Exporting/Importing and Firm Performance: Evidence from India

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Abstract

Contents

1 Introduction **3**

2 Literature Review **4**
2.1 Importing and Productivity . . . 4
2.2 Exporting and Productivity . . . 5
2.3 Cost Complementarity between Exporting and Importing . . . 5
2.4 Productivity Estimation . . . 6

3 Data **6**

4 Descriptive Statistics **7**
4.1 Self-Selection . . . 7
4.2 Trade Premia . . . 8
4.3 Complementarity between Exporting and Importing . . . 8
4.4 Productivity and Export/Import . . . 9
4.5 Sunk Cost (Transition Probability) . . . 10

5 Preliminary Analysis **11**
5.1 Learning-by-doing . . . 12
5.1.1 Levinsohn-Petrin . . . 12
5.2 Ackerberg, Caves, and Frazer 2006 . . . 13
5.2.1 Self Selection and Sunk Cost hypothesis . . . 13
5.3 Complimentarity between exporting and importing(Lagged and Simultaneous) . . . 16
5.4 Conclusion . . . 17

6 Model **18**
6.1 Static Decision . . . 18
6.2 Transition of Productivity . . . 20
6.3 Dynamic Model . . . 20

7 Estimation **21**

8 Appendix **22**
8.1 Productivity Estimation (OP,LP,ACF) . . . 22
8.1.1 Olley and Pakes 1992 (OP) . . . 22
8.1.2 Levinsohn and Petrin 2003 (LP) . . . 23
8.1.3 Ackerberg, Caves, and Frazer 2006(ACF) . . . 24
8.2 Dynamic Random Effects Probit Model . . . 25

1 Introduction

There is vast literature which states that exporters/importers tend to out-perform non-exporters/non-importers in terms of wages, capital, productivity. Bernard and Jensen 1999 say that this can be due to these reasons:

- export/import increases productivity (Self-selection)
- productivity increases export/import (Learning by doing)

Self-selection (SS) hypothesis states that more productive firms self-select into export as participation in the trade market is accompanied by additional costs such as transport costs, establishing a distribution channel, cost of traversing bureaucratic channels etc. This means that there are substantial sunk costs to participating in the trade market. Therefore, firms which are more productive enter the export market.

Learning-by-doing hypothesis for exporting (Haidar 2012) states that exporting firms deal with tougher competition in the international market as compared to the domestic market, and therefore must improve their performance to remain active in the export market. Moreover, participating in the international market leads knowledge flows from international buyers to help post entry performance of export starters. This means that exporting should cause productivity spillovers as well.

The same hypothesis (self-selection and learning-by-doing) can apply to import behavior of firms. Since importing also involves additional similar costs like additional taxes, transport costs, import duties etc. , firms that are more productive will enter the import market. Also, a firm participating in the import market can have access to higher quality of intermediated goods. Topalova and Khandelwal 2011 and Halpern, Szeidl, et al. 2011 find that improved access to foreign technology can boost productivity.

Since participating in the export/import market involve sunk costs, therefore, firms that are the most productive must self-select themselves into participating in both export and import market. Also, it would be interesting to see if participating in one activity affects participation in the other (i.e Complementarity between exporting and importing). I plan to investigate whether there are benefits of importing to exporting and vice-versa by estimating the cost complementary nature between the two.

India provides an interesting case as it liberalised its economy in 1992 which resulted in import tariffs, deregulation of markets, reduction of taxes, and greater foreign investment. According to Topalova and Khandelwal 2011, *the government's trade policy under the Eighth Five-Year Plan (1992-97) ushered in radical changes to the trade regime by sharply reducing the role of the import and export control system. The share of products subject to quantitative restrictions decreased from 87 percent* *in 198788 to 45 percent in 1994-95, and the actual user condition on imports was discontinued. And since 1997, the decrease in output and input tariff has been very marginal.*

So, my reasearch plan is to investigate:

- Self-selection hypothesis: Check whether more productive firms participate in the expprt/import market
- Learning-by-doing hypothesis: Check if there are productivity spillovers from participation in the export/import market
- Estimate the fixed and sunk costs of participation in the export/import market and the decrease in costs due to the complimentary (simultaneous and lagged) nature between the two
- Run counter-factual experiment to see the effect of decrease in the costs to exporting/importing.

2 Literature Review

Most papers on this can be differentiated into three different categories:

1. Importing and Productivity
2. Exporting and Producitivity
3. Complimentarity between exporting and importing and its effect on productivity

In this section, I write down the major literature contributions towards my topic.

2.1 Importing and Productivity

If a firm resorts to importing inputs, then it can have access to higher quality of intermediate goods and might pave the way for future exporting by increasing the productivity or by providing cost-complementarity between the two activities.

Halpern, Szeidl, et al. 2011 studies effect of imports on productivity by estimating a structural model of importers in a panel of Hungarian firms. They find that imports have a significant and large effect on firm productivity, about one-half of which is due to imperfect substitution between foreign and domestic goods.

Topalova and Khandelwal 2011 find that the pro-competitive effects of the tariffs led firms to become more efficient, the larger impact appears to have come from increased access to foreign inputs.

2.2 Exporting and Productivity

Most studies find that there is self-selection of more productive firms into exporting, however there is mixed evidence for learning-by-exporting.

Aw, Mark J. Roberts, and Xu 2011 estimate a dynamic structural model that captures both the behavioral and technological linkages among R&D, exporting, and productivity. They find that Relative to a plant that does neither activity, export market participation raises future productivity by 1.96 percent, R&D investment raises it by 4.79 percent, and undertaking both activities raises it by 5.56 percent.

Bernard and Jensen 1999 test the self-selection and learning-by-doing hypothesis of exports on firms. They find that Good plants become exporters i.e. learn to export. and find that exporting increases the survival probability but it does not contribute towards productivity growth.

Mark J Roberts and Tybout 1997 quantify the effect of prior exporting decision on the current exporting decision and test the sunk cost hypothesis of these activities. They develop a dynamic discrete- choice model of exporting behavior that separates the roles of profit heterogeneity and sunk entry costs in explaining plants' exporting status and find that sunk costs are significant as prior export experience increases the probability of exporting by 60 percent.

In terms of work in this field with Indian firm level data, Haidar 2012 and Gupta, Patnaik, and Shah 2018 find evidence of self-selection of more productive firms into exporting, but they do not find evidence of learning-by-exporting.

2.3 Cost Complementarity between Exporting and Importing

As far as I am aware, there have been two major papers in this field i.e Aristei, Castellani, and Franco 2013 and Kasahara and Lapham 2013.

Aristei, Castellani, and Franco 2013 estimate a bivariate probit model to understand the two-way relationship between exporting and importing. Thy suse firm-level data for a group of 27 Eastern European and Central Asian countries from the World Bank Business Environment and Enterprise Performance Survey (BEEPS) over the period 20022008, and after controlling for size (and other firm-level characteristics), find that firms exporting activity does not increase the probability of importing, while the latter has a positive effect on foreign sales.

Kasahara and Lapham 2013 estimate a stochastic model of exporting and importing that incorporates heterogeneity in transport costs and estimate export and import complimentarities between the two trade activities. They find that policies which inhibit the importation of foreign intermediates can have a large adverse effect on the exportation of final goods.

Another research paper in this field, Muûls and Pisu 2009 find that productivity advantage of exports towards non-exporters may be overstated in the current literature, because imports were not taken into account as well as exports.

2.4 Productivity Estimation

Productivity estimation in all of the papers mentioned is done using the methods highlighted below: Olley and Pakes 1992,Levinsohn and Petrin 2003, Ackerberg, Caves, and Frazer 2006 and Wooldridge 2009. These papers take inspiration from one another and the difference in estimation mentioned in these papers is very minimal. These methods have been explained in section 8.1

With regards to productivity estimation, De Loecker 2013 highlights the importance of endogenising the export decision in the minimisation problem of the productivity estimation.

3 Data

I use annual firm level data from Centre for Monitoring Indian Economy (CMIE) which provides data from 1989 to 2017.

I fetch the following variables from CMIE:

Table 1 shows the variables and their meaning. I chose the variables which might be the most pertinent to my research question. The variables stated above are nominal values. I fetch Wholseale Price Index (WPI), which provides the inflation rate of the wholesale prices and deflate the variables to give real values. Then, I clean the data to remove missing values and select firms with the broad industry classification code indicating that they are a manufacturing firms. Table 2 shows the composition of firms by year:

I restrict the time period of the study from 2001 to 2016. Since, firms are under no legal obligation to report their finances, this might mean that small firms are less likely to report their finances. Therefore, I do not analyse the effect of export/import on the survival probability of the firm and do not consider the entry/exit decision of a firm. However, this dataset includes all publicly listed firms as their firm financials are public information. This might affect the results as the dataset is biased towards bigger firms.

I create two additional variables *Export*, *Import*, *Domestic Sales* by adding the following variables from the Table 1.

1. Export: sa_export_goods + sa_export_serv
2. Import: sa_import_rawmat + sa_import_stores_spares + sa_import_fg +sa_import_cap_goods
3. Domestic Sales: Total Sales - Export Sales

Then, I create four dummy variables of trade market participation using the *Export* and *Import* variables:

- None: Firms that do not participate in the export/import market
- Export only: Firms that participate in the export market only
- Import only: Firms that participate in the import market only
- Both: Firms that participate in both export/import market

Table 3 displays the composition of firms according to their trade market participation status. It is seen that number of firms that do not participate in the trade market is low, around 20 to 35 %. Surprisingly, the number of firms that participate in the trade market is really high. Another interesting feature is that the number of firms that participate only in the import market is higher than the firms that participate only in the export market. This must mean that the demand for foreign intermediaries is really high. Almost 50 % of firms in each year participate in both export/import market. It is also seen that the participation rate in the trade is not increasing year on year.

4 Descriptive Statistics

4.1 Self-Selection

As a first step to see if more productive firms self-select into participating in the trade market, I calculate the mean and standard deviation and create the density plots for log of sales, gross fixed assets, salaries and expenditure on power and fuel for firms with different trade activity status. Tables 4, 5, 6 and 7 the results for the variables mentioned above. It can be seen that firms that participate in the trade market have a distribution that is more skewed towards the right for all the variables mentioned above. In the case of sales, firms that do not participate in the trade market have a mean of 5.52 whereas firms that participate in either export or import have a mean value of 6.86 and 6.82 respectively. Also, firms that participate in both export/import have higher mean of 7.74. It is also seen that firms that participate in the both export/import market have higher mean gross fixed assets, salaries, expenditure on power and fuel than firms that participate in only export and only import. On the other hand, the standard deviation in all the cases is very similar. This indicates that firms participating in the trade market has an positive effect on the observable characteristics of the firm.

4.2 Trade Premia

Trade premia is defined as the difference in attributes of firms based on their trade participation status. I estimate the trade premia using the following regression:

$$X_{it} = \alpha + \beta_1 d_{it}^X + \beta_2 d_{it}^M + \beta_3 d_{it}^X * d_{it}^M + \beta_4 age_{it} + \epsilon_{it}$$

where X_{it} is firm level characteristics such as Sales, Gross Fixed Assets, Expenditure on Raw Material and Salary, d_{it}^X is the export dummy,d_{it}^M is the import dummy, the interaction term between these two variables and age_{it} is the age of the firm. I estimate this equation using fixed-effects regression controlling time fixed effects. Table 8 displays the results for the above regression.

It is seen coefficients for both export and import dummy are positive and significant at 1% significance level. This means that firms that participate in the export/import market have more capital and assets and spend more on salary and raw materials than firms that do not participate in the trade market. The interaction term between the export and import dummy is very low in two cases and not significant in the other two. This means that firms that participate in the both export and import have higher sales,assets etc. than firms that participate in one of these trade activities. The age variable also has a positive coefficient and is significant at 1% significance level. Therefore, the older a firm becomes the higher its capital, assets etc. become.

This section verifies the presence of trade premia in our dataset. In the next section, I descriptively check whether exports have an effect on vice-versa.

4.3 Complementarity between Exporting and Importing

The difference between density plots of exporting firms that only participate in the export market and firms that participate in import market will help give an idea whether there is an effect of one activity on the other. Table 9 displays the export value for firms that participate only in the export market and for firms that participate in both export/import market.

It is seen in Table 9 that firms that participate in both the export/import market have a higher mean of exports (5.24) than firms that only participate in the export market (3.56). This suggests that importing has a positive effect on exporting such that the firms export more than they would if they did not participate in the import market.

Table 10 displays the import value for firms that participate only in the import market and for firms that participate in both export/import market. It is seen in Table 10 that firms that participate in both the export/import market have a higher imports (4.95) than firms that only participate in the import market (3.41) . This suggests that exporting has a positive effect on importing firms.

Tables 9and 10 suggest that both these activities have a positive effect on the other and this might be because importing complements exporting and vice-versa. Therefore, there is correlation between these activities that needs further research.

I estimate the trade premia on exporting value of the discrete decision to import and vice-versa. This is done by estimating the following equation:

$$ln(Export)_{it} = \alpha + \beta_1 d^M_{it} + +\beta_2 age_{it} + \epsilon_{it}$$

$$ln(Import)_{it} = \alpha + \beta_1 d^X_{it} + \beta_2 age_{it} + \epsilon_{it}$$

The first two columns of table 11 display these results. It is seen that the discrete decision to import has a positive and significant effect on the value of imports such that the discrete decision to participate in the import market increases the value of export by 0.506 . The discrete decision to export also has a positive and significant effect on the quantity of imports by increasing the value of imports by 0.458. This further suggests the presence of complementarity between exporting and importing.

In the next section, I investigate if exporting/importing contribute towards rough measures of productivity.

4.4 Productivity and Export/Import

Gupta, Patnaik, and Shah 2018 define a rough measure of productivity known as *capital productivity*. It is defined as the log of value added per unit of capital used by a firm:

$$log(VA_{it} - log(K_{it}))$$

where VA_{it} is firm-level value added, computed as total industrial sales plus change in stock minus power and fuel expenditures, and raw material expenses. Table **??** displays the summary statistics for this variable based on the trade activity status. It can be seen that mean of capital productivity increases as activity status moves from *None* to *Export only/Import only* to *Both*, whereas the standard deviation also decreases.

Table 12 displays the summary statistics of Profit to Sales based on a firms trade market status. Profit to sales is calculated by dividing the profit after tax with sales. This measure can be interpreted as a profitability measure. It is seen in table 12 that participating in the trade market increases the profit to sales ratio by 0.17. Firms that do not participate in the trade market have a very high standard deviation of profit to sales. It is also interesting to see that mean profit to sales ratio in every case is negative.

I also use another rough measure of productivity i.e *Profit to Sales* which is calculated by dividing the profit of a firm with its sales. Table 13 shows the summary statistics for this variable.

The same pattern is observed for these variable as well. The mean of these values increases from -0.1 when a firm is not participating in the trade market to -0.03 and -0.06 when a firm is participating in import and export respectively to 0.01 when a firm is participating in both of the trade market activities.

The last two columns of table **??** estimate the trade premia for the crude measures of the productivity defined above i.e Capital Productivity and Profit-to-sales ratio. It is seen that both of the crude measures of productivity react positively to the discrete decisions to import and export. The discrete decision to participate in the export market increases the capital productivity by 0.159 and profit to sales ratio by 0.061. The discrete decision to import increases the capital productivity by 0.097 and profit to sales ratio by 0.021. Moreover, since the interaction term is really low in one case and is not significant in the other. This means that participation in both activities leads to higher productivity than participation in one activity.

4.5 Sunk Cost (Transition Probability)

Table 14 displays the transition probabilities observed in the data to see whether there is persistence in trade activity behavior. It is seen that there are very high levels of persistence from *None* in t-1 to *None* in t and from *Both* in t-1 to *Both* in t. This means that there must be high sunk costs to enter in the export/import market since only 12% of the firms that do not participate in the trade market in t-1 start participating in the trade market in t. The high levels of persistence in *Both* must mean that this mechanism benefits the firms in a lot of ways. The levels of persistence in *Import Only* and *Export Only* is not as high. A large portion of firms switch to participating in both the trade market activities.This can mean that participating in the export in time period in t-1 complements participating in the export market in period t and vice-versa. Also, the number of firms that flip-flop (i.e switch trade market status) is low, which provides further evidence that there are fixed costs to participating in the stock market as well.

This section provided descriptive evidence that firms that participate in the trade market are bigger (Trade premia), have higher productivity than firms that do not participate in the trade market. It provide evidence that exporting firms export more if they participate in the import market as well and vice-versa. It also provided evidence that there is persistence in trade status.

In the next section, I proceed to calculate productivity using more sophisticated techniques used in the literature and check the endogenous effect on the decision to export/import on productivity. Then, check if the sunk cost hypothesis and self-selection hypothesis is observed using a dynamic random effects probit model. I end the next section by estimating a bivariate probit model to examine the complementary nature of these two activities.

5 Preliminary Analysis

Before modelling this behavior, I try to check if the phenomenon seen in the descriptive statistics are also seen in more sophisticated techniques.

I divide this into three parts and check whether:

- Learning-by-Doing: How does lagged choice of export/import impact productivity?
- Self-Selection and Sunk Cost Hypothesis : Selection of more productive firms into exporting/importing and persistence of these activities
- Complementarity between exporting and importing(Lagged and Simultaneous): Does engaging in one activity complements participation in the other ?

5.1 Learning-by-doing

I estimate endogenously the effect of export/import on productivity using two techniques used widely in this field: Levinsohn and Petrin 2003 (LP)and Ackerberg, Caves, and Frazer 2006 (ACF). ACF results are shown to highlight the robustness of the results.

5.1.1 Levinsohn-Petrin

Levinsohn and Petrin 2003 assume the following Cobb-Douglus production function:

$$y_{it} = \beta_o + \beta_l l_{it} + \beta_k K_{it} + \omega_{it}(m_{it}, k_{it}) + \eta_{it} \tag{1}$$

Using OLS residuals of the Cobb-Douglus estimates provide biased estimates of productivity since there is correlation between productivity and characteristics of firms.

I use the variable gross fixed assets as a measure of capital, salary as a measure of labor and a expenditure on raw materials as a measure of intermediated input. The estimation procedure has been described below (see here **??**). Since Levinsohn and Petrin 2003 assume a markovian nature of productivity evolution, where the productivity evolution is assumed to follow the procedure below:

$$\omega_{it} = \alpha_o + \alpha_1\omega_{it-1} + \alpha_2\omega_{it-1} + \alpha_3\omega^2_{it-1} + \alpha_4 d^X_{it-1} + \alpha_5 d^M_{it-1} + \alpha_6 d^X_{it-1} d^M_{it-1} + \nu_{it}$$

where d^X_{it-1} and d^M_{it-1} is the discrete decision to export and import respectively. I use the method highlighted in De Loecker 2013 to accommodate endogenous productivity evolution which allows past export experience to impact the evolution of capital. The estimates of the productivity evolution are shown in Table 16. The Cobb-Douglus coefficients are shown in Table 15.

De Loecker 2013 say that exogenously accomodating the decision to export/import implies that past export/import experience has no impact on direct technological improvements. Therefore, the coefficient of capital will be biased if the trade market decisions is correlated with capital. Table 17 displays the coefficients when the export/import decision is not endogenously allowed to contribute towards the productivity evolution. In this case, the coefficient of capital is biases upwards since the variation in output is attributed more towards capital.

It is seen that productivity evolutions depends non linearly on past productivity. The interesting result is that lagged decision to export does not a have a significant effect on productivity. However, it is seen that the discrete decision to import does have a significant effect on productivity i.e the decision to import causes the productivity to increase by 3 per cent. The interaction term between exporting and importing also does not have a significant effect on productivity. Table 23 and 22 display the Cobb-Douglus coefficients when the productivity is dependent on the continuous value of export and import and they show results similar to the ones shown in tables 15 and 16 for the discrete decision.

5.2 Ackerberg, Caves, and Frazer 2006

The results from this method are shown in 18 and 19. The coefficient of labor is much lower in this estimation method. This might mean that the labor coefficient is also correlated to productivity. However, in terms of the endogenous effect of export/import on productivity is roughly the same. The export decision does not have a significant effect on productivity and the import decision has a 2.9% increase to the productivity.

Based on these results, I conclude that manufacturing firms experience learning-by-importing and do not experience learning-by-exporting.

In the next section, I check if more productive self-select into exporting/importing and if the sunk cost hypothesis is observed for the discrete decision to export and import.

5.2.1 Self Selection and Sunk Cost hypothesis

The self-selection hypothesis states that entry into the trade market involves fixed and sunk costs and only the most productive firms can overcome these trade costs. Therefore, to participate in the export/import market a firm must pay a certain costs and only the most productive are able to pay the costs. To check this hypothesis, I estimate a dynamic random effects probit model similar to the model used in Mark J Roberts and Tybout 1997. I define D_{it}^X as the discrete decision to export, where Bellman equation for a profit maximising firm is:

$$V_{it}(S_{it}) = max_{D_{it}^X} E_t(\sum_{i=1}^{\infty} \delta^{t+i} R_{i,t+i} | S_{it}) \tag{2}$$

where δ is the one-period discount factor, S_{it} is the relevant state variables affecting the firms decision, R_{ij} is the revenue. The equation above can also be written as:

$$V_{it}(S_{it}) = max_{D_{it}^X} E_t(\pi^D + D_{it}^X(\pi^X - f^X - c^X(1 - Y_{it-1})) + \sum_{j=t+1}^{\infty} \delta^{t-j} R_{ij} | S_{it}) \tag{3}$$

$$V_{it}(S_{it}) = max_{D_{it}^X} E_t(\pi^D + D_{it}^X(\pi^X - f^X - c^X(1 - Y_{it-1})) + \delta E(V_{it}(S_{it+1}) | S_{it}, d_{it}^X)) \tag{4}$$

Thus, a firm will participate in the export market if:

$$\pi^*_{it} = \pi^D + \pi^D + Y_{it} + \delta^t E_t(V_{i,t+1}(S_{it+1}|S_{it}, Y_{it} = 1) - V_{i,t+1}(S_{it+1}|S_{it}, Y_{it} = 1)) - (f^X + c^X(1 - Y_{it-1})) \tag{5}$$

And the reduced form expression of the equation above becomes:

$$d^X_{it} = \begin{cases} 1, & \text{if } \pi^*_{it} >. \\ 0, & \text{if } \pi^*_{it} < 0. \end{cases} \tag{6}$$

To make it a probit model, I write the equation above as a linear function of firm-level characteristics along with dummy variables for industry and time.

$$d^X_{it} = \begin{cases} 1, & \text{if } \gamma^X_1 d^X_{it-1} + \gamma^X_3 \hat{\omega}_{it-1} + \beta^X_1 K_{it-1} + IndustrialDummy^X_i + TimeDummy^X_t + \alpha_i + \epsilon^X_{it} >= 0. \\ 0, & \text{otherwise.} \end{cases} \tag{7}$$

So if the coefficient of d^X_{it-1} is signifcantly positive, it provides evidence of sunk cost to participate in the export market and if the coefficient of ω_{t-1} is positive, then firms with high productivity self-select into participation in the export market.

A similar model can be estimated with the discrete decision to import, since importing also involves additional fixed and sunk costs, a firm would be only participate in the import market if gets productivity benefits to overcome the costs. Learning-from-importing has been demonstrated in the previous section, therefore a firm will import if:

$$\pi + \delta^t E_t(V_{i,t+1}(S_{it+1}|S_{it}, d^M_{it} = 1) - V_{i,t+1}(S_{it+1}|S_{it}, d^X_{it} = 0)) >= (f^M + c^M(1 - d^M_{it-1})) \tag{8}$$

Since S_{it} contains productivity which will benefit from participating in the import market, a firm will import if the productivity benefits outweigh the costs to participate in the import market. This can be tested with a reduced form probit model similar to the discrete decision to export:

$$d^M_{it} = \begin{cases} 1, & \text{if } \gamma^X_1 d^M_{it-1} + \gamma^M_3 \hat{\omega}_{it-1} + \beta^M_1 K_{it-1} + \beta^M_2 L_{it-1} IndustrialDummy^M_i + TimeDummy^M_t + \alpha_i + \epsilon^M_{it} >= \\ 0, & \text{otherwise.} \end{cases} \tag{9}$$

Therefore, the reduced form equations for both the discrete choices can be written as:

$$d^M_{it} = \gamma^M_1 d^M_{it-1} + \gamma^M_3 \hat{\omega}_{it-1} + \beta^M_1 K_{it-1} + \beta^M_2 L_{it-1} IndustrialDummy^M_i + TimeDummy^M_t + \alpha_i + \epsilon^M_{it} \tag{10}$$

$$d^X_{it} = \gamma^X_1 d^X_{it-1} + \gamma^X_3 \hat{\omega}_{it-1} + \beta^X_1 K_{it-1} + \beta^X_2 L_{it-1} IndustrialDummy^X_i + TimeDummy^X_t + \alpha_i + \epsilon^X_{it} \tag{11}$$

I use the dynamic random effects probit specification with Wooldridge method which treats the intial conditions problem by accounting for the correlation of the initial value with α:

$$\alpha_i = \gamma d_{i1} + \tilde{\alpha_I}$$

	(1) exp	(2) imp
main		
lagexp	1.870^{***}	
	(77.04)	
L.lpres	0.173^{***}	0.205^{***}
	(13.61)	(18.05)
L.lgfa	0.0856^{***}	0.118^{***}
	(7.09)	(10.74)
L.lsalary	0.158^{***}	0.157^{***}
	(12.48)	(14.21)
initexp	1.221^{***}	
	(29.21)	
lagimp		1.648^{***}
		(72.70)
initimp		1.009^{***}
		(28.73)
_cons	-2.973^{***}	-3.031^{***}
	(-15.67)	(-16.97)
lnsig2u		
_cons	-0.508^{***}	-0.782^{***}
	(-8.66)	(-13.65)
N	67591	67591
rho	0.376	0.314
sigma_u	0.776	0.676

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The state dependence variable has a high positive value significant at 1% level for both the exporting and importing. This means that there is a lot of persistence in both exporting and importing. This means that both these activities require a fixed cost as illustrated above. It is seen that the lagged productivity coefficient is also positive and significant at 1% level. This means that if the lagged productivity increases, then the chance of a firm participating in the export and import market also increases. This provides evidence of Self-Selection. The capital and salary variables are also positive and significant. This provides evidence of the sunk cost hypothesis and the self-selection hypothesis.

Since there are large number of firms that participate in both export/import market.

I also include the lagged decision to export in the the dynamic probit specification of the decision to import and vice-versa. This would provide evidence of the lagged complementarity between the decisions.

However, this estimation does not account for the simultaneous and lagged correlation between exporting and importing. The next section shows the results of a biprobit estimation of the equation above along with lagged dependence of exporting on importing and vice-versa.

5.3 Complimentarity between exporting and importing(Lagged and Simultaneous)

Since the previous dynamic probit model does not account for simultaneous and complementarity between exporting and importing, I estimate a dynamic bivariate probit model of exporting and importing behavior.

Let d_{it}^{X} be the discrete decision to participate in export market and d_{it}^{XM} be the discrete decision to participate in import market. Then, the bivariate dynamic probit model takes the following form

$$d_{it}^{X} = \begin{cases} 1, & \text{if } d_{it}^{X*} > 0. \\ 0, & \text{if } d_{it}^{X*} < 0. \end{cases} \tag{12}$$

$$d_{it}^{M} = \begin{cases} 1, & \text{if } d_{it}^{M*} > 0. \\ 0, & \text{if } d_{it}^{M*} < 0. \end{cases} \tag{13}$$

The discrete decision of exporting and importing is modelled as a function of previous import and export status controlling for lagged firm characteristics and industry and time fixed effects.

$$d_{it}^{X*} = \gamma_1^X d_{it-1}^X + \gamma_2^X d_{it-1}^M + \gamma_3^X \hat{\omega}_{it-1} + \beta_1^X K_{it-1} + IndustrialDummy_i^X + TimeDummy_t^X + \epsilon_{it}^X \tag{14}$$

Here γ_1 identifies the state dependence coefficient, γ_2 accounts for the fact that participating in one activity in time t-1 improves the odds of participating in the other at time t (lagged complimentarity),γ_3 accounts for the self-selection mechanism, β_1 accounts for capital at time t-1 and $IndustrialDummy_i^M$ $TimeDummy_t^M$ are industrial and time dummies respectively.

$$d_{it}^{M*} = \gamma_1^M d_{it-1}^M + \gamma_2^M d_{it-1}^X + \gamma_3^M \hat{\omega}_{it-1} + \beta_1^M K_{it-1} + IndustrialDummy_i^M + TimeDummy_t^M + \epsilon_{it}^M \tag{15}$$

The bivariate specification also allows for the contemporaneous correlation between the two choices as ϵ_{it}^X and ϵ_{it}^M are allowed to be correlated. This gives gives the following form to the error structure:

$$\begin{pmatrix} \epsilon_{it}^X \\ \epsilon_{it}^M \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix}\right)$$

The estimated ρ measures the correlation between the unobserved errors between the two activities. Therefore, this provides evidence of simultaneous complementarity if it significantly positive after controlling for different effects. This model specification has been used to test the contemporaneous relationship by Aristei, Castellani, and Franco 2013 and Aw, Mark J. Roberts, and Xu 2011. The initial conditions problems is treating by assuming that d_{i1} is endogenously given. The equation is estimated by assuming that lagged firm characteristics and industry and time dummy variables account for the differences between firms, negating the use of a random effects model.

Table 13 displays the results for dynamic probit specification. All the coefficients are significant at 1% level. The state-dependence coefficient has the strongest effect amongst all the variables, suggesting that there is persistence in both the activities. There is a positive effect of lagged productivity on both activities, providing further evidence of self-selection of firms into exporting and importing.

The results suggest a two-way relationship between exporters and importers: Firms which were importing in the previous year are more likely to be exporters and firms which were exporting in the previous year are more likely to be importing this year. Also, the correlation between the errors represented by ρ is significantly different than zero suggesting that there simultaneous complementarity between exporting and importing.

5.4 Conclusion

The results from this section and descriptive statistics suggest a few overall themes of the data:

- Learning-by-doing: I estimate productivity using Levinsohn and Petrin 2003 such that they are dependent on the lagged export and import choices and I get the following results for the two trading activities:
    1. Export: Firms do not display learning-by-exporting as the coefficient of discrete choice of lagged export decision does not have a significant effect on productivity.
    2. Import: Firms display learning-by-exporting a the coefficient of discrete choice of lagged import decision does have a significant effect on productivity
- Self-Selection: I regress the lagged productivity values of the estimated productivity for $t = t-1, t-2$ and $t-3$ on the discrete choice of exporting

and importing after controlling for firm characteristics and industry and time fixed effects and get the following result:

1. Export: The coefficient for the discrete export choice has a positive effect significant at 1% level on the lagged values of productivity. This suggests that firms learn to export.
2. Import: The coefficient for the discrete import choice also has a positive effect significant at 1% level on the lagged values of productivity. This suggests that firms learn to import as well.

- Complementarity between exporting and importing: I run a bivariate dynamic probit regression of discrete choice of exporting/importing on their lagged values, firm characteristics and industry and time dummies to get the following results:

  1. Export: There is strong persistence in exporting behavior, lagged import decision has a positive effect on current exporting behavior.
  2. Import: There is strong persistence in importing behavior, lagged export decision has a positive effect on current importing behavior.
  3. : Simultaneous Complementarity: There is a strong presence of simultaneous complementarity since the errors for the equations are highly correlated are significant at 1% level.

  The bivaraite dynamic provide results suggest that there is strong cost complementarity between exporting at time t with importing at time t and t-1 and vice-versa. But, the learning by export result show that there is no learning by exporting. This must mean that importing must help in reducing the cost to export since they do not enter the productivity mechanism.

6 Model

I use a model inspired from Aw, Mark J. Roberts, and Xu 2011 and Kasahara and Lapham 2013.

6.1 Static Decision

A firm i has a standard Cobb-Douglas Production Function and faces a marginal cost:

$$lnc_{it} = \beta_o + \beta_k lnk_{it} + \beta_w lnw_t + \omega_{it} \tag{16}$$

where

- K_{it} is the unit of output

- w_t is a vector of variable input prices common to all firms
- ω_{it} is the productivity shock

A firm faces a constant elasticity of demand (CES) function assumed to be of the Dixit-Stiglitz form :

$$Q_{it}^D = Q_t^D (\frac{P_{it}^D}{P_t^D})^{\eta_d} = \Phi_t^D (p_{it}^D)^{\eta_d} \tag{17}$$

where Q_t^d is the industry aggregate output, P_t^d is the price index and P_{it}^d is the firm i's price, η_D is the constant elasticity of demand. So, the firms demand depends upon aggregate market conditions Φ_t^D

The demand function in the export market has a similar structure except that it also depends on an industry-specific demand shifter:

$$Q_{it}^X = Q_t^X (\frac{P_{it}^X}{P_t^X})^{\eta_d} exp(z_{it}) = \Phi_t^X (p_{it}^X)^{\eta_d} exp(z_{it}) \tag{18}$$

where z_{it} is the unobserved firm specific demand shock.

Equation 2 can be used to obtain an expression for P_{it} and a firms domestic revenue is $R_{it} = P_{it}Q_{it}$, and inserting price into the revenue function and taking a log to get the revenue function in the domestic market:

$$lnr_{it} = (\eta_d + 1)ln\frac{\eta_d}{\eta_d + 1} + ln\Phi_t^D + (\eta_d + 1)(\beta_k K_{it} + \beta_w lnw_t + \omega_{it}) \tag{19}$$

The revenue function for the export market can be similarly derived to get:

$$lnr_{it} = (\eta_d + 1)ln\frac{\eta_d}{\eta_d + 1} + ln\Phi_t^X + (\eta_d + 1)(\beta_k K_{it} + \beta_w lnw_t + \omega_{it}) + z_{it} \tag{20}$$

Das, Mark J Roberts, and Tybout 2007 display a relation between profits and revenue. I use this estimate the constant demand of elasticity in both the domestic and export market. In the domestic market, the profits are:

$$\pi_{it}^d = \frac{1}{\eta_d} r_{it}^d (K_{it}, \omega_{it}, \Phi_t^D) \tag{21}$$

In the export market, the profits are:

$$\pi_{it}^X = \frac{1}{\eta_X} r_{it}^X (K_{it}, \omega_{it}, \Phi_t^X) \tag{22}$$

6.2 Transition of Productivity

The firm-level productivity is allowed to the be endogenously affected by the firms decision to export and import just as before. . Therefore, the law of motion of productivity is:

$$\omega_{it} = g(\omega_{it-1}, d^X_{it-1}, d^M_{it-1}) + \nu_{it} \tag{23}$$

$$\omega_{it} = \alpha_o + \alpha_1\omega_{it-1} + \alpha_2\omega_{it-1} + \alpha_3\omega^2_{it-1} + \alpha_4 d^X_{it-1} + \alpha_5 d^M_{it-1} + \alpha_6 d^X_{it-1} d^M_{it-1}\nu_{it} \tag{24}$$

where d^X_{it-1} is an indicator function of the firms lagged export participation, d^M_{it-1} is an indicator function of the firms lagged import participation and ν_{it} is an iid shock to the productivity. The lagged export and import indicator variables allow for learning-by-exporting and productivity benefits from importing.

The model assumes that productivity is only affected by the intensity of export/importing but is only dependent on the decision.

The firm-specific demand shockz_{it}, and industry index Φ^X_t and Φ^X_t is modelled as an exogenous AR(1) process.

6.3 Dynamic Model

Firm must pay a fixed/sunk costs of trading. Let $d^X_{i,t}$ be the indicator function of participation in the export market and $d^M_{i,t}$ be the indicator function of participation in the import market. Then the total costs (sunk and fixed) paid by firm i in period t is given by:

$F(d_{it}, d_{it-1}) =$

1. $f^x + c^X(1 - d^X_{it-1})$ for $(d^X_{it}, d^M_{it}) = (1, 0)$
2. $f^M + c^M(1 - d^M_{it-1})$ for $(d^X_{it}, d^M_{it}) = (0, 1)$
3. $\lambda[f^x + f^M + c^X(1 - d^X_{it-1}) + c^M(1 - d^M_{it-1})]$ for $(d^X_{it}, d^M_{it}) = (1, 1)$
4. 0 for $(d^X_{it}, d^M_{it}) = (0, 0)$

Here f^X is the fixed cost of exporting,C^X is the sunk cost of exporting, f^M is the fixed cost of importing, f^M is the fixed cost of importing and λ captures the degrees of complementarity between exporting and importing.

$$S_{it} = (\omega_{it}, K_{it}, d^X_{it-1}, d^M_{it-1}, \Phi^X_t, \Phi^D_t, z_{it})$$

$$V_{it}(S_{it}) = max_d(\pi_{it}^d + d_{it}\pi_{it}^X + F(d_{it}, d_{it-1}) + \beta E(V_{it}(s_{it+1}|s_{it}))) \quad (25)$$

7 Estimation

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8 Appendix

8.1 Productivity Estimation (OP,LP,ACF)

8.1.1 Olley and Pakes 1992 (OP)

Olley and Pakes 1992 (OP) use the following strategy to estimate the Cobb-Douglus function:

The log transformation of the production function is written as :

$$y_{it} = \beta_o + \beta_l l_{it} + \beta_k K_{it} + \omega_{it} + \epsilon_{it} \tag{26}$$

where l_{it} is labour, K_{it} is capital, m_{it} is the demand for materials, ω_{it} is firm-level-productivity observable to the firm and ϵ_{it} are shocks to production.
The optimal investment decision of the firm is characterised by the following function:

$$i_{it} = f_K(l_{it-1}, K_{it}, \omega_{it}) \tag{27}$$

The optimal labor decision is characterised by the following function:

$$l_{it} = f_K(l_{it-1}, K_{it}, \omega_{it}) \tag{28}$$

These are the assumptions made by **OP**:

1. $f_K(l_{it-1}, K_{it}, \omega_{it})$ is invertible in ω_{it}
2. ω_{it} follows a first order markov process
3. Investment at period i is not active until period $t+1$: $K_{it+1} = (1-\delta)k_{it} + i_{it}$
4. Labor is a perfectly flexible input i.e there are no labor adjustment cost

The estimation procedure proceeds in two step:

1. Estimation of β_k: Since $\omega_{it} = f_K^{-1}(l_{it-1}, k_{it}, i_{it})$ and inserting this in the Cobb-Douglus equation to get:

   $$y_{it} = \beta_l l_{it} + \phi_{it}(l_{it-1}, i_{it}, K_{it})$$

   where $\phi_{it}(l_{it-1}, i_{it}, K_{it}) = \beta_k K_{it} + f_K^{-1}(l_{it-1}, k_{it}, i_{it})$ $\phi_{it}(l_{it-1}, i_{it}, K_{it})$ is approximated using a polynomial expression and $beta_l$ is estimated by using OLS on the above equation

2. Estimation of β_k: Since ω_{it} follows a first order markov process, it can be written as:

   $$\omega_{it} = h(\omega_{it-1}) + e_{it}$$

   Then ϕ_{it} can be written as:

   $$\phi_{it} = beta_k K_{it} + h(\omega_{it-1}) + e_{it}$$

   $$\phi_{it} = beta_k K_{it} + h(\phi_{it-1} - \beta_k k_{it-1}) + e_{it}$$

   The unknown form of function h is approximated by quadratic function and for any value of β_K to get:

   $$\hat{\phi_{it}} = beta_k K_{it} + \gamma_0 \gamma_1 \omega_{it-1}^{\hat{\beta_k}} + \gamma_2 (\omega_{it-1}^{\hat{\beta_k}})^2 + \gamma_3 (\omega_{it-1}^{\hat{\beta_k}})^3$$

   This expression is minimised to get the estimate of β_k.

8.1.2 Levinsohn and Petrin 2003 (LP)

Levinsohn and Petrin 2003 **LP** uses a similar strategy but use intermediate input demand as the function to invert out ω_{it}. Here, the intermediated material demand function is given by:

$$m_{it} = m_{it}(\omega_{it}, k_{it})$$

This function is assumed to be montonically increasing and therefore productivity can be found by inverting the function above. Therefore, we can write the equation above as:

$$y_{it} = \beta_l l_{it} + \phi_{it}(m_{it}, K_{it})$$

where $\phi_{it}(m_{it}, K_{it}) = \beta_k K_{it} + \omega_{it}(m_{it}, K_{it})$

They suggest to use a third degree polynomial approximation of ϕ_{it} and substitute it into the equation above to give the following result:

$$y_{it} = \beta_l l_{it} + \sum_{i=0}^{3} \sum_{j=0}^{3-i} \delta_{ij} k_{it}^i m_{it}^j$$

The coefficient is β_l is estimtated by OLS using the equation above and $\hat{\phi_{it}}$ is estimtated by subtracting labor from the fitted value of the above equation:

$$\hat{\phi_{it}} = \hat{y_{it}} - \hat{\beta_l} l_{it} = \sum_{i=0}^{3} \sum_{j=0}^{3-i} \hat{\delta_{ij}} k_{it}^i m_{it}^j$$

Therefore,

So, for any value of β_k^*:

$$\hat{\omega_{it}} = \hat{\phi_{it}} - \beta_k^* k_{it}$$

$$y_{it}^* = y_{it} - \beta_l l_{it} = \beta_k K_{it} + \omega_{it}(m_{it}, K_{it})$$

Since it is also assumed that ω_{it} follows a first order markov process :

$$\omega_{it} = E[\omega_{it}|\omega_{it-1}] + \epsilon_{it}$$

They also assume a polynomial expansion of the expectation above to give:

$$\omega_{it} = \gamma_o + \gamma_1 \omega_{it-1} + \gamma_2 \omega_{it-1}^2 + \gamma_3 \omega_{it-1}^3 + \epsilon_{it}$$

Therefore, the value of β_K, for which the expression below is minimized is chosen to be the coefficient.

$$\min_{\beta_k^*} \sum (y_{it} - \beta_l \hat{l}_{it} - \beta_k^* K_{it} - E[\omega_{it} \hat{|} \omega_{it-1}])^2 \tag{29}$$

8.1.3 Ackerberg, Caves, and Frazer 2006(ACF)

Ackerberg, Caves, and Frazer 2006(ACF) suggest that labour might be correlated with productivity and might not be a fully flexible method and therefore the firms input material demand is written as:

$$m_{it} = f_{it}(\omega_{it}, k_{it}, l_{it})$$

Inverting this function for ω_{it} and substituting into the production function results in the following equation of the form:

$$y_{it} = \beta_l l_{it} + \beta_k k_{it} + f_{it}^{-1}(m_{it}, k_{it}, l_{it}) + \epsilon_{it} \tag{30}$$

They suggest that the labor coefficient should be estimated in the second stage of the estimation since it is correlated with productivity. They suggest the following steps:

1. Obtain $\phi_{it}(m_{it}, k_{it}, l_{it}) = \beta_l l_{it} + \beta_k k_{it} + f_{it}^{-1}(m_{it}, k_{it}, l_{it})$ by regression y_{it} on polynomial approximation of $\phi_{it}(m_{it}, k_{it}, l_{it})$
2. Use the markovian nature of $\omega_{it} = E(\omega_{it}|\omega_{it-1}) + e_{it}$ and use the following moment equations to estimate β_K and β_l:

$$E[e_{it}|(k_{it}, l_{it-1})] = 0 \tag{31}$$

8.2 Dynamic Random Effects Probit Model

Let i be the unit and t be the time. A dynamic random effects probit is written as:

$$y_{it}^* = \gamma y_{i,t-1} + x_{it}'\beta + \alpha_i + \epsilon_{it}; y_{it} = 1[y_{it}^* > 0]$$

where γ is the state dependence parameter.

Assumptions:

1. The i units are a random sample
2. $\epsilon_{it}\tilde{}N(0,1)$ is independent of x_i
3. $\alpha_{it}\tilde{}N(0, \sigma_{alpha}^2)$ is independent of x_i and ϵ_{it}

There are three ways to estimate the above equation:

1. Treat y_{i1} as exogenously given and do not explain it
2. Heckman Method
3. Wooldridge Method

Code for bivariate probit model *biprobit dumexp dumrd x lnk lagexp lagdumrd year92-year93, r*

The marginal effects are given by:

$$\frac{\delta E[y_{it}|x_{it}, \alpha_i]}{\delta x_{it,j}} = \beta_j \phi(x_{it}^{'}\beta + \alpha_i) \tag{32}$$

I report the average marginal effects which are given by:

$$\frac{1}{N}\sum_{i}\phi(x_{it}^{'}\beta+\alpha_i)\hat{\beta}_j$$

Other way to write down marginal effect is the marginal effect at the average.

Table 1 Data Variables

variable	indicator
sa_company_name	Prowess company name
sa_finance1_year	Year
sa_total_income	Total Income
sa_sales	Sales
sa_industrial_sales	Industrial sales
sa_sales_n_chg_in_stk	Sales and change in stocks
sa_total_expense	Total expenses
sa_rawmat_exp	Raw material expenses
sa_power_and_fuel_exp	Power & fuel
sa_salaries	Salaries & wages
sa_pat	Profit after tax
sa_pbdita	PBDITA
sa_current_liabilities	Current liabilities
sa_capital_employed	Capital employed
sa_borrowings	Borrowings
sa_commercial_papers	Commercial papers
sa_total_assets	Total assets
sa_gross_fixed_assets	Gross fixed assets
sa_current_assets	Current assets
sa_export_goods	Export of goods(fob)
sa_export_serv	Export of services
sa_import_rawmat	Import of raw materials (cif)
sa_import_stores_spares	Import of stores and spares (cif)
sa_import_fg	Import of finished goods (cif)
sa_import_cap_goods	Import of capital goods (cif)
nic.2digit	Broad industry classification code

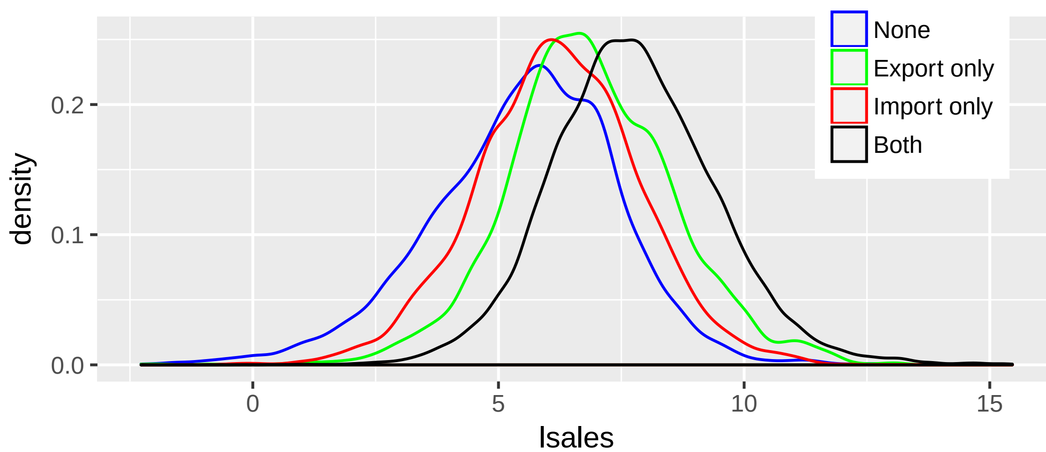
Table 2 Compostion of firms by year

Year	Number of firms
1988	23
1989	60
1990	44
1991	56
1992	74
1993	148
1994	437
1995	562
1996	385
1997	388
1998	818
1999	1130
2000	3346
2001	3847
2002	3889
2003	4447
2004	4675
2005	5151
2006	5344
2007	5456
2008	5638
2009	5903
2010	5917
2011	5330
2012	4737
2013	4320
2014	4050
2015	3087
2016	2477
2017	3

Table 3 Composition of firms based on trade market participation

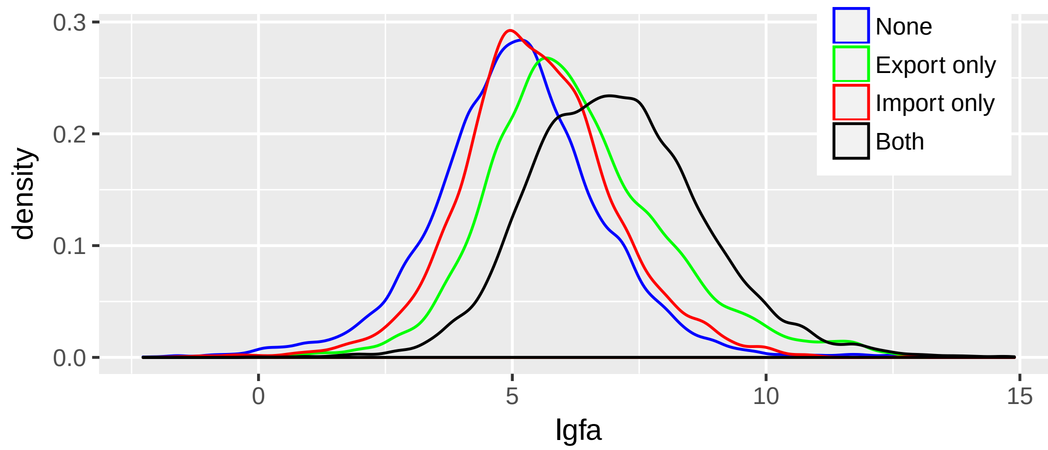
Year	None	Export only	Import only	Both	Total
2001	0.28	0.08	0.18	0.46	3847
2002	0.29	0.08	0.18	0.46	3889
2003	0.30	0.08	0.18	0.44	4447
2004	0.32	0.09	0.16	0.43	4675
2005	0.35	0.08	0.16	0.41	5151
2006	0.34	0.08	0.16	0.42	5344
2007	0.35	0.08	0.16	0.42	5456
2008	0.34	0.08	0.16	0.42	5638
2009	0.35	0.08	0.15	0.42	5903
2010	0.36	0.08	0.16	0.40	5917
2011	0.37	0.08	0.15	0.41	5330
2012	0.35	0.07	0.14	0.44	4737
2013	0.33	0.08	0.14	0.45	4320
2014	0.31	0.08	0.14	0.47	4050
2015	0.24	0.08	0.14	0.54	3087
2016	0.20	0.07	0.14	0.58	2477

Table 4 Summary statistics of Sales (log)



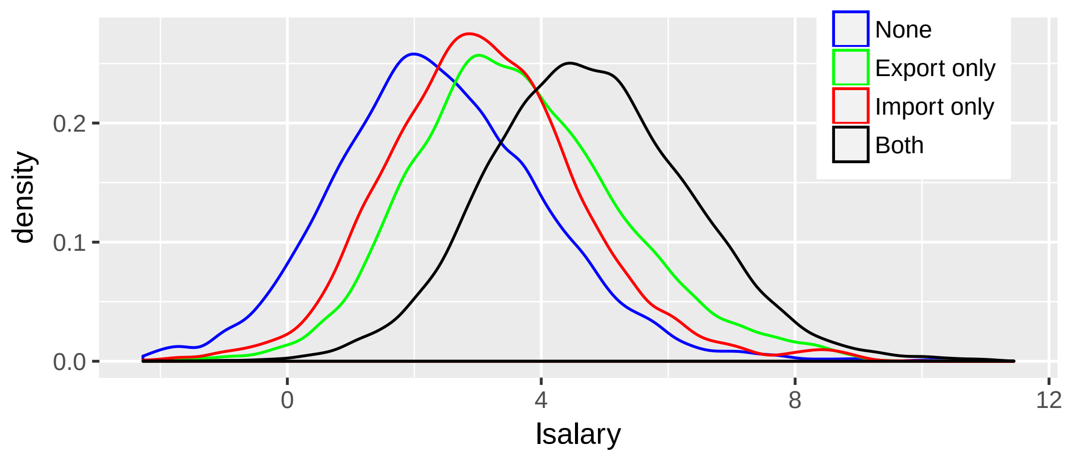
Status	mean	sd
None	5.52	1.91
Import only	6.86	1.72
Export Only	6.2	1.66
Both	7.74	1.69

Table 5 Summary statistics of Gross Fixed Assets (log)



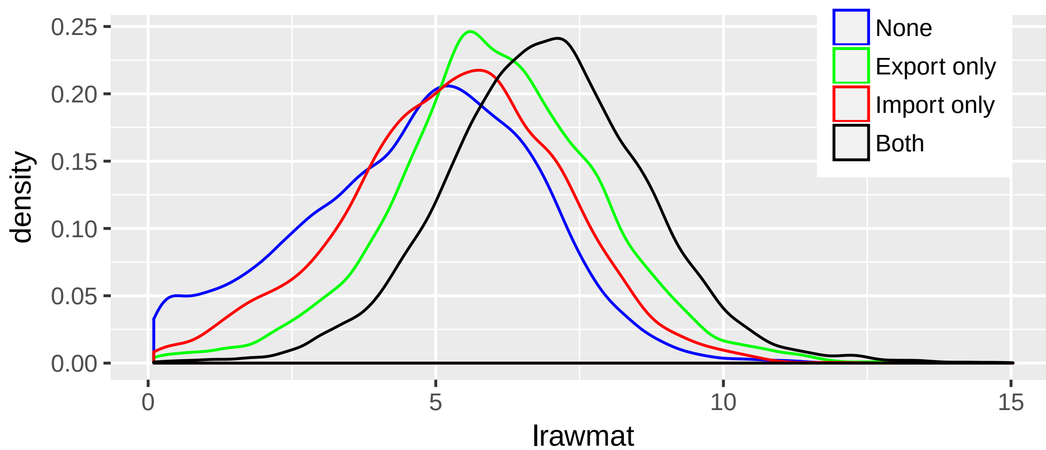
Status	mean	sd
None	5.09	1.68
Import only	6.26	1.8
Export Only	5.49	1.53
Both	7.06	1.73

Table 6 Summary statistics of Salary (log)



Status	mean	sd
None	2.41	1.67
Import only	3.63	1.66
Export Only	3.11	1.56
Both	4.76	1.63

Table 7 Summary statistics of Expenditure on raw material (log)



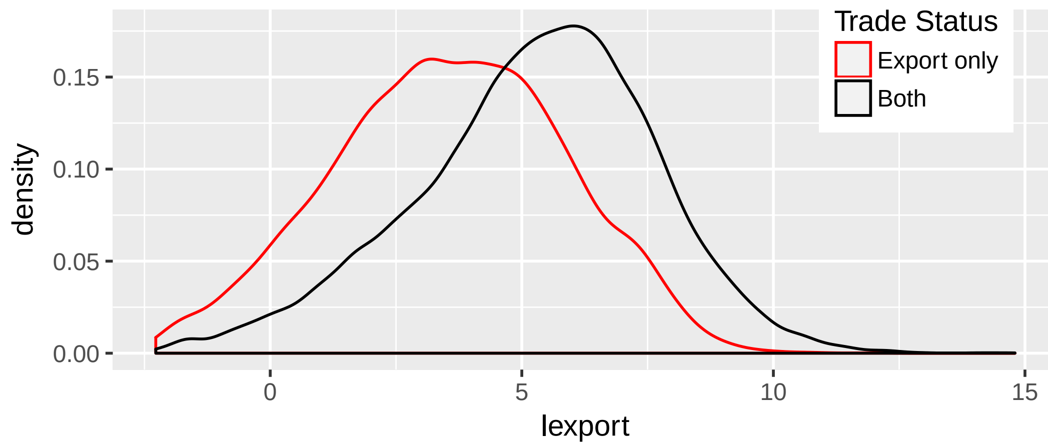
Status	mean	sd
None	4.73	2.03
Import only	6.04	1.82
Export Only	5.32	1.88
Both	6.9	1.77

Table 8 Export and Import Premia

	Dependent variable:			
	Sales	Gross Fixed Assets	Raw Materials	lsalary
	(1)	(2)	(3)	(4)
d_{it}^X	0.422***	0.209***	0.422***	0.311***
	(0.014)	(0.011)	(0.016)	(0.012)
d_{it}^M	0.430***	0.188***	0.451***	0.287***
	(0.012)	(0.009)	(0.013)	(0.010)
Age_{it}	0.039***	0.048***	0.041***	0.062***
	(0.001)	(0.001)	(0.001)	(0.001)
$d_{it}^X * d_{it}^M$	−0.060***	0.023*	−0.037**	−0.004
	(0.016)	(0.012)	(0.019)	(0.014)
Industry Dummies	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Observations	73,882	73,882	73,882	73,882
R^2	0.142	0.171	0.137	0.255
Adjusted R^2	0.026	0.059	0.021	0.154
F Statistic (df = 18; 65079)	599.067***	745.988***	575.117***	1,234.501***

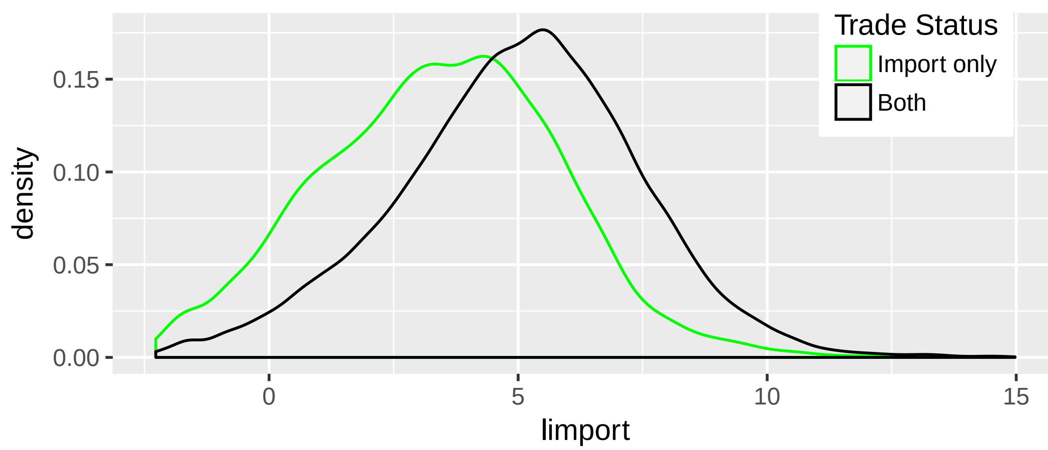
Note: *p<0.1; **p<0.05; ***p<0.01

Table 9 Summary statistics of Export (log)



Status	mean	sd
None	0	0
Import only	0	0
Export Only	3.56	2.3
Both	5.24	2.39

Table 10 Summary statistics of Import (log)

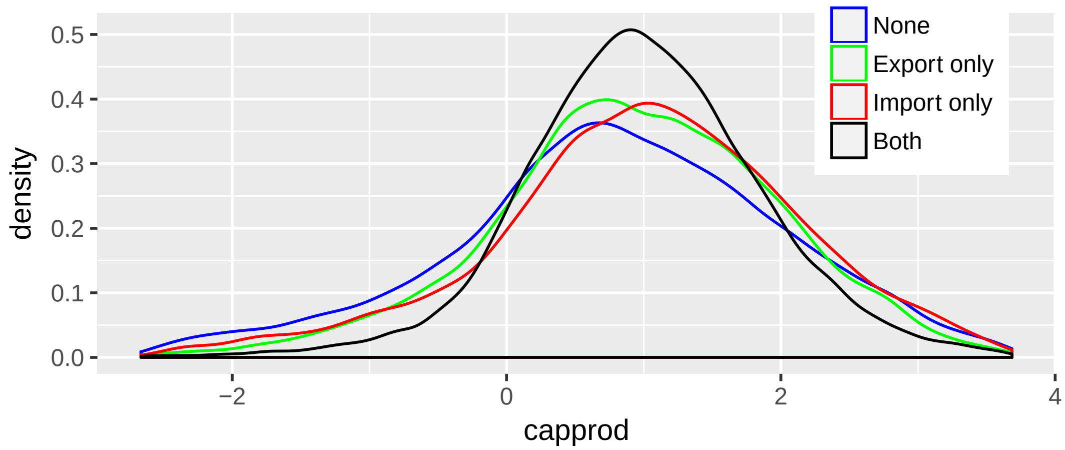


Status	mean	sd
None	0	0
Import only	3.44	2.38
Export Only	0	0
Both	4.99	2.45

Table 11 Export and Import Premia

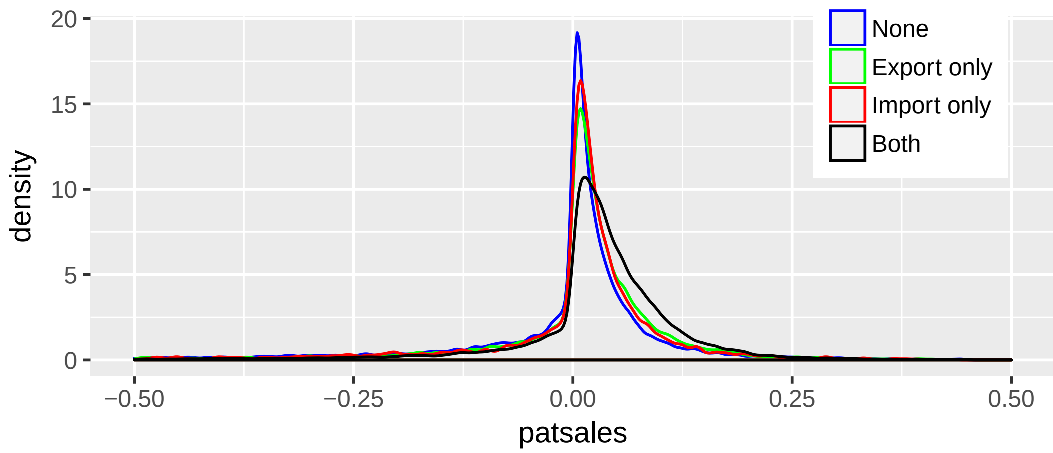
	Dependent variable:			
	Export	Import	Capital Productivity	Profit to Sales
	(1)	(2)	(3)	(4)
d_{it}^M	0.506***		0.159***	0.061***
	(0.026)		(0.009)	(0.004)
d_{it}^X		0.458***	0.097***	0.021***
		(0.024)	(0.011)	(0.005)
Age_{it}	0.068***	0.051***	$-$0.005***	$-$0.001**
	(0.003)	(0.002)	(0.001)	(0.0004)
$d_{it}^X * d_{it}^M$			$-$0.027**	$-$0.005
			(0.013)	(0.006)
Industry Dummies	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Observations	38,359	44,174	69,374	72,401
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 12 Summary statistics of Capital Productivity (log)



Status	mean	sd
None	0.8	1.2
Import only	0.94	1.03
Export Only	1	1.1
Both	0.99	0.86

Table 13 Summary statistics of Profit to Sales



Status	mean	sd
None	-0.1	0.43
Import only	-0.03	0.29
Export Only	-0.06	0.34
Both	0.01	0.21

Table 14 Transition probability

T-1/ T	None	Import Only	Export Only	Both
None	0.877	0.068	0.033	0.022
Import Only	0.131	0.732	0.011	0.127
Export Only	0.134	0.023	0.664	0.179
Both	0.016	0.036	0.033	0.915

Table 15 Cobb-Douglus coefficients

	Value	Bootstrap Standard Errors
$ \beta_{l}$	0.299	0.005
$ \beta_{k}$	0.437	0.021

Table 16 Productivity Evolution

	Dependent variable:
	ω_{it}
$alpha_1$	0.701***
	(0.005)
$alpha_2$	0.082***
	(0.002)
$alpha_3$	−0.008***
	(0.0003)
$alpha_4$	0.002
	(0.007)
$alpha_5$	0.035***
	(0.005)
$alpha_6$	−0.006
	(0.009)
$alpha_0$	0.341***
	(0.007)
Observations	62,487
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 17 Cobb-Douglus coefficients

	Value	Bootstrap Standard Errors
$ \beta_{l}$	0.295	0.005
$ \beta_{k}$	0.452	0.021

Table 18 Productivity Evolution

	Dependent variable:
	ω_{it}
$alpha_1$	0.755^{***}
	(0.004)
$alpha_2$	0.073^{***}
	(0.002)
$alpha_3$	-0.008^{***}
	(0.0003)
$alpha_4$	0.00003
	(0.007)
$alpha_5$	0.026^{***}
	(0.005)
$alpha_6$	-0.005
	(0.009)
$alpha_0$	0.250^{***}
	(0.006)
Observations	62,487
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 19 Cobb-Douglus coefficients

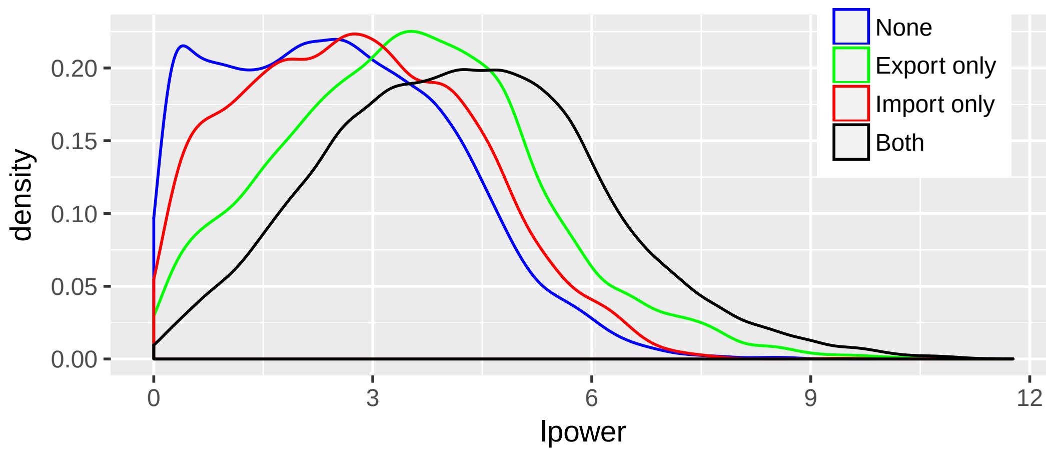
	Value	Bootstrap Standard Errors
$ \beta_{l}$	0.374	0.100
$ \beta_{k}$	0.474	0.062

Table 20 Dynamic Probit Estimates

	Dependent variable:	
	d_{it}^{X}	d_{it}^{M}
d_{it-1}^{X}	2.520***	0.407***
	-158.98	-25.13
d_{it-1}^{M}	0.388***	2.173***
	-21.58	-136.24
$\omega_{\hat{it-1}}$	0.0759***	0.126***
	-8.97	-15.72
K_{it-1}	0.0220**	0.0899***
	-2.88	-12.23
L_{it-1}	0.107***	0.106***
	-13.62	-13.92
cons	-2.068***	0.446***
	(-14.17)	-31.66
ρ	0.4457163***	
	(-0.01407)	
N	67593	

Note: *p<0.1; **p<0.05; ***p<0.01

Table 21 Summary statistics of expenditure on power and fuel (log)



Status	mean	sd
None	2.51	1.56
Import only	3.5	1.75
Export Only	2.81	1.57
Both	4.24	1.88

Table 22 Productivity Evolution

	Dependent variable:
	ω_{it}
$alpha_1$	0.693***
	(0.005)
$alpha_2$	0.083***
	(0.002)
$alpha_3$	−0.008***
	(0.0003)
$alpha_4$	0.003
	(0.007)
$alpha_5$	0.036***
	(0.005)
$alpha_6$	−0.006
	(0.009)
$alpha_0$	0.354***
	(0.007)
Observations	62,487
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 23 Cobb-Douglus coefficients

	Value	Bootstrap Standard Errors
$ \beta_{l}$	0.299	0.005
$ \beta_{k}$	0.429	0.019