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Abstract

The empirical evidence on learning by exporting is mixed. In this paper, we examine whether productivity growth among Indian exporters is higher than that of non-exporters. After controlling for self-selection into exporting, we do not find evidence for learning by exporting in a panel of manufacturing firms. There is also no evidence of heterogeneity in learning by exporting with regard to age, size, or productivity. The study finds that exporters grow bigger at a significantly higher rate than their domestic counterparts. But the growth in size does not appear to translate into growth in productivity after entry into foreign markets. Instead, exporters exhibit a boost in productivity 1 year prior to entering export markets.

Keywords: Exports, self-selection, learning by exporting (LBE), firm productivity

JEL Classification: F43, L1, D24

1. Introduction

Following Bernard et al. (1995), a growing body of empirical studies has shown that exporters are more productive than non-exporters. This empirical finding led to an increased interest in why this is the case. Melitz (2003) and Bernard et al. (2003) argued that only the most productive firms are induced to export since entering export markets is costly; therefore, better firms will self-select into exporting, which explains why exporters outperform non-exporters. However, policymakers have long believed that firms can learn by exporting through channels such as exposure to better technology and high quality products, heightened competition in foreign markets, and increases in scale of operations. This line of reasoning suggests that firms experience high productivity growth after entering export markets. Evidence in favor of self-selection of firms and/or learning by exporting (LBE) has important implications for the direction of policies to promote growth.

In this paper, we study the correlation between productivity and export status using a panel of 10,685 Indian manufacturing firms between 1990 and 2011. The promotion of exports has been a top priority of Indian policymakers over this period. Exports as a percentage of gross domestic product (GDP) increased from 6.8% in 1990 to 21.9% in 2011. During this period in which the Indian economy was deregulated, many firms switched from domestically oriented to exporter status. This transition among firms offers a great opportunity to conduct a laboratory-like experiment to study the pre- and post-entry performance of exporters, and compare that with the large pool of firms that chose to stay domestically oriented. Using this dataset, we test for self-selection using a simple probit regression, and use propensity score matching to test for LBE. The methodology is discussed in detail in section 4.

We find evidence for self-selection of more productive firms into exporting. New exporters are also found to be bigger and younger, and have higher wage bills, prior to entering foreign markets. We fail to find evidence for LBE. Many authors have argued that an insignificant post-entry effect might be due to heterogeneity in learning based on firm characteristics such as age and export intensity, or because firms might be investing in improving productivity prior to entering. We do not find evidence for heterogeneity in LBE, but do see that new exporters are learning to export prior to actually exporting.

The rest of the paper proceeds as follows. Section 2 reviews the evidence thus far on self-selection and LBE. Section 3 outlines the data and sample characteristics. Section 4 discusses the methodology we have used to study the learning effects of exporting and the results we obtained. Section 5 discusses the robustness tests. Section 6 concludes.

2. Empirical Research on Firm Productivity and Exporting

The empirical evidence for self-selection and LBE now spans many countries. Wagner (2007) reports that most studies have found evidence of self-selection, while the debate on post-entry productivity growth remains inconclusive.

The evidence for LBE from developed economies is mixed. Bernard and Jensen (1999) and Hung et al. (2004) for the United States (US), Delgado et al. (2002) for Spain, and Wagner (2002) and Arnold and Hussinger (2005) for Germany all find little or no evidence for LBE. On the other hand, Baldwin and Gu (2003) for Canada and Girma et al. (2004) and Greenaway and Kneller (2008) for the United Kingdom (UK) find evidence for both self-selection and LBE.

Evidence from emerging economies is also not unanimous across studies. Aw et al. (2000) show that while LBE is seen in Taipei,China, exporters in the Republic of Korea do not experience a boost in productivity after they begin to export. Isgut (2001) for Colombia, and Clerides et al. (1998) for Colombia, Mexico, and Morocco do not find evidence in favor of LBE. However, De Loecker (2007) for Slovenia, Van Biesebroeck (2005) for Sub-Saharan Africa, and Blalock and Gertler (2004) for Indonesia report post-entry increases in productivity for firms.

The lack of evidence for LBE has often been attributed to the argument that learning is specific only to a certain kind of firm, and studying average treatment effects can nullify these differences in learning. LBE has been found to be more pronounced for firms that (i) belong to an industry that has high exposure to foreign firms (Greenaway and Kneller 2008), (ii) are younger (Delgado et al. 2002), or (iii) have greater exposure to export markets (Kraay 1999; Castellani 2002). Another line of thought suggests that firms do not learn from exporting but learn to export. Alvarez and Lopez (2005) argue that productivity changes occur after making the decision to start exporting, and firms are likely invest in new technologies before entering foreign markets to be able to compete internationally. Iacovone and Javorcik (2012) find that firms improve quality exactly 1 year prior to entering export markets, while there is no upgrade after entry.

Recently, two studies have analysed self-selection and LBE for Indian firms. Tabrizy and Trofimenko (2010) use a sample of 1,822 firms from 1998 to 2008 and find evidence for self-selection but not for LBE. While this study uses simple regression techniques, we use propensity score matching to control for self-selection of firms. Ranjan and Raychaudhuri (2011) find evidence for both self-selection and LBE.

Though this paper also uses propensity score matching, our methodology and results are considerably different. First, this paper conducts analysis on continuing exporters while we study self-selection and learning effects among export starters. Our technique, discussed in section 4, defines export starters as firms that have been domestically active for at least 3 years prior to entering export markets, followed by at least 4 years of export activity.

Second, we match an export starter with a non-exporter in each year to control for any macroeconomic changes. Third, while we use an event study framework with bootstrapping to study the outcome variable at a 1-, 2-, and 3-year horizon from the date of entry into exporting, Ranjan and Raychaudhuri (2011) use “nnmatch” in Stata to calculate the average treatment effect for the treated (ATT). Also, our panel covers 10,685 Indian manufacturing firms from 1990 to 2011, while their sample is much smaller. Finally, while they find evidence for LBE, we do not find such evidence.

3. Data and Descriptive Statistics

We source firm-level data from the Prowess database provided by the Centre for Monitoring Indian Economy (CMIE). We restrict the analysis to manufacturing firms since their exporting activity is easily distinguishable. CMIE Prowess currently has data for 10,685 manufacturing firms dating back to 1990; however, data are sometimes not available or reported as missing. Table 1 provides the summary statistics of the data. There is a lot of heterogeneity in the data in terms of firm size, age, and capital intensity.[1]

In this sample, between 47% and 60% of the firms each year report positive earnings from exports. The mean export-value-to-domestic-sales ratio for the sample is stable at 12%–13% every year (Table 7). There are exporters in all industrial sectors, but there is considerable variation in the internationalization of each sector. In 2007, 59% of the firms in the chemicals industry, 66% in the transport equipment industry, and 71% in the nonelectrical machinery industry were exporting, while only 30% in the paper and pulp industry were exporting.[2]

3.1 Productivity Measurement

To measure firm-level productivity, we assume that the production function at the firm level is the logarithm of the Cobb-Douglas function:

$$Y_{it} = \beta_0 + \beta_1 k_{it} + \beta_2 l_{it} + w_{it} \quad (1)$$

where y_{it} represents the logarithm of firm output, k_{it} and l_{it} represents the logarithm of capital and labor, respectively, and w_{it} is the productivity component. But this equation cannot be estimated consistently using simple ordinary least squares (OLS) due to endogeneity problems. We use the semi-parametric estimator for total factor productivity developed by Levinsohn and Petrin (2003) (henceforth TFP-LP). This measure uses intermediate inputs as proxies to control for the correlation between input levels and the unobserved productivity shocks.

We estimate TFP-LP for each industry separately and use raw material expenses deflated by the Wholesale Price Index for Manufacturing firms (WPI-M) as a proxy. Output is calculated as the sales deflated by WPI-M, and capital is calculated as the gross fixed assets divided by WPI-M. Labor is estimated by deflating the total wage bill by the consumer price index for industrial workers. The productivity measure is made comparable across industries by demeaning the TFP-LP values of each firm by its industry mean (Petkova 2012). We use the Stata command *levpet* for the estimation.[3]

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1 Manufacturing companies in CMIE Prowess accounted for 79% of the total output in India's registered manufacturing sector in 2008–09. CMIE also has a well-developed "normalization" methodology that ensures inter-year and inter-firm comparability of accounting data. Many empirical papers for India have been written using this database, such as Bertrand et al. (2002), Ghemawat and Khanna (1998), and Goldberg et al. (2010). The reporting by firms is sometimes not continuous and can lead to problems of missing data.

2 The pattern is similar in all years.

3 The estimation in Stata, when gross revenue is the dependent variable, is discussed in Petrin et al. (2004).

3.2 Becoming an Exporter is Costly

We look at the transition probability of firms between exporter and non-exporter status from year t to $t+1$. In Table 2, 0 depicts non-export status and 1 depicts export status. There is significant on-diagonal mass (89.51 and 92.54), which means that since entering export markets is costly, firms do not easily switch from one status to another over a 1-year horizon. But there is also a non-zero probability of entering and exiting export markets. When a firms starts out as a 0, there is a 10.49% probability of moving into exporting. The probability of exiting from export markets is 7.46% over a 1-year horizon.

3.3 Superior Exporter Performance

The literature has established that exporters are different from non-exporters in important ways (Bernard et al. 1995). Following Bernard and Jensen (1999), we run the following specification:

$$Y_{it} = \alpha + \beta EXP_{it} + \gamma Controls_{it} \quad (2)$$

where y_{it} is the firm characteristic for firm i at time t. EXP_{it} is an export dummy equal to 1 if firm i reports positive earnings from exports in period t; $Controls_{it}$ includes the number of employees (wages deflated by the consumer price index for industrial workers [CPI-IW]), age, and ownership type. We also add industry, year, and location fixed effects. The β for different firm characteristics is reported in Table 3. It is clear that exporters are superior to non-exporters. They are bigger, have higher wage bills, sales, and investment, and are also more productive than non-exporters.

But as discussed earlier, the superior performance of exporters could be due to either one of two reasons: self-selection or LBE. Self-selection suggests that more productive firms are more capable of incurring the sunk costs of exporting, and hence enter foreign markets. This theory suggests that the superior performance of exporters is due to their inherently higher productivity. But as firms enter foreign markets, they are likely to acquire knowledge with respect to technology, corporate governance, and economies of scale, and hence perform better than non-exporters. We test these two hypotheses in the following sections.

4. Results

Studying self-selection and LBE is not a trivial matter since the two hypotheses create a two-way causality between firm performance and export status. Self-selection looks at the pre-entry characteristics of exporters as compared to non-exporters, and LBE looks at the post-entry performance of export starters in comparison to non-exporters.

In our sample, there is both an inward and outward movement of firms from export markets. Moreover, about 4,139 firms report discontinuously, and as many as 1,301 enter and exit the export market at least once. We factor these issues into our analysis

and define an export starter and a non-exporter using a clean trajectory definition. A firm is considered an export starter if it reports no export earnings for at least 3 consecutive years prior to a transition into exports and remains in the export market for at least the next 4 years. A firm is a non-exporter if it reports no earnings from exports for 7 or more consecutive years. We have 527 export starters and 1,695 non-exporters using this definition.

4.1 Self-Selection

To study the self-selection effects, we look at how firm characteristics in $t-1$ affect the probability to export. Here $START_{it}$ is the dependent variable. It is a dummy variable equal to 1 when firm i begins to export in year t, and 0 otherwise. Since the dependent variable is binary, we use a probit specification as follows:

$$Pr(START_{it} = 1) = F\,(Productivity_{it-1}\,,\, size_{it-1}\,,\, wagebill_{it-1}\,,\, ownership_{it-1}\,) \qquad (3)$$

where $F(.)$ is the normal cumulative distribution function. We control for productivity, size of the firm,[4] the wage bill (as a proxy for skill of the labor force), and ownership type in $t-1$. To control for industry specific comparative advantage and the proclivity to internationalize, we add industry fixed effects. We also add year fixed effects to control for macroeconomic changes. All variables are in logarithmic form.

The results of the probit, shown in Table 4, indicate that the probability of beginning to export increases as the productivity, size, and wage bill of the firm increases, and decreases as the age of the firm increases. Thus, firms with better characteristics in $t-1$ are more likely to enter the export market or self-select into exporting.

4.2 Do Firms Learn by Exporting?

To study the causal impact of exporting on firm performance, we need to evaluate the $w_{is}^{\,1} - w_{is}^{\,0}$, where w is the firm productivity for firm i at time s, and the superscript is equal to 1 when firm i exports and 0 when it is a non-exporter. But for an exporter, we do not observe $w_{is}^{\,0}$ (i.e., the outcome had it not exported). Hence, we need to create a counterfactual to estimate the firm productivity of exporters had they not exported. Since exporters are *a priori* better than non-exporters, we need to match the export starter to a similar non-exporter in the year prior to the year of entry. We use propensity score matching (Rosenbaum and Rubin 1983) to control for this self-selection and construct a counterfactual for the exporting firms.[5]

The export starters, as defined at the beginning of this section, form the treatment group and the non-exporters form the control group. The model discussed in section 4.1 gives the propensity to export for all firms in the treatment and control groups. We use this propensity score to do nearest-neighbor matching with replacement in each year such that if P_{it} is the predicted probability of entry at time t for firm i (a firm in the treatment

[4] Size is defined as the log of total assets.

[5] Girma et al. (2004) and De Loecker (2007) use a similar methodology for the UK and Slovenia, respectively, to study LBE.

group), a non-exporter j is chosen as its matched partner if its probability to enter export markets is closest to P_{it} among all non-exporters in year t.[6] We use a caliper matching method to ensure a region of common support. If we do not find a close-enough control unit for a treated firm, we drop the firm from subsequent analysis. We get 242 matched pairs using this technique. Table 5 shows the number of firms in the control group and treatment group, and the number of matched pairs in each year.

The caliper matching ensures that we get good matches; that is, the difference in propensity scores of a treated firm and its counterfactual is not substantial. Table 6 shows the match balance statistics. We use the standardized difference and Kolmogorov–Smirnov test (K–S test) to check if the treatment and control groups are significantly different based on the calculated propensity scores and firm characteristics in the year prior to treatment. We achieve good match balance with the distribution of the propensity score, productivity, size, and wage bill being very similar in both groups after matching. For example, the standardized difference for propensity score before matching is 0.71 and almost 0 after matching. Similarly, in the K–S test, while the p-value is 0 before matching, it is almost 1 after matching for the propensity score, showing that the distribution for the treated and the corresponding control firms is not significantly different.

For the matched pairs, we calculate the following statistic

$$LBE_S = \quad (\delta w_{is} - \delta w_{js}) \tag{4}$$

where *i* is the treated firm, and *j* is the corresponding matched control firm; $s = -3, -2, -1, 0, 1, 2, 3$ is the rescaled time where 0 is the time at which a treated firm starts exporting; and δw is the change in productivity of the firm. We bootstrap[7] this statistic to obtain significance at the 95% level.[8] We then plot the bootstrapped difference-in-difference (DID) statistic and check if it is significantly different from zero.

4.2.1 Learning by Exporting?

Figure 1 shows the impact of exporting on productivity for the event window –3 to 3. On the aggregate, we do not see LBE since the difference in productivity growth of the treated and the control firms (black line in the graph) is not significantly different from zero at a horizon of 1, 2, and 3 years after treatment date.

4.2.2 Heterogeneity in Learning

The above analysis only considers learning as an average treatment effect across all matched pairs. But as discussed in Section 2, learning can vary across firms based on

[6] We do the matching in each year to control for macroeconomic effects. The year of treatment is the year in which the treated firms transitions from non-exporter to exporter status. This treated firm is matched with a firm from the control group in the same year as the year of treatment.

[7] We calculate the average treatment effect as described in Becker and Ichino (2002) and find that our results (discussed later) still hold.

[8] We use package event studies to convert our data from real time to event time and bootstrap the statistic. Available at http://cran.r-project.org/web/packages/eventstudies/

certain characteristics. In this section, we explore if learning is heterogeneous and what firm characteristics are correlated with high learning effects.

We divide matched pairs into quartiles based on firm characteristics in the period before entry (t -1). The three variables we consider are age, size of the firm, and productivity level. For the matched pairs in each quartile, we study the difference in productivity growth of the matched pairs.

Figures 6, 7, and 8 in the Appendix show that for quartiles by each firm characteristic, there is no LBE at a horizon of 1, 2 and 3 years; that is, the difference in productivity growth of the matched pairs is not significantly different from zero. However, for quartile 1 w.r.t. productivity, there is a significant difference in the productivity of treated and control firm 2 years after entering export markets. This shows that firms in the lowest productivity quartile learn by exporting. For quartiles 3 and 4 w.r.t. productivity and quartile 3 w.r.t. size, the productivity growth of treated firms is significantly higher than that of the control firms. This shows that firms prepare to export and hence experience a boost in productivity.

4.2.3 Learning to Export

An alternate explanation for not observing LBE is that firms learn to export. Figure 2 shows the productivity trajectory of export starters, before and after they become exporters. We see that firms that become exporters experience a significant rise in productivity 1 year prior to entering foreign markets. This suggests that firms prepare themselves to enter foreign markets; that is, they learn to export.

4.2.4 Growth in Size

We calculate the statistic in equation (3) for the size of firms. In Figure 3 we see that treated firms have a significantly higher growth rate in terms of size both prior to and after entering foreign markets. It is interesting, that prior to entry, the DID is increasing, suggesting again that firms prepare themselves for entry into foreign markets. After entry, the growth is positive but the DID is on a downward trend.

5. Robustness Tests

To check the robustness of our results, we perform the following tests detailed in this section.

5.1 Stronger Trajectory Definition

Similar to the definition of treatment and control groups in section 4, we now consider a firm in the treatment group if after 4 years of being a non-exporter, the firm becomes an exporter and remains one for at least the next 4 years. Similarly, a firm is in the control group if it was a non-exporter consecutively for at least 9 years. We repeat all the above steps with our new treatment and control group and get 140 matched pairs.

Figure 4 shows that even with a stronger trajectory definition, we do not observe any LBE. However, the treated firms grow at a considerably higher rate than the controls at a horizon of 1 and 2 years after entry.[9]

5.2 Labor Productivity

As an alternate measure of productivity, we follow Tabrizy and Trofimenko (2010), who use the same dataset to build a proxy for labor productivity. Data for the number of employees is often missing as it is not mandatory for firms to report this series. Hence, we use the wage bill as a proxy for labor input. We calculate labor productivity as follows:

$$log(\varphi_{it}) = log(VA_{it}) - log(W_{it}) \quad (5)$$

where, φ_{it} *represents* labor productivity; VA_{it} is the firm-level value-added, computed as total sales minus power and fuel expenditures, and raw material expenses; and W_{it} is the total wage bill.

We get 240 matched pairs in this case and the results are shown in Figure 5. Here too, we see that firms are not learning from exporting at a horizon of 1 and 2 years after beginning exporting. However, at a 3-year horizon, the DID is significantly different from zero. This is different from our earlier result (Figure 1), which could be because labor productivity does not account for the switch from being labor intensive to capital intensive. Also, the treated firms are growing bigger at a significantly higher rate than the controls.

Our results are robust to other alterations to the empirical strategy defined in Section 4, such as matching firms in the same industry and in the same year, or tightening the caliper, or changing the probit model.

6. Conclusion and Policy Implications

This paper examines the reasons for the differences in the performance of exporters compared with non-exporters. While we do find that more productive firms self-select themselves by participating in foreign markets, our analysis does not provide evidence of LBE. Learning is also neither heterogeneous nor specific to a certain kind of firm. However, we do find preliminary evidence of learning to export. The productivity of exporters increases significantly in the period prior to their entry into foreign markets, suggesting that firms learn to export ahead of actually entering export markets. This is a particularly interesting result, and further research can shed light on the investment decisions taken by firms prior to exporting.

[9] These results also hold if we weaken the trajectory definition and define export starters as those who after being a non-exporter for more than 2 years have been an exporter for at least 1 year.

For policymakers, these findings are important. Evidence in favor of self-selection among firms and learning to export suggests that policies should focus on (i) enabling firms to improve their productivity by reducing the distortionary costs of government intervention, (ii) investing in infrastructure, and (iii) promoting investment in R&D. The higher the productivity of firms, the more likely they are to export and compete in global markets. Also, since we find that firms grow faster after entering export markets, the gradual increase in market share of these firms forces less-productive firms to exit. This reallocation of resources toward more productive firms can propel growth in an economy (Melitz 2003). Moreover, the lack of evidence in favor of LBE suggests that trade missions and trade liberalization alone cannot lead to growth in firm productivity. Thus, the focus of policy should be to push for a more conducive environment for business to reduce their costs of operation. This can lead to increased global competitiveness and the overall growth of the economy.

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Table 1: Summary Statistics (Rs million)

	Min	0.25	Median	Mean	0.75	Max
Sales	0	82	308	2,680	1,072	3,579,000
Gross fixed assets	0	46	144	1,354	509	2,213,000
Total assets	0	77	240	2,370	871	2,849,000
Wage bill	0	4	16	119	59	62,410
Exports	0	0	0	304	38	1,405,000
Raw material expenses	0	41	157	1,281	542	1,932,000
Power expenses	0	3	11	111	45	42,080

Note: While the maximum sales are Rs 3,579 billion, the mean sales are only Rs 2,680 million. The distribution for all variables is positively skewed. This indicates that there are a large number of small firms in the dataset.

Source: Authors' computations based on the Prowess database of the Centre for Monitoring Indian Economy (CMIE).

Table 2: Transition Probability from *t* to *t* + 1

	0	1
0	89.51	10.49
1	7.46	92.54

Source: Authors' computations.

Table 3: Are Exporters Different?

LHS Variable	Beta
Gross fixed assets	1.11 (0.036) ***
Wages	1.34 (0.033) ***
Sales	1.56 (0.039) ***
Investment	1.08 (0.07) ***
Total assets	1.22 (0.034) ***
Total factor productivity	0.05 (0.007)***

Notes:
1. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
2. Robust clustered standard errors are reported in bracket.

Source: Authors' computations.

Table 4: Self-Selection

	Estimate	Standard Error	p-value
$Prod_{it-1}$	0.33	0.10	0.00
Age_{it-1}	-0.01	0.00	0.00
$Size_{it-1}$	0.14	0.04	0.00
$Wage\ Bill_{it-1}$	0.18	0.04	0.00

Source: Authors' computations.

Table 5: Matched Pairs (year-wise)

Year	Number of Controls	Number of Treated	Matched Pairs
1996	22	4	1
1997	26	3	1
1998	41	2	2
1999	80	6	4
2000	98	7	6
2001	373	28	24
2002	495	32	29
2003	507	24	20
2004	536	42	36
2005	568	33	27
2006	696	36	32
2007	709	37	36
2008	427	24	24
Total	**4,578**	**278**	**242**

Notes: Since we impose a caliper, we get matches for a fewer number of treated firms than the total firms in the treatment group. For example, in 2006, the number of treated firms is 36, but we get matches for only 32 firms. This leads to a loss in data, but we get a better match balance and can do a more robust analysis for the outcome variable.

Source: Authors' computations.

Table 6: Match Balance

Standardized Difference

	Before Matching	After Matching
Propensity Score	0.71	-0.00
$TP_{i,t-1}$	0.35	0.06
$Log(Size)_{i,t-1}$	0.66	0.00
$Log(Salary)_{i,t-1}$	0.63	-0.01

Kolmogorov–Smirnov Test

	Before Matching	After Matching
Propensity Score	11.7642	-0.003
	(0)	(0.9976)
$TFP_{i,t-1}$	5.6283	0.5649
	(0)	(0.5724)
$Log(Size)_{i,t-1}$	14.6315	0.0191
	(0)	(0.9848)
$Log(Salary)_{i,t-1}$	10.5527	-0.1639
	(0)	(0.8698)

Notes: The values in brackets are p-values. Both tests show that before matching treated and control firms are significantly different in terms of firm characteristics, while after matching they are similar.

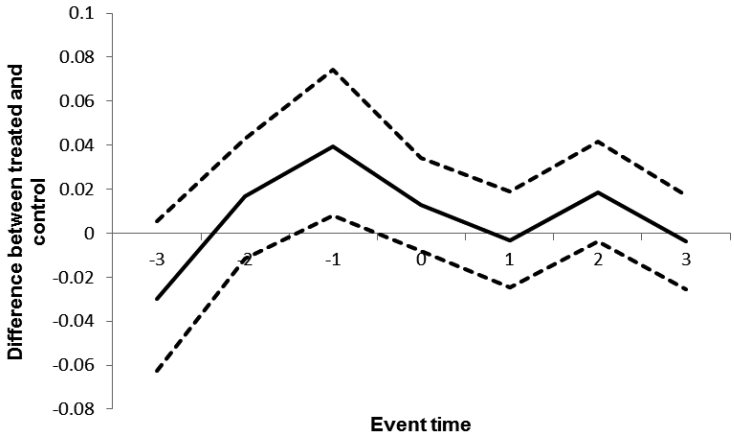
Source: Authors' computations.

Table 7: Export Statistics by Year (%)

Year	Exporters	Mean Export Sales
1990	52.51	9.38
1991	50.56	11.26
1992	53.06	12.46
1993	52.08	14.61
1994	52.31	17.95
1995	52.14	19.52
1996	54.11	20.84
1997	54.81	21.45
1998	53.55	21.69
1999	50.92	21.89
2000	49.47	21.59
2001	50.55	22.67
2002	49.70	22.91
2003	49.08	24.68
2004	49.17	24.04
2005	47.66	24.45
2006	48.54	24.13
2007	49.61	24.43
2008	50.72	23.63
2009	51.11	24.49
2010	51.32	23.15
2011	60.65	21.36

Source: Authors' computations based on the Prowess database of the Centre for Monitoring Indian Economy (CMIE).

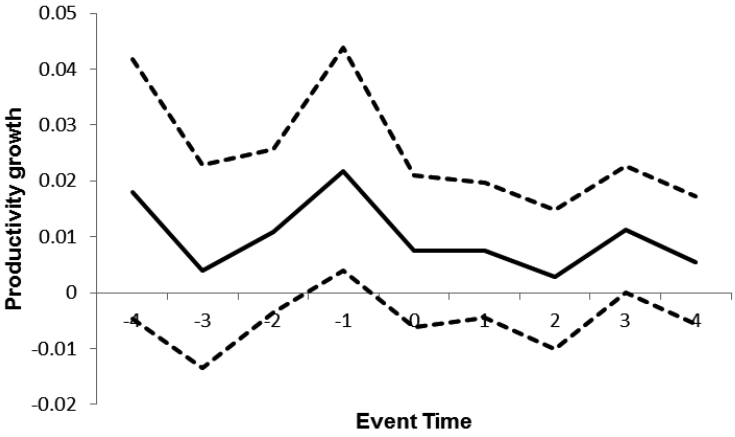
Figure 1: DID for Productivity



Notes: The black line in the graph is the estimate of the statistic calculated using equation (3). The dotted lines depict the 95% confidence interval. 0 on the x-axis is the year of treatment. The horizontal line is a reference line indicating no statistically significant difference between the control and treated firms.

Source: Authors' computations.

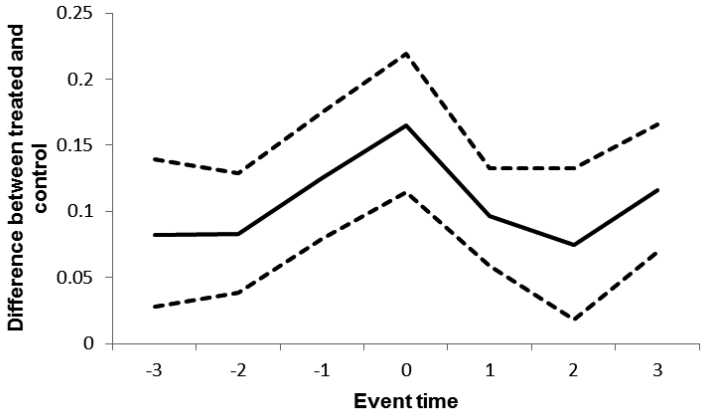
Figure 2: Productivity Growth of Treated Firms



Note: As per Figure 1.

Source: Authors' computations.

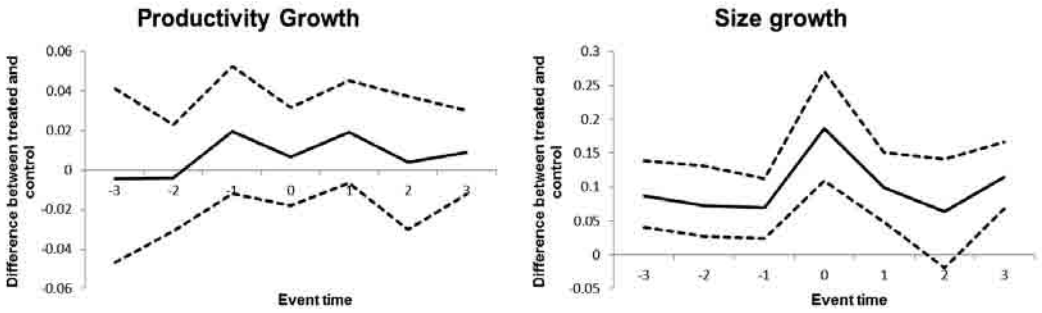
Figure 3: DID for Size



Note: As per Figure 1.

Source: Authors' computations.

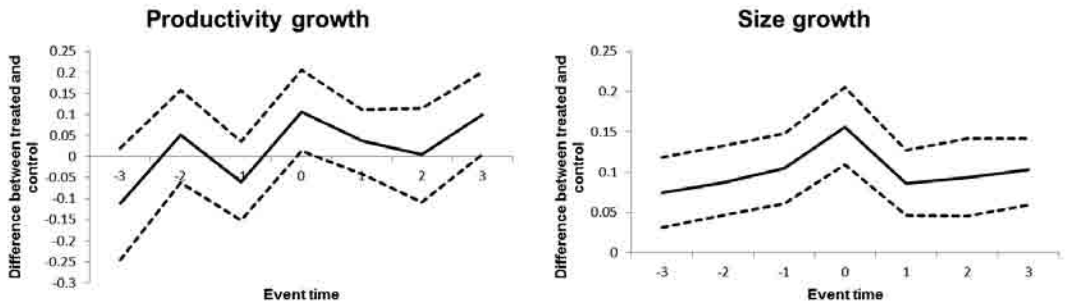
Figure 4: Stronger Trajectory Definition



Note: As per Figure 1.

Source: Authors' computations.

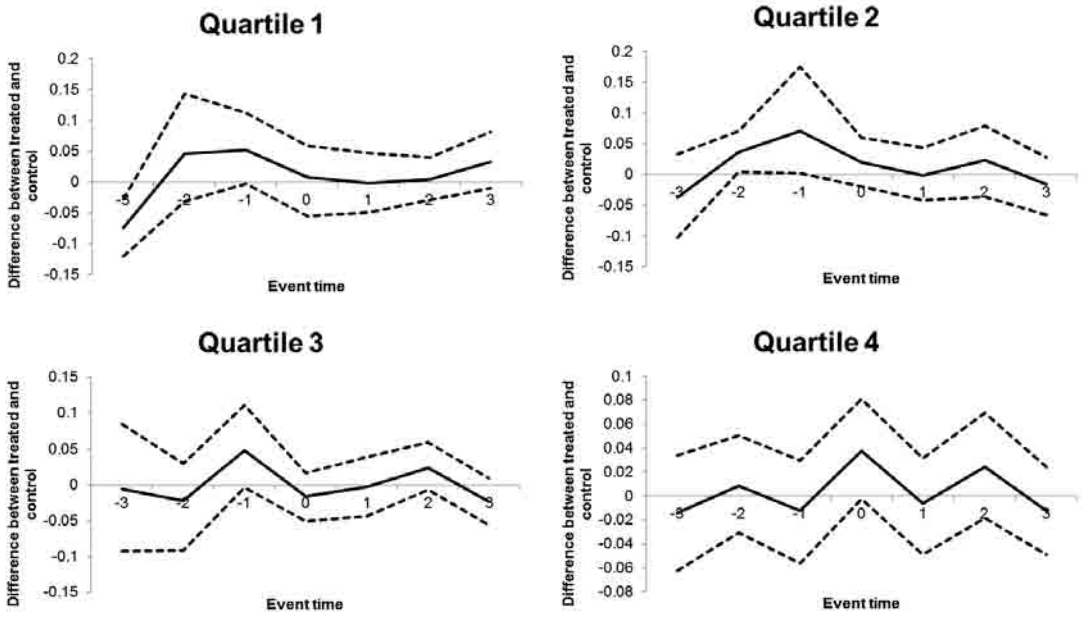
Figure 5: Labor Productivity



Note: As per Figure 1.

Source: Authors' computations.

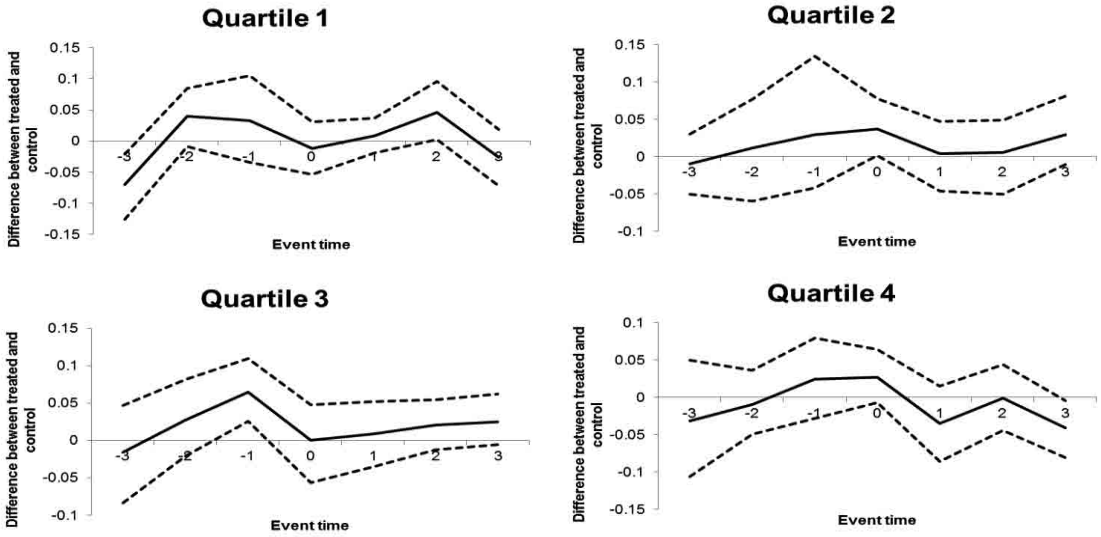
Figure 6: Firm Age



Note: As per Figure 1.

Source: Authors' computations.

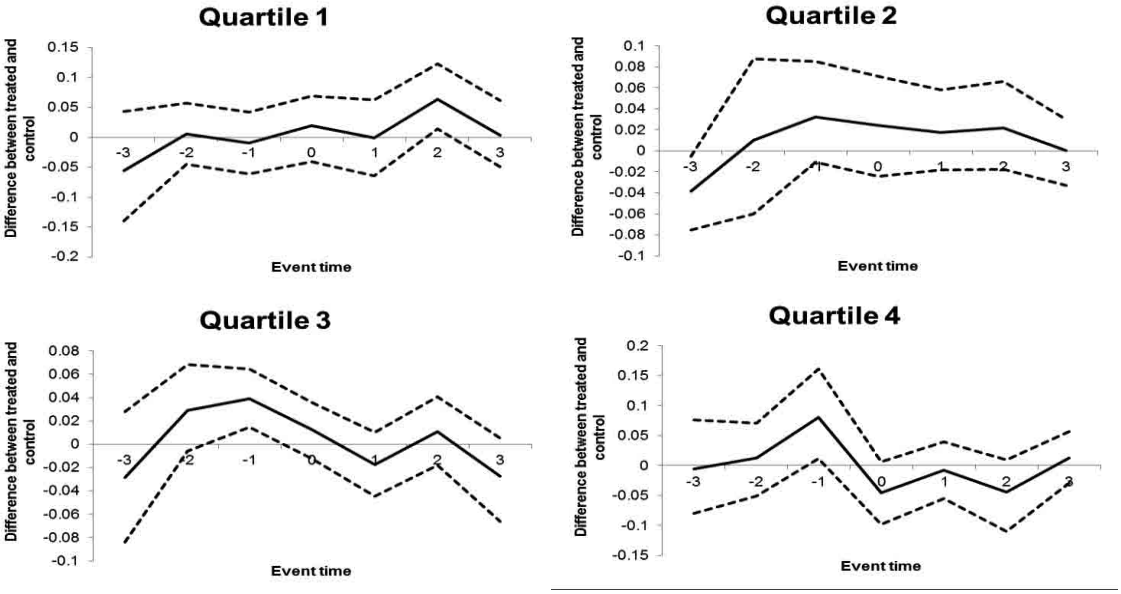
Figure 7: Size



Note: As per Figure 1.

Source: Authors' computations.

Figure 8: Productivity



Note: As per Figure 1.

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