models. Plants with higher productivity, ex ante, tend to enter the export market and exporters with low productivity tend to exit. Moreover, in several industries, entry into the export market is followed by relative productivity improvements reinstating the effect of learning-by-exporting. However, the evidence of self selection on the basis of productivity is much weaker in the case of South Korea. In addition, study explicated no significant productivity changes following entry or exit from the export market that are consistent with learning from exporting.

Baldwin and Gu (2003) examined how Canadian manufacturing plants has responded to reductions in tariff barriers between Canada and the rest of world over the past two decades. The study brought out three main conclusions. Study found that trade liberalization was a significant factor behind the strong export growth of the Canadian manufacturing sector. As trade barriers fell, more Canadian plants entered the export market and existing exporters increased their share of exports. Export-market participation was associated with increase in a plant level productivity growth. They found the effect is much stronger for domestic-controlled plants than for foreign-controlled plants and for younger businesses than for older businesses. Study reported strong learning effect in terms of export market participation.

Girma et al(2004) reported the presence of learning and self selection for a sample of matched firms from UK for the period 1990-1996. Study find exporters are larger and more productive than non exporters and reported evidence of self selection of more productive firms in the export market. Further they found significant productivity improvements through exporting due to learning effect. Biesebroeck (2005) reports positive self selection and learning effect for a sample of firms from 9 countries in Sub-Saharan Africa for the period from 1992-1996. Study employed GMM-system, MLE method to identify possible learning effect. The results indicate that exporters in these countries are more productive compared to non-exporting firms. Further, exporters increase their productivity advantage after entry into the export market. The results are robust when unobserved productivity differences and self-selection into the export market are

controlled for using different econometric methods. International Study Group on Exports and Productivity (ISGEP, 2007), found that the 30 to 60 percent productivity differential between exporters and non-exporters is attributed to the selection of more productive and faster growing firms into exporting. Having gained a productivity advantage prior to the entry into foreign markets, exporters do not experience additional productivity gains from the exporting activity per se. Moreover, exporters who fail to survive in foreign markets lose this productivity advantage and end up being worse off than the firms who never export.

4. The empirical model

We follow the method adopted by Bernard and Jensen (1999) to examine the performance difference between exporters and non exporter. To test self selection we employ Probit model(the details of the model is explained in section). We use two methods to identify possible learning effect *first*, we use GMM-SYS method developed by Arellano and Bover (1995) and Blundell and Bond (1998, 2000) and *Second*, to investigate learning effect across different exporter category we use the method used by Bernard and Jensen(1999)

4.1 Productivity Estimation

In recent years great attention has been paid on the measurement of total factor productivity. The estimation of production function using Ordinary Least Squares (OLS) gives inconsistent and biased estimates of explanatory variables. There are likely to be a host of firm, industry, time, and region-specific influences that are unobservable to the econometrician but are known to the firm. These unobservable might influence the usage of production inputs and usage of inputs thus determined endogenously. Since OLS technique assumes production inputs are uncorrelated with omitted unobservable variables, it fails to address this endogeneity issues and thereby results in inconsistent and biased estimates of production function, which is otherwise known as 'simultaneity or endogeneity problem'. To solve these issues semi parametric method by Olley and Pakes(1996) and Levinsohn and Petrin(2003) has been used in many studies. Both these methods takes into account the simulataneity bias(and selection bias attrition bias in the case of OP). For the use of OP method investment is used as a proxy for controlling bias(unobservable productivity shocks). However in this study OP method cannot be used due to the large number of zero observations on investment. It will cause a large truncation of the dataset.

Hence, in this paper we use Levinsohn and Petrin (2003) (LP) methodology to estimate firm level production function. Levinshon – Petrin method uses energy as the proxy for controlling unobservable productivity shocks. The detail of the estimation is as follows. We assume a production function of the form:

$$y_t = \beta_o + \beta_k k_t + \beta_l l_t + \beta_m m_t + \beta_e e_t + \omega_t + \eta_t \qquad (1)$$

Where y_t, k_t, l_t, m_t, and e_t are the ln of output, capital stock, labour input, material, and energy of firm respectively, ω_t denotes productivity of the firm and η_t stands for measurement error in output, which is uncorrelated with input choices.

To control for unobservable productivity shock, in this study we take energy as proxy to take care of the endogeneity bias. LP assume that firm's energy demand function as, $e_t = e_t(\omega_t, k_t)$ is monotonically increasing in productivity given its capital stock. This allows inversion of energy demand function as $\omega_t = \omega_t(e_t, k_t)$. Thus the unobservable productivity term (ω_t) depends solely on two observed inputs, e_t and k_t. Rewriting equation (2) gives us:

$$y_t = \beta_l l_t + \beta_m m_t + \phi(k_t, e_t) + \eta_t \qquad (2)$$

Assuming the monotonocity condition this can be rewritten as

$$\phi(k_t, e_t) = \beta_o + \beta_k k_y + \beta_l m_t + \omega_t(k_t, e_t) \qquad (3)$$

Here the error term (η_t) is not correlated with the inputs. The estimation of production function is carried out in two stages. First stage involves the estimation of the above equation, where, conditional moments $E(y_t | k_t e_t)$, $E(m_t | k_t e_t)$, and $E(l_t | k_t e_t)$ are estimated. For the estimation of coefficients in the second stage, we use two moment conditions to identify β_e and β_k . First moment condition identifies β_k by assuming that capital stock does not respond to the innovation in productivity, i.e., $E(\eta_t + \xi_t | k_t) = 0$; second moment condition identifies β_e by using the fact that last period's energy choice should be uncorrelated with innovation in productivity this period, i.e., $E(\eta_t + \xi_t | e_{t-1}) = E(\xi_t e_{t-1}) = 0$. The final estimation requires several steps[9]. The value of the statistic is computed for each of these samples and the distribution of estimates so generated

[9] See Levinsohn and Petrin(2003) for detailed discussion of the estimation of production function.

provides the bootstrap approximation to the sampling distribution of the statistics. Using the estimated coefficients of production function $\hat{\beta}_l$, $\hat{\beta}_m$, $\hat{\beta}_k$ and $\hat{\beta}_e$ we estimate

$$lnTFP_{ijt} = ln\, y_{ijt} - \hat{\beta}_l\ lnl_{ijt} - \hat{\beta}_m\ lnm_{ijt} - \hat{\beta}_k\ lnk_{ijt} - \hat{\beta}_e\ e_{ijt} \quad (4)$$

5. The Data and preliminary analysis

We use firm level data from Prowess Database. The sample period is 1990-2009. The Data is collected by the Centre for Monitoring Indian Economy (CMIE) from the company balance sheets and income statements and covers both listed and unlisted firms from a wide cross section of manufacturing, services, utilities and financial industries. Prowess covers 60-70 percent of organized sector in India, 75 percent of corporate taxes and 95 percent of excise duties collected by the government of India (Goldberg et al. 2010). In our study we use only manufacturing firms – an average of 2481 firms spread across the 20 years. It includes the data on exporting, non-exporting, domestic, foreign and Indian firms investing abroad. The data is curled out based on the National Industrial Classification (NIC) provided by the Central Statistical Organization. After editing the data for possible erroneous observations, the sample consists of 45394 observations on an average of 5154 firms spread across different years(2541 on an average). The sample firms covers around 50 percent of output in a year reported in Annual Survey of Industries (ASI). We used an unbalanced panel, where the observations vary across time and firm characteristics. Since it is not mandatory for firms to report their balance sheets to the data collecting agency, firm entry and exit from the sample is primarily related to reporting rather than their actual entry and exit from the industry. Apart from firm level data, we also use data obtained from annual survey of industries and National Sample Survey Organization (NSSO). Out of 45394 total observations 24721 cater to the exporting firms which enter and exit out of the export market during the study period and 20673 non-exporting firms.

Table 1 gives the summary of key firm characteristics for the study period(total sample). The mean values of total sample indicate that the mean size of the sample firm is 151.66 (in Rs.crores). Where deflated (base 1993-'94) sales is taken as an indicator of size. On average, the wage bill stands around 6.4 (in Rs. Crores). The firms included in the sample are experienced if we count in terms of age, the average age of the firms is 26 years. The study makes use of the

year of incorporation to construct the age of a firm. Export intensity of the total sample is 12.31 percent of the sales, which indicates that on an average, firms spend 12.31 percent of their sales revenue, are generated from exports. The range of export intensity is from 0 to 100, which indicates that the sample includes firms which are non-exporting and hundred percent export oriented. On an average, firms spend 10 percent of their sales on import. The sample includes firms which spent 90 percent of their sales on import. Table 2 compares the mean and standard deviation between different types of firms, exporting, non-exporting, foreign and domestic. We use t-test to find out if the mean difference is significant. It shows that exporting firms on an average are big firms. The significant difference in firm size between the exporting and non-exporting firm indicate that exporting firms are bigger than the non-exporting firms. In addition to that if we compare foreign and domestic firms, foreign firms are bigger in size. Those firms which export are more experienced than the non-exporting firms. The import intensity of exporting firms is 15 percent which indicate that exporting firms build their capacity by importing materials, which facilitates their export.

6. Performance of Exporters Vs Non exporters

In this section we try to document the difference between exporters and non-exporters. Many studies found significant productivity differential between exporters and non-exporters. Following Bernard and Jensen (1999) we estimate the OLS regression.

$$\ln x_{it} = \alpha + \beta E_{it} + \chi Z_{it} + \sum_t \delta_t Time_t + \sum_k \lambda_k Ind_k + \varepsilon_{ikt} \qquad (5)$$

where x_{it} refers to the characteristic of firm *i* at time *t* in the industry *k*. E is a dummy variable equal to one if the firm is an exporter and zero otherwise. The coefficient on the export dummy E measures the percentage difference of a performance characteristic between exporters and non-exporters. We control for size, age and ownership of the firm. To find out the difference in firm performance for exporters based on the level of participation of firm in the export market, we classify firms into four categories.

Continuous non-exporter = if the firm does not export (export =0) throughout the period of study

Enter = if firm do not export at the beginning of the period but starts export in between for
eg:export =0 in t and export >0 in t+1

Switch = if the firm switches its export position in between. eg: if export is >0 in t , =0 in t+1, >0 in t+2

Continue = if firm continuously export during all years or it export continuously for 5 years in a row

Exit = if the firm export for at least 3 years and exit out of the export market. eg: export>0 in t and exp=0 in t+1

Table 6 reports the mean and standard deviation of TFP for exporting, non- exporting, entering, continuing and exiting firms in the sample. Exporting firms tend to be more productive compared to the non- exporting firms. The mean TFP for exporting firms are high compared to entering and exiting firms. In Table 7, Column 1 reports the export difference between exporters and non- exporters for the full sample. For the full sample exporters seems to reap. Export coefficient is positive and significant for various firm characteristics if we take the case of full sample. By far the largest difference is found in the case of output. The productivity levels are higher for exporters compared to the non-exporters in all groups other than entering firms (column 3). The result indicates that the exporters at the outset are more productive than the non-exporting firms. However, when we take the magnitude of productivity difference between exporting and non-exporting, we find it very small. Column 5 reports finding for continuing firms. The continuing firms in the export market are 10% more productive compared to the non-exporting firms. Column 7 reports the findings for firms which exit out of the export market (year prior to exit).

7. Self selection: Do better firms become exporters?

Following Bernard and Jensen (1999) Probit model is used to test the self selection hypothesis. To understand the nature of export market participation and productivity in the liberalization phase we divide the sample into two sub-samples (1990-1999 and 2000-2009). The dependent variable in the case of Probit model is binary type depending upon the export market participation of the firm. Firms enter into the export market only if the profits from doing so are enough to cover the sunk cost of exporting. we use the following function.

$$\text{Prob}\{Y_{ijt}=1\}= \Phi(\beta_0 E_{ijt-1} + \beta_1 I_j + \sum \beta_t \text{ Year Dummy}_t + \beta_3 Z_{ijt-1}) + e_{ijt} \qquad (6)$$

Where Y_{ijt} =1 if firm is an exporter and 0 otherwise. E_{ijt-1} is the export status of the firm at t-1. Z_{ijt-1} is the vector of firm characteristics and. Φ indicates the standard normal cdf. The various characteristics that are used as independent variables and influence the decision to export are lagged productivity, age of the firm, size of the firm and ownership. Productivity is measured in terms of TFP (using the Levinsohn- Petrin method). A strong positive association between a given firm's characteristics and its participation in export markets could reflect self selection of better firms into the export market.

The main issue in identifying an exporter is that there are several firms with negligible exports (in Rs. Crores) but are exporting at least one year. It is very difficult to classify these firms as exporting firms. In addition there are large firms with large export revenue but the export intensity of these firms are very small. Hence, for detailed investigation and to take care of this problem we classify our sample into four categories:

Exporter 1- if the export intensity is greater than 5% in the firms export history

Exporter 2- if the export intensity is greater than 10% in the firms export history

Exporter 3- if the export intensity is greater than 20% in the firms export history

Exporter 4- if the export intensity is greater than 25% in the firms export history

Table 8 reports the finding of Probit estimation of export performance. Table 9 highlight the findings for the sub-sample. The decision of the firm to participate in the export market largely depend on the past export performance of the firm. This results are similar to Arnold and Hussinger(2005) for German manufacturing and Baldwin and Gu(2003) for Canadian firms. We find that the TFP measure is not significant in the case of full sample. In the case of sub-sample TFP measure is positive and significant for the 1990-1999 sub groups. This indicate the participation in the export market during immediate years of liberalization largely dependent on TFP. However, this is not same for the 2000-2009 time period. One reason could be the immediate productivity change brought by the product market liberalization. Another reason could be the convergence of productivity of exporting firms to the level of non exporting firms over the years.

8. Learning by exporting: Does exporting boost productivity?

In this section we investigate whether exporting boost productivity. To account for the simultaneity of input choices and unobserved productivity we apply the system GMM approach proposed by and Blundell and Bond(1998, 2000) and Arellano and Bover (1995). This estimation procedure is appropriate when N is large, but T is small and the explanatory variables are endogenous. Unobserved firm characteristics may affect both firm performance and exports, which can lead to spurious correlation between productivity level and past exporting status. For example, certain firms might have more energetic managers who run efficient operations with low unit costs than their competitors and also aggressively seek out foreign markets, while other firms might run by more conservative managers who are unwilling to implement efficiency-enhancing reforms and also prefer to rely on traditional domestic markets. Such unobservable firm characteristics may give rise to spurious correlations between lagged exports and current firm performance. Further, this method provides more appropriate estimates when unobserved firm-specific effects are correlated with other regressors. Firm performance may be serially correlated over time and if jointly determined by exports. For example, if firms self –select into export market and the positive productivity shock is serially correlated, current productivity will also be correlated with previous export experience without any learning by exporting.

The GMM system procedure allows us to examine the cross-sectional relationship between the levels of exporting and productivity since the firm-specific effect is not eliminated but rather controlled by the lagged differences of the dependent and independent variables as instruments. Here, the assumption is that the differences are not correlated with a firm-specific effect compared to levels. For checking the validity of the instruments we use two the specification tests f*irst*, we apply the Sargan test, a test of over identifying restrictions. This is to determine any correlation between instruments and errors. For an instrument to be valid there should be no correlation between the instrument and the error terms. *Second*, we test whether there is a second-order serial correlation with the first differenced errors. The GMM estimator is consistent if there is no second-order serial correlation in the error term of the first differenced equation

Table 11 reports the GMM-system estimation results. Past export performance are not important factor to determine the current productivity of firm. But the growth of productivity

largely depends on the intensive margin of exporting. The co-efficient of variable indicating lagged export growth is positive and significant. To understand this further we investigate the productivity improvements related to entry, continued stay, switching export positions and exit out of the export market.

Productivity changes are associated with entry, continued stay, switching export positions and exit out of the export market. The results reported in Table 12 is divided two samples(1990-1999 and 2000-2009) to identify the nature of the productivity change during the immediate years of liberalisation We follow Bernard and Jensen(1999) and estimate the below model.

$$\Delta Y_{it} = \beta_0 + \beta_1 entering_{it} + \beta_2 continue_{it} + \beta_3 exit_{it} + \beta_4 switch + \chi controls_{it} + \varepsilon_{it} \quad (7)$$

Where, ΔY_{it} is the growth in productivity. The coefficients, $\beta_1, \beta_2, \beta_3, \beta_4$ give the differential in productivity growth rates for entering, continuing, switching and exiting firms for the full sample and the sub-sample. Firm level controls include age, size and ownership. The classification on the exporting history followed here is the same as in the other sections. Table 12 reports the findings for full sample and for the sub-period. The entry into the export market is associated with high productivity for the firm in the initial period of liberalization (1990-1999). Starting to export is associated with increase in productivity during early years of liberalisation. However the productivity increase during the later period (2000-2010) due to entry is less. The continuous participation in the later half (2000-2009) is the associated with positive productivity improvements. The exit from the export market leads to a productivity loss in the initial years of liberalization.

9. Conclusion

In this paper we examine the nature of productivity heterogeneity and firm level export market participation in the Indian manufacturing sector. The two key questions examined are whether more productive firms export and/or whether exporting improves productivity(testing of alternative hypothesis *self-selection* vis-à-vis *learning by exporting*). We use firm level data provided by the Centre for monitoring Indian Economy (CMIE) for the period 1990-2009 for analysis. Preliminary analysis indicate that , on an average, exporting firms are bigger in size , are more experienced in the market and pay high average wage compared to the non- exporting firms. As a next step, we test the empirical regularity that exporters are more productive compared to non-exporters. Total Factor Productivity is calculated using Levinsohn and Petrin(2003) method. The results indicate that exporting firms on an average are more productive compared to the non- exporting firms for the full sample. However, the extent of this productivity difference is small compared to other countries. Prior to entry, there are no significant productivity differences between entering and non-entering firms. However, there is positive evidence that the productivity difference between continuous exporters and non-exporters widens over time.

As a next step, we test whether more productive firms self-select into the export market. We found no evidence of self- selection in the case of Indian manufacturing firms. These results are similar to the one obtained by Aw, Chung and Roberts(2000) for Korea. To investigate further we divided the sample into two time periods from 1990-1999 (immediate years following liberalization) and 2000-2009. We found positive evidence of self selection for the immediate period following liberalisation(1990-1999). We apply the system GMM approach proposed by Arellano and Bover (1995) and Blundell and Bond (1998, 2000) to examine learning by exporting effect. Results indicate no significant evidence of exporting on current productivity level of the firm . However we found evidence of positive productivity growth due to intensive margin of exporting. This is in line with findings by Biesenbroeck(2005) for Sub-Saharan Africa. Entry into the export market is a time of productivity growth and improved firm performance for the period from 1990-1999. During the same time firms that stop exporting perform badly. This finding corresponds to the study by Berbard and Jensen (1999) in the case of USA. However, results indicate that continuous exporting during the period 2000-2009 brings positive productivity growth at the firm level.

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TABLES

Table 1: Summary Statistics (Full sample)

Variable	Mean	Std. Dev.	Min	Max
Size	151.66	1257.79	.03	72385.60
Wage Bill	6.40	35.50	0.02	1974.77
Age	25.99	19.36	1	120
Expint	12.31	23.48	0	100
Impint	10.36	90.09	0	87
Variables used in Production Function				
Output	154.71	963.11	1.00	47487.02
Labour	763.18	3526.50	10	140648
Capital	97.02	615.55	1	33501.50
Energy	2	28.13	1	1245.69
Materials	66.98	468.33	1	26579.54

Note: Rme-deflated material expense, energy – deflated total expense on electricity in Rs. crores. Wage bill- deflated value of salaries and wages in Rs. Crores. Expint- export/sales turnover, Impint-Total import payments/sales, Total number of observations**:** 45394

Table 2: Comparison of means between different types of firms

Variables in production function estimation					
Variable	Total (1)	Export (2)	Non-Exp (3)	Domestic (6)	Foreign (7)
Output	154.71	292.05*	49.77	142.25	366.12*
	(963.11)	(1537.75)	(209.16)	(960.6)	(981.14)
Labour	763	1415*	307.24	697	1873*
	(3526.5)	(5317.11)	(1149.84)	(3497.62)	(3818.1)
Capital	97.02	172.03*	32.32	91.28	194.36*
	(615.55)	(751.8)	(132.8)	(620.45)	(516.01)
Energy	5.72	9.65*	2.88	5.50	9.54*
	(28.13)	(40.16)	(10.92)	(27.77)	(33.57)
Materials	66.98	119.90*	23.85	61.54	159.21*
	(468.33)	(721.88)	(126.4)	(463.28)	(538.81)
Observations	45394	24721	20673	42800	2594

Note: Significant at 5% level (t-test). Comparing group for 3rd, 4th and 5th Column is exporters (2) and 6th and 7th column is each other. Standard deviation in parenthesis, Materials- raw material expense, energy – deflated total expense on electricity

Table 3: Comparison of means between different types of firms

(other firm characteristics)

Variable	Total	Export	Non-Exp	Domestic	Foreign
	1	2	3	4	5
Size	151.66	312.53*	43.15	140.02	349.24*
	(1257.79)	(2293.04)	(183.33)	(1272.48)	(954.3)
Wage Bill	6.40	11.94*	2.10	5.81	16.45*
	(35.5)	(45.59)	(7.28)	(35.43)	(35.15)
Age	25.99	28.19*	24.94	25.66	31.56*
	(19.36)	(20.11)	(19.78)	(19.22)	(20.8)
Expint	12.31	22.74	0.00	12.22	13.84*
	(23.48)	(28.59)	(0)	(23.61)	(21.1)
Impint	10.36	14.59*	10.10	10.04	15.65
	(90.09)	(115.55)	(101.09)	(93.11)	(21.89)
Observations	45394	24721	20673	42800	2594

Note: Significant at 5% level (t-test). Comparing group for Column 3 is exporters (2) and column 5 is Domestic(4) . Standard deviation is reported in parenthesis. Wage bill- deflated value of salaries and wages in Rs.crores. Expint- export/sales turnover, Impint-Total import payments/sales

Table 4: Industry classification (Manufacturing sectors included for study

Industry NIC code	Sector
10	Manufacture of food products
11	Manufacture of Beverages
12	Manufacture of Tobacco products
13	Manufacture of textiles
14	Manufacture of wearing apparel
15	Manufacture of leather and related products
16	Manufacture of wood and products of wood
17	Manufacture of paper and paper products
18	Printing and reproduction of recorded media
19	Manufacture of coke and refined petroleum products
20	Manufacture of chemical and chemical products
21	Manufacture of pharmaceutical, medicinal Chemical and botanical products
22	Manufacture of rubber and plastic products
23	Manufacture of other non-metalic mineral products
24	Manufacture of basic metals
25	Manufacture of Fabricated metal products, except machinery and equipment
26	Manufacture of Computer, electronic and optical products
27	Manufacture of electrical equipment
28	Manufacture of machinery and equipment n.e.c.
29	Manufacture of motor vehicles, trailers and semi-trailers
30	Manufacture of other transport equipment
31	Manufacture of Furniture
32	Other Manufacturing

Note: NIC classification 2008 which corresponds to the ISIC rev 4.

Table 5: Production function estimation (Capital and Labour co-efficient by industry)

	OLS			L-P		
NIC code	Capital	Labour	NOB	Capital	Labour	NOB
10	0.178***	0.156***	5,501	0.138***	0.406***	6,615
11	0.245***	0.380***	792	0.205***	0.630***	801
12	0.172***	0.090***	149	0.132***	0.340***	199
13	0.199***	0.095***	5,281	0.159***	0.345***	6,615
14	0.076**	0.149**	830	0.036***	0.399***	901
15	0.404***	0.123***	499	0.364***	0.373***	702
16	0.382***	0.071***	284	0.342***	0.321***	355
17	0.336***	0.145***	1,559	0.296***	0.395***	1,775
18	0.627***	0.309***	154	0.587***	0.559***	205
19	0.371***	0.210***	357	0.331***	0.460***	399
20	0.233**	0.202***	5,741	0.193***	0.452***	6,211
21	0.114***	0.317***	2,881	0.074***	0.567***	3,155
22	0.252***	0.160***	2,956	0.212***	0.410***	3,866
23	0.386***	0.160***	1,804	0.346***	0.410***	1,909
24	0.258***	0.143***	4,170	0.218**	0.393***	4,988
25	0.312***	0.164***	1,507	0.272***	0.414***	1,601
26	0.263***	0.318***	1,761	0.223***	0.568***	1,809
27	0.199***	0.216***	2,387	0.159***	0.466***	3,488
28	0.195***	0.239***	2,674	0.155***	0.489***	3,966
29	0.050***	0.065***	141	0.010***	0.315***	176
30	0.341***	0.212***	3,119	0.301***	0.462***	3,618
31	0.012***	0.012***	62	0.002***	0.262***	166
32	0.305***	0.141***	785	0.265***	0.391***	986

Note: *** significant at 1%, ** significant at 5% and * 10%. NOB- Number of observations, L-P levinsohn- Petrin method. OLS- Ordinary least square

Table 6: Mean and standard deviation

	Mean TFP	S.D	Observations
Exporter	1.825	1.262	24721
Non-exporting	1.802	1.336	20673
Continue	1.813	0.559	23112
Enter	1.596	0.588	1891
Exit	1.818	1.299	1678
Switch	1.224	0.516	4376

Note: S.D Standard Deviation

Table 7: Exporting and firm performance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Output	0.268***	0.72	0.084***	0.71	0.269**	0.009	0.133**	0.020
Capital	0.171***	0.70	0.043***	0.68	0.194**	0.019	0.046**	0.021
Average Wage Bill	0.043***	.003	0.015***	.002	0.025***	.003	0.024***	0.006
TFP	0.017*	0.76	0.001	0.78	0.101***	0.023	0.006**	0.008
Observations	45394		1891		23112		1678	

Note: column 1, 3, 5 and 7. lnY – ln output, ln TFP- total factor productivity. ***significant at 1% level,**significant at 5%level,*significant at 10% level.. Column 1 provides the exporting premium for the entire sample. Column 3,5,7 premiums for entering(year prior to entry), continue and exiting firms(year prior to exit). Column 2, 4, 6, 8 reports the standard error.

Table 8: Probit estimation of export participation (Full Sample)

	Model 1		Model 2	
	1	2	3	4
Expt-1	0.068***	0.001	0.067***	0.001
TFP_{t-1}	0.062	0.006	-0.055	0.006
TFPt-2			-0.029	0.005
Size	0.355***	0.006	0.342**	0.006
Age	0.003**	0.000	0.004***	0.000
FP	0.456**	0.038	0.466**	0.038
constant	-0.035		-0.065	
Time	Yes		yes	
Industry	Yes		yes	
NOB	36802		29209	
Log likelihood	-16491.9		-12999.100	

Note: ***Significant at the 1% level. **Significant at the 5% level. **Significant at the 10%. Probit estimates with export dummy as dependant variable. Dependent variable is export dummy 1 if firm exports otherwise 0.

Table 9: Probit estimation of export participation (Sub-sample)

	1990-1999		2000-2010	
	1	2	3	4
Expt-1	0.075***	0.006	0.067***	0.001
TFP_{t-1}	0.277*	0.096	-0.051	0.006
size	0.312***	0.033	0.339***	0.006
Age	0.004**	0.002	0.003**	0.000
FP	0.002	0.235	0.474	0.038
constant	-0.015	0.042	-1.880	0.030
Time	Yes		Yes	
Industry	Yes		Yes	
NOB	2098		35678	
Log likelihood	-539.98		-16069.99	

Note: ***Significant at the 1% level. **Significant at the 5% level. **Significant at the 10%. Probit estimates with export dummy as dependant variable. Dependent variable is export dummy 1 if firm exports otherwise 0.

Table 10: Robustness check (self selection- hypothesis)

	Exporter1		**Exporter 2**		**Exporter3**		**Exporter 4**	
	1	2	3	4	5	6	7	8
Expt-1	0.088***	0.021	0.108***	0.041	0.118***	0.051	0.138***	0.071
TFP_{t-1}	-0.042	0.026	-0.022	0.046	-0.012	0.056	0.008	0.076
size	0.375**	0.026	0.395**	0.046	0.405**	0.056	0.425**	0.076
Age	0.017***	0.020	0.037***	0.040	0.047***	0.050	0.067***	0.070
FP	0.476**	0.058	0.496***	0.078	0.506**	0.088	0.526**	0.108
constant	-0.015	0.042	0.005	0.062	0.015	0.072	0.035	0.092
Time		Yes		Yes		Yes		Yes
Industry		Yes		Yes		Yes		Yes
NOB		15738		12480		8948		7759
Log likelihood		-16488.9		13445.6		15633.2		14822.5

Note:***Significant at the 1% level. **Significant at the 5% level. **Significant at the 10%. Probit estimates using export dummy as dependant variable

Table 11: Dynamics of exporting and productivity

	ΔlnTFP		lnTFP	
	1	2	3	4
lnTFP(t-1)			0.816**	0.023
lnTFP(t-2)			0.061	0.021
Δ lnTFP	0.056**	0.033		
Δ lnTFPt-1	-0.668	0.022		
ln EXP(t-1)			-0.004	0.001
ln EXP(t-2)			-0.005	0.001
Δ ln EXP	0.064***	0.002		
Δ ln EXPt-1	0.025***	0.005		
Size	0.075***	0.035	0.125***	0.085
Age	0.053***	0.021	0.103***	0.071
Year	yes		yes	
N.Observations	29899		36805	
Sargan Difference test	0.222		0.251	
Sargan test	0.354		0.311	
AR(1) p-value	0.306		0	
AR(2) p-value	0.107		0.675	

Notes: (1) Asymptotically robust standard errors are reported in column 3 and 4 . (2) The Sargan test is a Sargan–Hansen test of overidentifying restrictions. (4) AR1 and AR2 are tests for first and second-order serial correlation in the first-differenced residuals. (5) Lagged levels of productivity and exports (dated $t-2$ and earlier) in the first-differenced equations, combined with lagged first differences of productivity and exports (dated $t-2$) in the level equations are used as instruments. (6) Year dummies are included in each model. ***Significant at the 1% level. **Significant at the 5% level. **Significant at the 10% level

Table 12: Exporting and productivity by exporter category

	ΔTFP					
	Full sample		**1990-99**		**2000-2010**	
	1	2	**3**	**4**	**5**	**6**
Start	0.023	0.031	0.013*	0.022	0.007	0.051
Continue	0.076*	0.053	0.087	0.001	0.152**	0.016
Exit	-0.026*	0.083	-0.156*	0.025	-0.016	0.013
Switch	-0.002	.0014	-0.156	0.043	0.143	.098
size	0.059**	0.094	0.048	0.048	0.006**	0.001
Age	0.013**	0.007	-0.082**	0.038	0.012**	0.008
FP	0.025	.0134	067	.003	.189	.098
Year	Yes		Yes		Yes	
Industry	Yes		Yes		Yes	
NOB	39385		2599		36786	
R	0.5789		0.7658		0.7258	

Note: ***Significant at the 1% level. **Significant at the 5% level. **Significant at the 10% level Column 1,3 and 4 estimated co-efficients. Column 2,4 and 6 shows the standard error in estimation. Dependent variable is ΔTFP. FP – ownership dummy.

Appendix

A.1 Construction of Capital stock

Measuring the capital stock of the firm this study follows the methodology of Srivastava (1996), which revalues the capital given at historical cost to a base year. The detailed computing routine is presented below. The PROWESS database provides the information on Gross Fixed Asset (GFA) at historical cost, its three components –land & building and plant & machinery. Actual invest for the present period is estimated by taking the difference between GFA for current year and that of last year. The real investment value is expressed in the base price of 1993-94 =100. This enables us to use the perpetual inventory method to construct capital stock as shown below.

As a first step we revalue the GFA at historical cost to a particular base year value. The rationale behind the revaluation of the capital to a base year price is as follows. In our estimation of production function to derive at the share of capital and labour the value of all these parameters (output and inputs) should be expressed in one base year. Given the output and variable inputs value in current price, the cost of capital also needs to be expressed in the replacement cost of same period. However, separate revaluation of capital for each firm would involve a Herculean task. Therefore, we resort to a number of simplifying assumptions. First of all we estimate a revaluation factor to convert the historical GFA to replacement cost in a base year. To ease our task, we have applied same revaluation factor for the firms employing capital of similar vintage. For estimating the revaluation factor first of all we have chosen a base year having maximum number of firms. Thus, in our case, year 2004-2005 has been selected as the base year. Before moving ahead one needs to understand that the capital employed by a firm operates only for a specific period of time. Therefore, depending upon the year of incorporation the machines would function only for a fixed duration. On this account, we take the life tenure of capitals employed in mining sector published by in the 'National Accounts Statistics-Sources & Methods, 2007' by the Central Statistical Organisation (CSO) New Delhi.

The estimation of revaluation factor involves following three underlying assumptions. *First,* given the 25 years life duration of capital and the selected base year 2004-05(maximum number of observation), it is presumed that the no firm has the capital of vintage earlier than 1980-1981 and firms incorporated this year have employed the capital of vintage of the same year. Thus firms incorporated (after 1980-81) in the same years are presumed to have capital of same

vintage and firms incorporated before 1980-81 to have the vintage of 1980-81. *Second*, Price of capital is also assumed to have changed at a uniform rate ($\prod = \frac{P_t}{P_{t-1}} - 1$) from 1980-81 or the year of incorporation, whichever is latter, up to 2004-05 for all the firms. Values for $\prod$ are estimated by constructing a price index for the Gross Capital Formation for the mining and quarrying sector compiled from the various volumes of National Account Statistics of India. *Third*, investment is assumed to have changed at a uniform rate ($g = \frac{I_t}{I_{t-1}}$) during 1980-81 and 2004-05 for the firms incorporated in same years. Here the growth rate of gross fixed capital formation in manufacturing sector at 1993-94 price is assumed to apply to all firms. Further, average annual growth rates are obtained for firms established after 1980-81. With these underlying assumptions we derive a series of revaluation factor (R_t^G) for the years between 1980-81 and 2004-05. The revaluation factor is multiplied to the value of capital at historical cost (VCHC) to derive the value of capital stock at replacement cost (VCRC). Thus VCRC = $R_t^G \times$ [VCHC] . The series of revaluation factors is derived using the formula.

$$R_t^G = \frac{\left[(1+g)^{t+1} - 1\right](1+\Pi)^t \left[(1+g)(1+\Pi) - 1\right]}{g\left\{\left[(1+g)(1+\Pi)\right]^{t+1} - 1\right\}} \qquad (1)$$

Where, GFA_t^H and GFA_t^R are gross fixed asset at historical costs and replacement costs respectively and I_t is the real investment at time *t*.

We have used GFA thus obtained, after deflating it with the wholesale price index for machinery and machine tools, as plant and machinery accounts for 71 percent of the GFA (RBI Bulletin, 1990). Finally, in this study we have used gross fixed asset of the firm rather than net fixed asset.

A.2 Output and Value added

Output is deflated sales adjusted for change in inventory and purchase of finished goods. In Prowess database the purchase of finished goods is defined as finished goods purchased from other manufacturers for resale. Hence we subtracted purchase of finished goods from sales to arrive at the firms' manufactured output. A positive increase in inventory is added to sales to arrive at output and a decrease subtracted.

A.3 Materials

We follow Balakrishnan et al. (2000) methodology to construct the materials variable. The materials bill was deflated by a material input-output price index. The input-output coefficients for the year 2004-05 have been used as the weights to combine the whole sale prices of relevant materials. The input-output weights were obtained from the CSO's input-output table for 2004-05 and the relevant whole sale price index is obtained from the "Index of Wholesale Prices in India with base year as 1994=100, provided by MOSPI.

A.4 Labour

The PROWESS database provides information on wages and salaries of the firm and provides no information on the number of employees. Therefore, we need to use this information to arrive at the number of person engaged in each firm. Number of persons engaged in a firm is arrived at by dividing the salaries and wages at the firm level by the average wage rate of the industry (at the three digit level) to which firm belongs.

Number of persons engaged per firm =Salaries and Wages/Average Wage Rate

To arrive at the average wage rate we make use of the Annual Survey of Industries (ASI) data on Total Emoluments as well as Total Persons Engaged for the relevant industry.

Average Wage Rate = Total Emoluments/Total persons engaged

A.5 Energy

Following (Topalova, 2011) electricity expenses incurred by the firm is taken as a proxy for energy input variable. Prowess data reports the electricity expenses incurred by the firms as 'power and fuel expenses' in the database. The electricity expenses incurred by the firms are converted in real terms by the electricity whole sale price index with base 1993-'94.