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Efficiency, innovation, and imported inputs: determinants of export performance among Indian manufacturing firms

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Efficiency, innovation, and imported inputs: determinants of export performance among Indian manufacturing firms *

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Abstract

This paper investigates the determinants of export behavior among Indian manufacturing firms, focusing in particular on the role of technology, cost and imported intermediate inputs. Our evidence suggests that innovation, in particular R&D, positively affects both firms' probability to export and firms' export volumes. We also find that imported intermediate inputs, incorporating foreign technology, play an important role in expanding export activities of firms. On the other hand, we find that higher productivity or lower unit labour costs are not systematically associated with the probability to enter export market, but they do positively affect export volumes.

JEL codes: D22, F13, F14, L25, O33

Keywords: Export behavior, Innovation, Imported Inputs, Trade policy, India

1 Introduction

This paper investigates the determinants of export market participation of Indian manufacturing firms. In particular, we address the distinct role of cost-competitiveness, technology and trade policy in affecting firms' trade patterns.

A large empirical and theoretical literature has already documented that exporters and non-exporters differ along several dimensions, reporting that exporters tend to be larger,

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more productive and to pay higher wages. The evidence is widespread and concerns several countries, including United States (Bernard and Jensen, 1999), Germany (Bernard and Wagner, 1997), Colombia, Mexico and Morocco (Clerides et al., 1998), Spain (Delgado et al., 2002), Italy (Castellani, 2002), The United Kingdom (Girma et al., 2004), Sweden (Nan and Hansson, 2004) and Slovenia (Damijan and Kostevc, 2006).[1] Most of these studies confirm that high productivity precedes entry into export market, suggesting the presence of sunk entry costs, which only the most productive firms can afford to pay.

Another stream of literature, including, among others, Dosi et al. (1990), Wakelin (1998), Cimoli et al. (2009), Bustos (2011), and Dosi et al. (2015), has highlighted the distinct role of technology and cost-related variables in determining export performance at the country, sector and firm-level. Following Dosi et al. (2015), we investigate, in the context of a developing country, the joint role of technology and cost-related characteristics in affecting export market participation and performance of firms.

When focusing on the relation between firm performance and openness in trade in the case of a developing country, one has to bear in mind that these economies have traditionally relied much on foreign technology, which they have adopted and sometimes imitated in several ways, one being the import of intermediate inputs (see, for instance, Goldberg et al., 2010). Recent empirical work has examined the relationship between imported intermediate goods and firm performance (see, in particular, Amiti and Konings, 2007; Halpern et al., 2015; Kasahara and Rodrigue, 2008; Schor, 2004). This literature has highlighted three main channels through which imported inputs affects firm performance: (i) cost reduction of production factors; (ii) access to new imported input varieties; and (iii) access to higher quality inputs. A related literature has examined the direct effect of imported input on export performance of firms (see Bas, 2012 for Argentina, Aristei et al., 2013 for countries from East Europe and Central Asia, Turco and Maggioni, 2013 for Italy, Bas and Strauss-Kahn, 2014 for France, Damijan et al., 2014 for Slovenia). Indeed, if access to foreign intermediate goods allows firms to reduce their marginal costs, or provide access to new foreign inputs, it is reasonable to expect a positive effect also on their export performance, this is even more true for developing countries if, as generally assumed, they tend to depend more on foreign technology. Despite the growing body of literature addressing this issue, no evidence has been provided, to our knowledge, for the existence of this relationship in the case of India.[2] We contribute to this literature by looking at the relationship between firms' export decisions and the availability of imported intermediate goods through input trade liberalization in India.

India is an interesting case since in the post-reform era policy makers have shown interest both in export-led growth, through various export promotion policies, and input tariff liberalization (Banga and Das, 2012). Export-promotion is one of the key policy stands of India's trade policy. For example, India's foreign trade policy over the period 2009-2014 aimed at expanding its overall share in international trade and massive employment creation through export growth.[3] However, India's growth in manufacturing and particularly in exporting has been slower than that of many other developing coun-

[1] See Bernard et al. (2012) for a recent survey of this literature.

[2] A related work by Topalova and Khandelwal (2011) focus on the relation between imported intermediate inputs and firm productivity in India.

[3] See Foreign Trade Policy 2009 (27th August 2009-31st March 2014), Government of India, Ministry of Commerce and Industry, accessible at (http://dgft.delhi.nic.in) for more details on India's export targets and trade policy of export promotion.

tries, notably China (Rajan et al., 2002). Another notable feature of the liberalization policies in India is the gradual and calibrated manner in which the reforms were executed, especially with respect to external liberalization. As Banga and Das (2012) put it, on the risk of being categorized as a "reluctant globaliser", India took a path of slow and steady liberalization and still maintains high tariffs in many manufacturing products. Hence, a proper understanding of the determinants of export market participation and the effects of liberalization on imported inputs is relevant for understanding firm-level responses to aggregate shocks and for pursuing suitable policies.

In this work, we start by documenting the substantial differences in the characteristics of exporters and non-exporters both in terms of cost and technology related variables. We then investigate how, among exporting firms, firm-level characteristics are related to different volume of exports. Interestingly, and at odds with most part of the existing empirical literature, we do not find evidence in favor of the self-selection of more productive firms into the export market, even though efficiency plays an important role in determining how much firms export, once they already started exporting. Process innovation, as proxied by spending on capital investments, and product innovation, as proxied by R&D spending, have a positive and significant effect both on the probability to be an exporter and on the levels of export. On the contrary, cost competitiveness, measured by unit labour costs, does not appear to be associated with the probability of firms to enter the export market, while it has an impact on export volumes. We also find that export status is quite persistent over time. Finally, we find that a reduction in input tariffs leads to an increase in the use of imported inputs which, in turn, is correlated with export performance of firms.

The rest of the paper is organised as follows. Section 2 and 3 provide a brief outline of the trade reforms that took place in India and review the literature on technological and cost-related determinants of firm export behavior. Section 4 describes the data while section 5 presents the results from the empirical analysis. Section 6 concludes.

2 Details on India's trade policy reforms

Trade policy in India until the beginning of 1990s has been mostly based on an import substitution strategy with the goal of supporting the domestic producers, especially the ones in the upstream level of the global value chain (see, for instance, Bruton, 1998). In 1990, a weak external balance of payments position forced the government to ask for the intervention of the IMF, whose loans were conditional on an adjustment program featuring macroeconomic stabilization and structural reforms. In June 1991, following the general elections, the new government started to modify one of the world's most complex trade regimes characterized by severe quantitative restrictions on imports and exports and extraordinarily high tariffs on imports (Krishna and Mitra, 1998).

The trade reforms included the removal of licensing and other non-tariff barriers on most of the imports of intermediate and capital goods and significant reductions in tariffs on all imports. Still, the reforms exempted a handful of intermediate inputs and capital goods from the removal of import licensing on them. In addition, some consumer goods, accounting for approximately 30 percent of tariff lines, remained under licensing. Only a decade later, after several debates with India's trading partners at the World Trade Organization, were these goods freed of licensing. However, India was still far less open to international trade than many other developing economies. For example, by the mid

1990s the import-weighted tariff rate in India was 33% as compared with 9% in Korea, 10% in Indonesia, 10% in Mexico and 14% in Brazil (see Ahluwalia et al. 1996). Today, with the exception of few goods whose trade is not allowed on environmental or health and safety grounds, and a few (including fertilizer, cereals, edible oils, and petroleum products) that are "canalized" (meaning they can be imported by government only), all goods may be imported without a license or other restrictions. Hence, even though the import liberalization was one of the main item in the package of economic reforms in 1991, the process was gradual, with almost complete liberalization of imports that was achieved only in the beginning of the last decade.

Following steps towards a liberalized trade regime, India's simple average tariff rate has come down significantly from 120% in 1989-90 to about 33% in 1997-98 (Goldar and Saleem, 1992; Nouroz, 2001), whereas the trade-weighted tariffs declined from 87% in 1991 to around 30% by 2000 (Goldar, 2002). For manufacturing, there was a decline in the average rate of tariff from about 120% in 1989-90 to about 33% in 1997-98 (Goldar and Saleem, 1992; Nouroz, 2001). India has been able to gradually increase its share in global merchandise exports from 0.44% in 1980 to 0.69% in 1999 and to 1.5% in 2010 (Government of India, 2011). Figure 2 in appendix A shows the trend of input tariffs in the manufacturing sector.

The trade policies in all five year plans set by the planning commission of India were committed to further improve trade liberalization, expecting productivity gains in the manufacturing sector. However, India continued to lag behind the East Asian economies in terms of performance of manufacturing exports (Rajan et al., 2002). In the next section, we review previous works, both theoretical and empirical, which investigate the determinants of export behavior of firms, focusing in particular on the role of technology and intermediate inputs.

3 Related literature

The recent international trade literature could benefit from the increasing availability of firm-level dataset also reporting detailed information on firm's international activities.

In this respect, the theoretical prediction of a self-selection of more productive firms into the export market (Melitz, 2003) has been confirmed by several empirical studies (see Introduction for a brief review) and is now a widely accepted empirical regularity. Also much relevant for our study, several contributions point towards the impact of innovation on exporting behaviour at the firm level. Some studies which investigated the impact of product and process innovation for exporting behaviour of firms include Wakelin (1998) Haidar (2012) and Dosi et al. (2015). A positive relation between R&D and exports emerges from firm-level micro-econometric studies (Kumar and Siddharthan, 1994; Fagerberg, 1996; Wakelin, 1998; Bernard and Wagner, 1997; Lefebvre et al., 1998; Sterlacchini, 1999; Hasan and Raturi, 2003; Yang et al., 2004). Few studies investigated the role of cost competition in firms' export performance, among others, Wakelin (1998), Basile (2001) and Dosi et al. (2015). While Wakelin (1998) and Dosi et al. (2015) find no evidence for the effect of unit labour costs on export performance, Basile (2001) do find negative and significant effect of labour costs. The focus on such firm characteristics is crucial for the understanding of the relationship between the "fitness" of a firm and its export participation and performance. In particular we will focus here on process innovation, which measures the efficiency gains resulting, for instance, from the acquisition

of new machinery, unit labour costs, proxying for cost competition, and R&D, proxying for product innovation and technology competition.

The analysis of international trade in a developing country has an additional and distinctive feature that must be accounted for: the sourcing of inputs abroad might be related to acquiring technology that is not available in the home country.

Previous literature, both theoretical and empirical, has emphasized economic gains from importing intermediate goods. Theoretical models (Ethier, 1979; Grossman and Helpman, 1991b,a; Markusen, 1989; Rivera-Batiz and Romer, 1991; Eaton and Kortum, 2002) and empirical work using country-level data (Coe and Helpman, 1995; Keller, 2002) have highlighted a positive relationship between importing foreign intermediate goods and economic growth. Empirical work using firm-level data shows that imported intermediate inputs increase firm productivity, even if the magnitude and the significance of the effect depends much on the choice of the country of analysis. Using semi-parametric estimation of total factor productivity, Halpern et al. (2015) for Hungary, Kasahara and Rodrigue (2008) for Chile, Amiti and Konings (2007) for Indonesia and Van Biesebroeck (2008) for Zimbabwe, find large positive effects of importing intermediate inputs on firm productivity. On the other hand, Muendler (2004) for manufacturing plants in Brazil, finds no significant effect of imported inputs on firm productivity growth.

In this work, we enrich the analysis of cost and technological determinants of export performance by also considering the role played by the possibility to import intermediate goods, and hence resorting to yet another channel to acquire new technology. In this respect the literature on the so-called two-way traders (see among the others, Muûls and Pisu, 2009; Castellani et al., 2010) have already shown that greater availability of imported inputs should increase firm productivity and this in turn might affect export propensity.

One might find several explanations for a positive correlation between the availability of foreign intermediate goods and firm performance. Let us start to consider the increase in product variety. Importing new intermediate inputs, not previously available on the domestic market, allows firms to expand the set of inputs (Goldberg et al., 2010; Klenow and Rodriguez-Clare, 1997), which in turn impacts variety expansion (Broda et al., 2006). Goldberg et al. (2010) disentangle the price and variety channels. Using firm-level data for India, they find that an expansion in firms' product scope is driven more by increased access to new imported varieties that were previously unavailable than lower import prices. Halpern et al. (2015) using firm-level data for Hungary show that most of the positive effect of importing intermediate goods on firm productivity comes from greater imported input variety. Smeets and Warzynski (2013) using firm-product level dataset from Denmark, show that imported inputs of different origins (OECD countries and low-wage countries) improve firm TFP.

Another explanation is related to quality upgrading, i.e, higher quality of imported inputs with respect to domestic intermediate inputs, and how this relates to firm performance. Kugler and Verhoogen (2009) using firm-product level data from Columbia show that importers use more distinct categories of inputs in their production and pay higher prices for imported inputs than for domestic inputs in the same product category. Also relevant to our analysis here, Verhoogen (2008) shows that firms in developing countries tend to sell products of higher quality in export market rather than in domestic market.

If imported inputs increase variety in input mix of firms, provide access to new inputs which are not available in the domestic market and allow firms to produce high quality products with higher quality imported intermediate inputs, we hypothesize that they

would have positive effects on firms export performance as well.

Among the firm-level studies that focus on Indian manufacturing sector, Topalova and Khandelwal (2011), using the same database as in this paper, study the impact of use of intermediate inputs in increasing productivity of firms. Few works also study the export selection hypothesis for Indian firms. Sharma and Mishra (2011) studies the export selection hypothesis, looking at the relationship between productivity and export intensity[4] and find positive relationship between the two.

Here, we are trying to combine these two streams of literature, by studying, on one hand, the relationship between firm-specific characteristics and their trade performance, by focusing in particular on cost and technology related dimensions. On the other hand, we address the role of import of intermediate inputs in influencing export performance of firms. The joint analysis of these two channels is also a distinguishing characteristic of this work.

4 Data and Descriptive analysis

In this work we employ firm-level data from the Prowess database, provided by the CMIE (Centre For Monitoring Indian Economy Pvt. Ltd.). The database includes both publicly listed and unlisted firms from a wide cross-section of manufacturing, services, utilities, and financial industries. In this paper, we use only manufacturing sector and the time span is from 1995 to 2011. The companies covered account for around 70 percent of industrial production.

In order to compute tariff rate, we use data from the UN Comtrade Database[5] which gives bilateral imports for six-digit Harmonized Commodity Description and Coding System HS products. To concord these data to the four-digit National Industrial Classification (NIC) of India, we first apply the concordance in Pierce and Schott(2012), by which one can assign HS products to SIC 4 digit industries. The SIC industries are later linked to the NIC 4-digit industries based on the United Nation's concordance.[6]

Table 1 reports, for each year, the total number of firms, the number of exporters, importers and two-way traders in the dataset. While the overall share of exporters has remained more or less constant over time, the share of importers and two-way traders shows an increasing trend especially during the years 1995-2001, with a jump in the year 1999.[7] Note that as our trade data (both on import and export) are collected at the custom, it is possible to identify only direct importers (exporters), and not firms that indirectly source their imported inputs from an intermediary.[8]

Table 2 shows the distribution of firms across different manufacturing sectors, for 1995 and 2010. The different columns report, respectively, (I) the number of firms in each sector; (II)-(III) the distribution of firms and sales across sectors; (IV) the percentage of exporting firms within each sector and (V) the distribution of export volumes across

[4]The study looks only at the intensity of exports and not the probability of entering the export market.

[5]Available at http://comtrade.un.org/db/default.aspx

[6]The file is available at http://unstats.un.org/unsd/cr/registry/regot.asp?Lg=1.

[7]As this could also be due to issues related to data coverage in the initial years, in the empirical analysis we remove the years 1995-1998 when analyzing the role of import intensity as determinant of export performance (see section 5.3).

[8]This is a very well known issue in the trade literature and depends on the data collection procedure. See, among the others, Bernard et al. (2015) for an assessment of the role of intermediaries in international trade.

Table 1: Exporters, importers, and two-way traders, by year

Year	All firms	Exporters	Exporters(%)	Importers	Importers(%)	Two-way traders	Two-way traders(%)
1995	3485	1720	50.65	109	3.13	65	1.87
1996	3464	1696	51.04	111	3.20	62	1.79
1997	3469	1679	51.60	163	4.70	85	2.45
1998	3566	1726	51.60	249	6.98	149	4.18
1999	3531	1660	52.99	1141	32.31	730	20.67
2000	3610	1691	53.16	1358	37.62	893	24.74
2001	3631	1679	53.76	1459	40.18	953	26.25
2002	3791	1660	56.21	1496	39.46	1002	26.43
2003	3944	1653	58.09	1619	41.05	1085	27.51
2004	3994	1674	58.09	1641	41.09	1093	27.37
2005	4008	1653	58.76	1649	41.14	1130	28.19
2006	3942	1624	58.80	1684	42.72	1156	29.33
2007	4011	1623	59.54	1707	42.56	1185	29.54
2008	4029	1639	59.32	1711	42.47	1205	29.91
2009	3962	1693	57.27	1685	42.53	1169	29.51
2010	3860	1731	55.16	1540	39.90	1089	28.21
2011	2699	1186	56.06	1042	38.61	774	28.68

Note. Exporters (importers) are defined as firms with strictly positive exports (imports). Two-way traders are firms which are both exporters and importers.

sectors. While the food and the textile sectors accounted for around 30% of firms in 1995 (slightly declining in 2010), the most important sectors in terms of sales were coke and petroleum, chemicals, basic metals and transport equipment, which accounted for around 60% of total manufacturing sales. The relative importance of these sectors increased to around 70% in 2010, mostly due to the coke and petroleum sector, whose share increased from 21.98% to 38.76% (whereas chemicals declined from 14.48% to 6.81%). The export propensity is above 40% in almost all sectors, with the exceptions of the food and wood sectors (around 30%); it is also, with few exceptions, increasing through time. Notice again the trend in the coke and petroleum sector, which between 1995 and 2010 witnessed both an increase in the export propensity (from 38.89% to 56.41%) and a huge increase in its share of export volume with respect to total manufacturing, from around 7.5% in 1995 to 44.37% in 2010.[9]

In this paper we consider, as main determinants of export performance, total factor productivity,[10] unit labour costs, R&D intensity, investment intensity, and import intensity. The definition of all the variables used in the analysis is provided in Appendix B; Table 3 reports some descriptive statistics on the variables of interest. Exporters are, on average, larger (in terms of sales) and more productive while the average unit labour cost is almost identical for the two categories of firms. The higher mean for the R&D dummy also suggests that exporters are more likely to undertake R&D activities, and usually with a higher R&D intensity. The value of investment intensity is higher for non-exporters. The correlation matrix for the variables used is presented in table 11 in appendix C.

The difference in size between exporters and non-exporters is also apparent when

[9]Since the coke and petroleum sector only contains 36 firms, our firm-level analysis is not supposed to be very much affected by the inclusion of this sector. However, we also performed a robustness check by excluding this sector and the results did not change.

[10]We can only employ TFP and not labour productivity because a well known issue of CMIE is the lack of data on the number of employees.

Table 2: Exporters and non exporters by sector of economic activity for selected years

Sector	1995					2010				
	(I)	(II)	(III)	(IV)	(V)	(I)	(II)	(III)	(IV)	(V)
Food, beverages, tobacco	489	14.03	7.65	34.15	10.44	476	12.33	6.78	33.40	5.29
Textiles, wearing, leather	539	15.47	6.66	61.60	24.47	530	13.73	3.92	61.70	7.53
Wood, paper, printing	148	4.25	1.93	30.41	0.96	180	4.66	0.98	31.11	0.37
Coke & petroleum	36	1.03	21.98	38.89	7.57	39	1.01	38.76	56.41	44.37
Chemicals	455	13.06	14.48	57.14	12.14	517	13.39	6.81	54.35	5.91
Pharmaceuticals	263	7.55	3.36	57.79	6.50	289	7.49	3.49	60.55	8.68
Rubber & plastics	226	6.48	4.15	45.58	4.84	256	6.63	2.93	58.59	2.75
Non-metallic minerals	156	4.48	4.40	46.15	2.95	142	3.68	3.13	52.11	1.02
Basic metals	357	10.24	14.01	44.26	14.58	420	10.88	13.31	51.43	11.45
Fabricated metal	98	2.81	0.91	41.84	1.43	133	3.45	0.88	57.89	0.80
Computer & electronic	136	3.90	2.09	54.41	1.68	141	3.65	1.34	58.16	0.97
Electrical equipment	171	4.91	3.61	51.46	2.12	202	5.23	2.54	58.42	1.70
Machinery	203	5.82	5.87	68.97	3.85	251	6.50	4.80	74.50	2.15
Transport equipment	204	5.85	8.90	57.84	6.47	278	7.20	10.34	73.02	7.01
Furniture	4	0.11	0.01	25.00	0.00	6	0.16	0.01	33.33	0.00
Total	3,485	100.00	100.00		100.00	3,860	100.00	100.00		100.00

Note. (I) Number of firms; (II) distribution of number of firms (%); (III) distribution of sales (%); (IV) percentage of exporting firms within each sector (%); (V) distribution of export volumes (%) .

we consider the whole distribution of the sales, as in Figures 1(a) and 1(b). As for the other variables, the visual inspection of the respective distributions reveal a less clear-cut differences between exporters and non-exporters. The distributions of TFP and investments for exporters are slightly to the right with respect to the non-exporters (see figure 1(c) - 1(f)). On the other hand, the distribution of unit labour cost for exporters seems to be more concentrated around the modal value than the one of non-exporters.

In order to have a more precise assessment of the differences in the distributions of the variables of interest for exporters and non-exporters, we now move to a formal, non parametric test. Table 4 reports the results for the Fligner-Policello (F-P) statistics[11]. The F-P test compares the distributions of, respectively, sales, TFP, unit labour cost, R&D intensity and investment intensity, for the two different groups of exporters and non-exporters. From Table 4, we observe that the distributions of variables of interest are significantly different for exporters and non-exporters. Here, non-exporters are the reference group and therefore a positive sign of the FP statistic means that the distribution of the variable of interest for exporters stochastically dominates that of non-exporters. F-P statistics are positive and significant for sales, TFP, R&D intensity and investment intensity for all the years, thus suggesting that exporters are bigger, more productive, have higher R&D and investment intensity. The statistics for unit labour cost is however significant only in 2005 and 2010 and the positive sign suggest that the unit cost of labour is higher for exporting firms.

To conclude the exploratory analysis concerning the characteristic of exporting firms, we investigate the persistence in the export status and the probability to switch from one status to the other by employing transition probabilities matrix. The results are reported in Table 5.

Values on the main diagonal, which display the probabilities of remaining in a given status from t to $t+1$, are rather high, thus suggesting persistency in the export as well

[11]Fligner-Policello is a non parametric test for the statistical equality of two distributions, the null hypothesis being that the median in the two groups (samples) is the same. For details, refer to Fligner and Policello (1981).

Table 3: Descriptive statistics of selected variables in 2010, for the whole sample and by export status

Variable	Mean	Median	Std.Dev.
ALL FIRMS			
Sales	4703.53	606.00	53040.68
Total factor productivity	128.41	8.61	1440.62
Unit labour cost	0.22	0.17	0.17
Import Intensity	0.27	0.18	0.27
R&D dummy	0.28	0.00	0.45
Investment intensity	0.22	0.12	2.01
EXPORTERS			
Sales	6036.49	837.00	62477.30
Total factor productivity	155.90	9.48	1668.26
Unit labour cost	0.21	0.17	0.15
Import Intensity	0.29	0.20	0.27
R&D dummy	0.40	0.00	0.49
Investment intensity	0.18	0.13	0.20
NON EXPORTERS			
Sales	1440.10	274.80	11383.01
Total factor productivity	66.81	7.58	696.20
Unit labour cost	0.22	0.16	0.19
Import Intensity	0.24	0.12	0.28
R&D dummy	0.09	0.00	0.29
Investment intensity	0.19	0.10	0.54

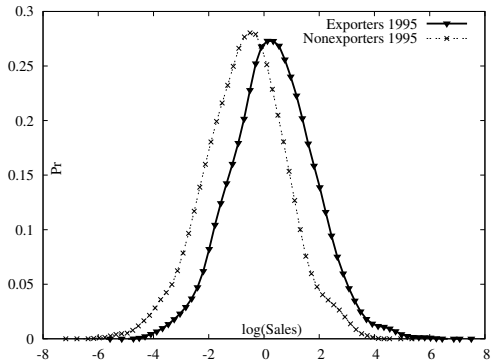
Note. All variables are defined as in section B. Sales are in rupee million.

Table 4: Fligner-Policello statistics

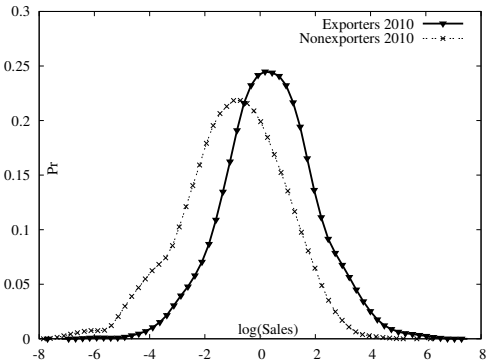
Year	Sales	TFP	ULC	R&D intensity	Investment intensity
1995	12.37	1.81	1.86	8.00	2.09
	(0.00)	(0.06)	(0.06)	(0.00)	(0.03)
2000	18.34	5.11	1.08	8.74	3.63
	(0.00)	(0.00)	(0.27)	(0.00)	(0.00)
2005	16.61	3.96	2.54	11.76	3.19
	(0.52)	(0.00)	(0.01)	(0.00)	(0.00)
2010	16.90	4.70	3.93	14.47	3.16
	(0.01)	(0.00)	(0.69)	(0.00)	(0.00)

Note. p-value in parentheses. All variables are taken as log deviation from their sectoral mean. R&D intensity in non-log deviation deviation from sectoral mean.

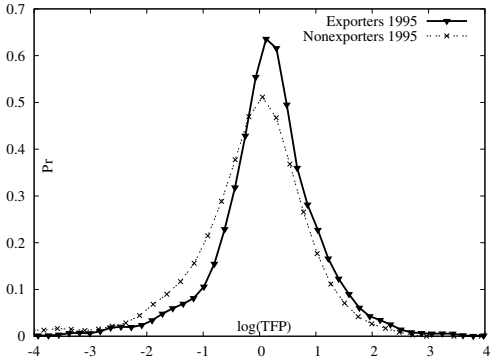
as in the non-export status. This persistent behaviour is consistent with the presence of sunk costs to export and with evidence from other countries (see, among other, Roberts and Tybout, 1997 for Colombia, Bernard and Jensen, 2004 for US, and Grazzi, 2012 for Italy.).



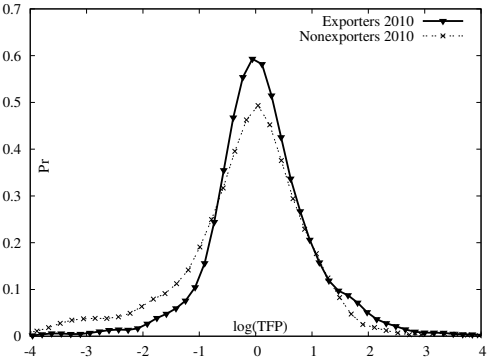
(a) Sales, 1995



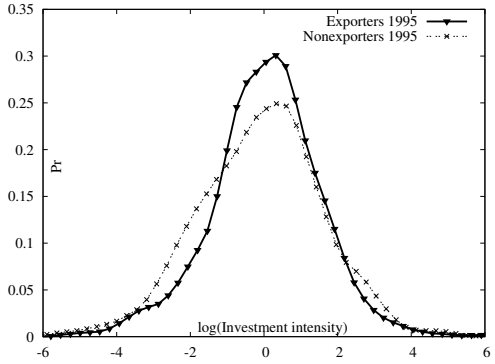
(b) Sales, 2010



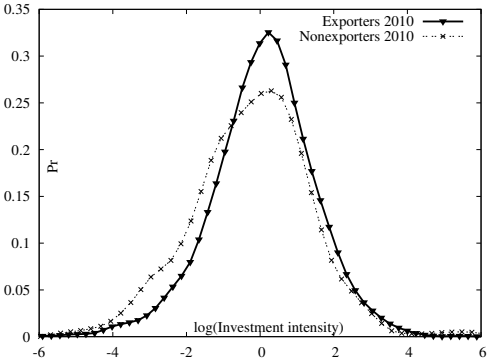
(c) TFP, 1995



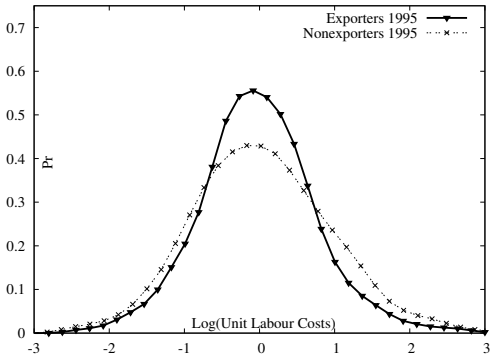
(d) TFP, 2010



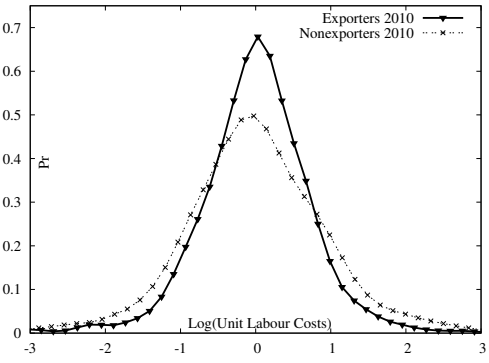
(e) Investment intensity, 1995



(f) Investment intensity, 2010



(g) Unit labour cost, 1995



(h) Unit labour cost, 2010

Figure 1: Kernel density estimation of main variables, exporters and non exporters

Table 5: Transition matrix in and out of exporting over the whole time period (1995-2011)

t	t+1		
	0	1	Total
0	20,745	2,985	23,730
	(87.42)	(12.58)	(100.00)
1	3,045	28,730	31,775
	(9.58)	(90.42)	(100.00)
Total	23,790	31,715	55,505
	(42.86)	(57.14)	(100.00)

Note. Absolute and relative (in brackets) frequencies. 0 and 1 represent the status of non-exporter and exporter.

5 Determinants of exporting behavior: Extensive and intensive margin

In the following we turn to more standard regression framework to investigate the firm-level determinants of export behavior focusing both on the probability of a firm being an exporter (the so-called extensive margin), and also on what determines the export volumes of firms, once they are already in the export market (intensive margin).

5.1 Productivity, costs and technology: export market participation

In this section, we analyze the determinants of export market participation, focusing in particular on productivity, cost and technology-related variables.

According to the seminal work of Melitz (2003), the presence of sunk entry costs restrict the access to international markets only to the most productive firms. The available empirical evidence is generally much consistent with this prediction (see the discussion in Section 1). Following this literature we include, among our regressors, both firm productivity, as measured by TFP (see Appendix B for the definition), and the lagged export status, which captures the persistence of exporting behaviour, usually interpreted as a sign of the presence of entry costs.

A more recent stream of literature focuses on the role of firm-level investments in activities such as R&D with respect to the export decision. Costantini and Melitz (2008), Lileeva and Trefler (2010) and Bustos (2011) explore the linkages between investments in innovation and the decision to export in the context of the liberalization of trade regimes. In this work we investigate the relationship between export market participation and innovative activities carried by firms using two different measures: firms decision to undertake R&D activities and investment in tangible assets. Finally, we also investigate the direct effect on export status of cost competitiveness of firms, as proxied by unit labour costs.

Since unit labour costs and productivity are strongly correlated, we estimate separately two equations. The first one reads:

$$P(D_{EXP_{it}} = 1) = \phi(\beta_1 D_{EXP_{it-1}} + \beta_2 PROD_{it-1} + \beta_3 R\&D_{it-1} + \\ + \beta_4 INV_{it-1} + \beta_5 SIZE_{it-1} + e_{it}) \quad (1)$$

where, $D_{EXP_{it}}$ is a binary variable which takes value one if a firm exports and zero otherwise; $PROD$ is the (log) total factor productivity estimated using the Levinsohn-Petrin method; $R\&D$ is a dummy which takes value one if the firm invests in $R\&D$ and zero otherwise; $SIZE$ denotes firm's dimension and is proxied by (log) total domestic sales[12]; INV denotes (log) firms' investment intensity, which is equal to firms' total investment divided by total sales.

The second model reads:

$$P(D_{EXP_{it}} = 1) = \phi(\beta_1 D_{EXP_{it-1}} + \beta_2 ULC_{it-1} + \beta_3 R\&D_{it-1} + \\ + \beta_4 INV_{it-1} + \beta_5 SIZE_{it-1} + e_{it}) \quad (2)$$

where, ULC is the (log) unit labour cost, which is equal to firms' total compensation to employees divided by value added of the firm.

Econometric literature discusses several estimation problems in discrete-choice models with fixed effects. First, a fixed effects probit model is theoretically not possible (Cameron and Trivedi, 2005). Further, discrete-choice models (logit or tobit) allow to adjust for firm specific effects but the coefficients would be severely biased with small T-periods and a high number of individuals (Nickell, 1981; Greene, 2004; Fernández-Val, 2009), as in our case. Additionally, computing linear models controlling for fixed effects with binary dependent variables is also problematic, especially when the dependent variable is rather persistent (Creusen and Lejour, 2011). As a result, we estimate Equations 1 and 2 using a pooled Probit specification. We also use a Probit model with Random Effects as a robustness check; the results are reported in Table 6.

We observe that both the decision to undertake R&D, i.e, our proxy for product innovation, and investment intensity, i.e, our proxy for process innovation, are important factors in influencing the export participation of firms. The coefficient on the lagged export dummy is positive and significant, suggesting a considerable role of sunk costs in exporting. In line with earlier literature, we find that bigger firms are more likely to enter the export market. Surprisingly, both productivity and unit labour cost are not significant[13] suggesting that, contrary to most previous findings, there is no compelling evidence in favor of self-selection of firms into exporting based on their relative productivity.

Table 12 in appendix D presents the results for selection using a Probit model performed separately for each two digit manufacturing sector. Similar to the results observed in whole manufacturing, the lagged export dummy is positive and significant in all the sectors. R&D is also positive and significant in most of the sectors. However, in few sectors, namely, food and beverages, coke and petroleum and computer and electronics

[12]We also performed robustness checks with other size measures like value added and total cost and we obtained similar results. However, we present the results with domestic sales as a proxy for size since it is the least correlated with other variables used in the analysis.

[13]One exception is when we use a Probit estimation, with productivity as an independent variable and without the lagged export dummy.

Table 6: Export Market Participation: All manufacturing

	(1) Probit RE	(2) Probit RE	(3) Probit	(4) Probit	(5) Probit RE	(6) Probit RE	(7) Probit	(8) Probit
Productivity	0.020	0.004	0.049***	0.003				
	(0.029)	(0.019)	(0.019)	(0.016)				
R&D Dummy	0.728***	0.443***	0.682***	0.363***	0.730***	0.446***	0.682***	0.369***
	(0.069)	(0.041)	(0.042)	(0.033)	(0.068)	(0.041)	(0.042)	(0.034)
Investment	0.037**	0.041***	0.072***	0.039***	0.037**	0.040***	0.072***	0.038***
	(0.015)	(0.011)	(0.010)	(0.009)	(0.015)	(0.011)	(0.010)	(0.009)
Domestic Sales	0.256***	0.116***	0.112***	0.093***	0.261***	0.113***	0.125***	0.091***
	(0.022)	(0.012)	(0.013)	(0.010)	(0.021)	(0.011)	(0.012)	(0.009)
Lag. Exp. Dum.		1.749***		1.892***		1.753***		1.889***
		(0.036)		(0.036)		(0.036)		(0.036)
Unit Labour Cost					0.016	-0.009	0.000	-0.009
					(0.031)	(0.018)	(0.020)	(0.016)
Sector Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18081	18081	18065	18065	18025	18025	18009	18009
Pseudo R^2			0.130	0.397			0.129	0.395
Number of firms	4388	4388			4379	4379		

Note. Robust standard errors (in brackets) are clustered at the firm-level. Columns (1)-(2) and (5)-(6) report the results from the Probit Random Effects estimation. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

sector, the coefficient is not significant. Investment intensity is significant only in few sectors, namely, textiles, chemicals and pharmaceuticals, where the sign of the coefficient is positive. Productivity is not significant in any of the sectors, thus suggesting that the result of the single specification in the aggregate regression (table 6, column 3) where productivity shows up as significant is, most likely, a statistical "artifact" due to the high number of observations.

5.2 Productivity, costs and technology: levels of exports

We now turn our attention to the impact of firm characteristics on how much firms export. The following equations present our empirical model:

$$EXPORTS_{it} = \alpha + \beta_1 PROD_{it-1} + \beta_2 R\&D_{it-1} + \beta_3 INV_{it-1} + \beta_4 SIZE_{it-1} + e_{it} \quad (3)$$

where $EXPORTS_{it}$ is log values of export of firm i at time t. As before, we also investigate the impact of unit labour cost on firms' export volumes by estimating the following equation:

$$EXPORTS_{it} = \alpha + \beta_1 ULC_{it-1} + \beta_2 R\&D_{it-1} + \beta_3 INV_{it-1} + \beta_4 SIZE_{it-1} + e_{it} \quad (4)$$

We begin by performing an OLS and fixed effects estimation to analyze the determinants of trade volumes for manufacturing firms. Following previous studies, such as Greenaway et al. (2004) and Kneller and Pisu (2007), we also employ a Heckman sample selection model (Heckman, 1979) to examine the impact of the independent variables on

export volumes. Since not all firms do exporting activities, then for a sample of firms the exporting behaviour is not observable. The impact of this unobserved export behaviour can be accounted for by the Heckman sample selection model. Firms' export behaviour involves a two-step decision: first they decide whether to export and then determine how much to export, conditioned on the export participation decision. Furthermore, these two events are usually correlated with each other. This two-step process can be captured by the Heckman sample selection model. However, Heckman approach can seriously inflate standard errors due to collinearity between the correction term and the included regressors, in particular in the absence of exclusion restrictions (Moffitt, 1999; Stolzenberg and Relles, 1990). We include exclusion variable, i.e, the variable that affects the selection process but not the equation of interest. The exclusion variable we use is lagged export dummy. As we observed before, exporting behaviour of firms is highly persistent, around 90% of the firms that export at time $t-1$ also export at time t,[14] therefore, lagged export dummy is very well suited to be used as a variable that predict the selection into export market.

Table 7: Levels of Exports: All manufacturing

	(1) OLS	(2) FE	(3) Heckman	(4) OLS	(5) FE	(6) Heckman
Productivity	0.3311***	0.1038***	0.3162***			
	(0.0393)	(0.0244)	(0.0379)			
R&D Dummy	0.6571***	0.1652***	0.4338***	0.7129***	0.1764***	0.4822***
	(0.0682)	(0.0549)	(0.0692)	(0.0691)	(0.0548)	(0.0697)
Investment	0.0996***	0.0534***	0.0762***	0.0881***	0.0502***	0.0637***
	(0.0174)	(0.0109)	(0.0171)	(0.0174)	(0.0107)	(0.0172)
Domestic Sales	0.3963***	0.3295***	0.3634***	0.4569***	0.3289***	0.4175***
	(0.0264)	(0.0375)	(0.0250)	(0.0243)	(0.0388)	(0.0232)
Unit Labour Cost				-0.2771***	-0.0963**	-0.2822***
				(0.0408)	(0.0384)	(0.0398)
Sector Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13759	13759	18081	13734	13734	18025
R^2	0.294	0.251		0.289	0.251	
Number of firms		3300			3298	

Note. Robust standard errors clustered at the firm-level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7 reports the results from estimation of Equations 3 and 4 by means of OLS, fixed-effects and Heckman selection for all manufacturing firms. Columns 1 to 3 report results using productivity as a proxy for efficiency, while, columns 4 to 6 presents the results with unit labour cost. The first and the fourth column show the OLS results, the second and the fifth shows the results with firm-level fixed effects, and the third and the sixth shows the results of the Heckman selection model.

[14]See table 5 for the transition probabilities matrix.

We observe that both R&D and investment intensity, our proxies for product and process innovation, play an important role in increasing export volumes. We also find that bigger firms are more likely to export more. Interestingly, both productivity and ULC are significant in explaining how much firms export, the positive sign of productivity suggests that more efficient firms export more. Similarly, the negative sign for unit labour cost suggests that lower unit labour costs is associated with a higher level of exports.

Table 13 in appendix D reports the results for levels of exports using a heckman selection framework for the various 2-digit sectors within Indian manufacturing. The picture at the sector level is more mixed than it was for the analysis of export participation. Out of 14 sectors, in 7 sectors the coefficient for productivity is significant.[15] Among these, in 2 sectors the sign is negative, namely electrical equipment and computer and electronics. Concerning R&D, the variable is significant and positive in 8 out of 14 sectors.[16] Investment intensity is positive and significant in 7 sectors.[17]

Overall the investigation of the determinants of the export status and export volumes offers a rather interesting and peculiar account on Indian firms. Contrary to most evidence to date, it appears that there is almost no effect of productivity on the probability to be an exporter. In this respect, the more detailed account at the sector level is even more compelling as productivity never appears to be significant in explaining the probability to be an exporter. However, once in the export status, productivity becomes a relevant factor: more productive firms export more.

5.3 Imported inputs and input tariff policy

In this section we continue our investigation on the determinants of export status and volumes by including in our analysis the role of imported inputs. As we detailed in section 3, one of the channels through which international technology transfer takes place is through the import and use of foreign intermediate goods by domestic firms. In this respect, imported inputs could in turn play a role by increasing firms' access to export market both on the intensive and the extensive margin.

This channel is very relevant in the case of India for at least two reasons. First, as a developing country, it relies much on imported technology (Goldberg et al., 2010). Second, India experienced a gradual but continuous decline in the average tariff over the 90's (see Section 2): Figure 2 in appendix A displays the evolution of weighted average tariffs on imports over the years of analysis. One also expects changes in input tariffs to affect the import of intermediate inputs. In this respect, to assess the relation between importing foreign goods and the related tariffs, we estimate the following equation:

$$IMPORT\,INTENSITY_{ijt} = \alpha + \alpha_t + \beta_1\, TARIFF_{jt-1} + \beta_2\, SIZE_{ijt-1} + \epsilon_{ijt} \qquad (5)$$

where $IMPORT\,INTENSITY_{ijt}$ is the import intensity of intermediate inputs for company i in industry j at time t computed as total imported inputs over total inputs used by the firm, $TARIFF_{j,t-1}$ is a measure of lagged input tariff at the four-digit industry

[15]The sectors include coke & petroleum, chemicals, pharmaceuticals, rubber & plastics, non-metallic minerals, fabricated metal, computer & electronic and electrical equipment.

[16]Sectors include food, beverages and tobacco, textiles, wearing and leather, chemicals, pharmaceuticals, rubber & plastics, non-metallic minerals, basic metals and electrical equipment.

[17]The sectors are wood, paper and printing, chemicals, pharmaceuticals, rubber & plastics, non-metallic minerals, basic metals and computer and electronics.

Table 8: Input tariff and import intensity of inputs: 1999-2011

	(1)	(2)	(3)
Import Tariff	-0.0028***	-0.0028***	-0.0022***
	(0.0003)	(0.0003)	(0.0004)
Size	No	No	Yes
Time dummies	No	Yes	Yes
Firm fixed effects	Yes	Yes	Yes
Observations	18165	18165	14153
R^2	0.004	0.004	0.007

Note. Robust standard errors clustered at the firm-level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

level, α_t is a set of year dummies that control for macroeconomic shocks common to all firms, and $SIZE_{ijt-1}$ is again proxied by domestic sales (for the definition of variables , see Appendix B).

This specification is similar to Topalova and Khandelwal (2011) where they study the effect of industry-level trade protection on firm-level productivity. We perform Fixed-Effects estimation with time dummies, which means that we relate within-firm variation in import intensity to within-sector variation (at 4-digits level) in input tariff. Notice that here, and in the following analysis, we use data over the period 1999-2011 since the coverage on import data during the initial years 1995-1998 is very scant (see Section 4).

The results, reported in Table 8, shows that the coefficient β_1 is negative and significant, meaning that lower input tariffs positively affect firms' import intensity. Our finding is consistent with Goldberg et al. (2010) who, using the same database, show that a reduction in input tariffs led companies to import new intermediate inputs, which in turn led to an increase in the domestic product scope of firms.

Let us now check whether an increase in the use of imported inputs helps firms in increasing their probability of exporting and boosting export values. We augment the selection equations 1 and 2 and the level equations 3 and 4 with our input intensity measure. The estimation techniques are the same we introduced in the previous section.

Tables 9 and 10 report the results from the relation between imported input use and export market participation and exporting levels respectively. Concerning the extensive margin (Table 9), the coefficient on the use of imported inputs is always positive and significant when we include the TFP variable as measure of efficiency; the exception is column 1, where we do not control for the lagged export status. When we use the unit labour cost variable, the coefficient is positive and significant when estimated with Probit; it becomes insignificant when estimated with Random Effects.

We also find that there is a strong and positive relationship between imported input use and exporting volumes, as we observe in table 10. In all the specifications, we find that the coefficient on the use of imported inputs is positive and significant at 1% level, highlighting the strong relationship between use of imported foreign inputs by firms and their export performance.

As for the other variables, the results are to some extent different with respect to Tables 6 and 7, where we did not include import intensity. However, these differences

Table 9: Import intensity of inputs and export market participation: 1999-2011

	(1) Probit RE	(2) Probit RE	(3) Probit	(4) Probit	(5) Probit RE	(6) Probit RE	(7) Probit	(8) Probit
Productivity	0.089	-0.171***	-0.042*	-0.074***				
	(0.057)	(0.054)	(0.023)	(0.026)				
R&D Dummy	0.959***	0.719***	0.590***	0.362***	0.955***	0.922***	0.566***	0.349***
	(0.086)	(0.090)	(0.036)	(0.040)	(0.086)	(0.091)	(0.037)	(0.041)
Investment	0.014	-0.002	0.050***	0.034***	-0.001	0.007	0.053***	0.039***
	(0.023)	(0.023)	(0.012)	(0.013)	(0.023)	(0.023)	(0.012)	(0.013)
Import intensity	-0.007	0.485**	0.163**	0.163**	-0.077	0.026	0.164**	0.152**
	(0.168)	(0.193)	(0.066)	(0.074)	(0.165)	(0.192)	(0.067)	(0.074)
Domestic Sales	0.183***	0.136***	0.086***	0.081***	0.291***	0.137***	0.086***	0.069***
	(0.033)	(0.030)	(0.012)	(0.014)	(0.030)	(0.034)	(0.011)	(0.012)
Lag. Exp. Dum.		0.209***		1.594***		0.170**		1.583***
		(0.075)		(0.039)		(0.077)		(0.040)
Unit Labour Cost					0.110**	0.061	0.091***	0.066***
					(0.046)	(0.046)	(0.022)	(0.024)
Observations	11685	11685	11658	11658	11615	11615	11588	11588
Pseudo R^2			0.093	0.278			0.094	0.276
Number of firms	1874	1874			1862	1862		

Note. Robust standard errors clustered at the firm-level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

are not driven by the inclusion of the import intensity variable. In table 14 and 15 in appendix E, we run our main equations on the reduced sample 1999-2011, without including the import intensity variable, and the results for the other variables are very much in line with Table 9 and 10.

Overall, our findings suggest that imported input use by firms has a significant impact in increasing export values, and also in increasing the probability to export. Let us recall our results on exporting-productivity linkage, where we could not find evidence for efficient firms self-selecting to export market, while we find evidence for more efficient firms exporting higher volumes. These combined evidences indicate that while the probability of entering the export market is mainly affected by technology (R&D, investment) and imported inputs, to perform consistently better in the export market (here proxied by export volumes), also efficiency plays an important role. The results are in line with other works that found similar evidence (see Bustos (2011); Bas (2012)). Our interpretation is that, since the access to foreign technology embodied in foreign inputs allows firms to increase their efficiency (see Topalova and Khandelwal (2011)), it might also lead to greater export opportunities.

6 Conclusions

The paper contributes to the analysis of the determinants of export behaviour of firms in two ways. First, it examines the importance of cost and technological competitiveness in firms' exporting behaviour. Our evidence points out that technology, as proxied by R&D, is an important determinant of export market performance of firms, both in increasing probability to export and in boosting export volumes. Instead efficiency and cost-competitiveness are an important determinant only for the levels of exports, and we could not find evidence for their impact on increasing the probability of firms' entering

Table 10: Import intensity of inputs and levels of exports: 1999-2011

	(1) OLS	(2) FE	(3) Heckman	(4) OLS	(5) FE	(6) Heckman
Productivity	0.1794***	0.1895***	0.2120***			
	(0.0693)	(0.0636)	(0.0695)			
R&D Dummy	0.5918***	0.0891	0.3183***	0.6396***	0.0812	0.3698***
	(0.1106)	(0.1140)	(0.1138)	(0.1114)	(0.1154)	(0.1142)
Investment	0.0726***	0.0219	0.0601**	0.0569**	0.0205	0.0460*
	(0.0281)	(0.0196)	(0.0279)	(0.0273)	(0.0195)	(0.0274)
Import Intensity	1.1716***	0.4747*	1.0825***	1.1406***	0.5314**	1.0569***
	(0.2492)	(0.2649)	(0.2471)	(0.2448)	(0.2699)	(0.2437)
Domestic Sales	0.6099***	0.6026***	0.5537***	0.6427***	0.6544***	0.5920***
	(0.0403)	(0.0601)	(0.0390)	(0.0350)	(0.0614)	(0.0344)
Unit Labour Cost				-0.2018***	0.1498**	-0.2319***
				(0.0781)	(0.0713)	(0.0760)
Observations	10125	10125	12786	10077	10077	12695
R^2	0.357	0.157		0.359	0.155	
Number of firms		1596			1588	

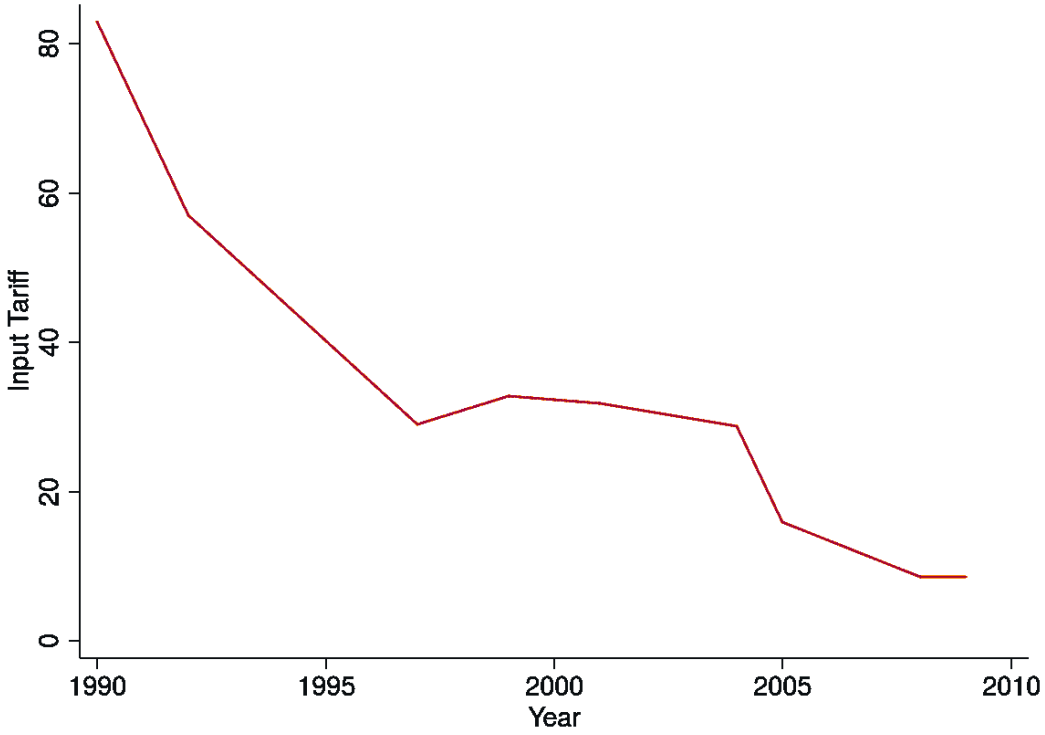
Note. Robust standard errors clustered at the firm-level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

the export market.

Second, this work provides evidence on the effect of trade policy on firms' export activities. The question on whether trade policy promoting the imports of intermediate goods helps in expanding export activities in developing countries is much relevant. One might assume that since the access to modern technology embodied in foreign inputs allows firms to increase their efficiency, it might also lead to greater export opportunities by improving firm profitability and competitiveness in the export market. In particular, in developing countries, the export-selection process can be reinforced by the ability of firms to import intermediate goods. One of the main contribution of the paper to this literature is to empirically document the positive impact of imported intermediate inputs, possibly favoured by input-trade liberalization, on firms' export performance in Indian manufacturing sector.

A Input tariff in Indian manufacturing sector over time

Figure 2: The evolution of weighted average tariffs in manufacturing sector in India.



B Variable definition

The following are the definitions of variables used in the paper.

Export value is the share of sales revenue received through sale of goods outside India.

Export dummy takes value 1 if the firms are exporters and 0 if firms do not export. We define exporters as firms with strictly positive exports.

Total factor productivity is calculated using the Levinsohn and Petrin (2003) method using energy as a proxy for controlling unobservable productivity shocks. TFP is estimated using inflation-adjusted [18] values of total revenue, wage bills, raw material inputs, capital (fixed assets) and power expenses.

Total revenue used for the calculation of TFP is the reported balance sheet data on total sales from sale of goods.

Net fixed assets are fixed assets that are adjusted for depreciation. This include both movable and immovable assets. This is the proxy for capital used in the production function equation.

Salaries and wages include total expenses incurred by an enterprise on all employees, including the management. Besides salaries and wages, items such as payment of bonus, contribution to an employees provident fund and staff welfare expenses are also included under wages. Salaries and wages also include commissions given to employees.

Raw material expenses includes cost of purchase of commodities by an enterprise in the process of manufacturing or rendering services or transformation into a product. Also, all the costs incidental to the purchase of raw material are included under this head. Some of the incidental expenses like transportation of raw material (which is known as freight inward), handling expenses, purchase tax, coolie and cartage form a part of the raw material cost.

Power and fuel expenses includes the cost of power and fuel.

Investment is measured as the additions to fixed assets of the firm, calculated as Net fixed assets_{it} - Net fixed assets_{it-1}

R&D expenses is the total amount spend on research and development by the firm.

R&D intensity is defined as expenses on R&D over sales.

R&D dummy takes value 1 if the firm has positive spending on R&D.

Investment Intensity is defined as investment over sales.

Unit Labour Cost is defined as total wages paid over value added.

Import Tariff Rate The tariff data, reported at the six-digit HS (HS6) level, are provided by the World Bank and available from the WITS database. We use the matching done by Pierce and Schott (2012) to match the tariff data of products to 4-digit industries using those products as inputs. The tariff for industry j in year t is thus the weighted average rate across all 6-digit HS products within each NIC 4-digit industry, using India's average import value from all destinations (averaging across destinations) as weights.

Import intensity is defined as total imported inputs over total inputs used by the firm.

C Correlation matrix for different variables

[18] deflated using 2-digit sector-specific price indices

Table 11: Correlations

	D_{EXP}	EXP	$SALES$	$WAGES$	$CAPITAL$	TFP	ULC	$D_{R\&D}$	$R\&D/SALES$	$INV/SALES$	$IMPORTINTENSITY$
D_{EXP}	1.0000										
	(62996)										
EXP	.	1.0000									
	(35009)	(35009)									
$SALES$	0.3183*	0.5900*	1.0000								
	(44607)	(31368)	(44607)								
$WAGES$	0.4095*	0.5165*	0.8234*	1.0000							
	(53144)	(34941)	(44583)	(53144)							
$CAPITAL$	0.3028*	0.4405*	0.7067*	0.6495*	1.0000						
	(54199)	(34962)	(44583)	(52950)	(54199)						
TFP	0.1220*	0.1664*	0.3990*	0.2651*	0.2908*	1.0000					
	(49094)	(33676)	(44306)	(49094)	(49085)	(49094)					
ULC	0.0005	-0.1747*	-0.3233*	0.1115*	-0.1288*	-0.2499*	1.0000				
	(44316)	(31302)	(44068)	(44316)	(44292)	(44060)	(44316)				
$D_{R\&D}$	0.3347*	0.2547*	0.4056*	0.4967*	0.3669*	0.2463*	0.0572*	1.0000			
	(44501)	(27631)	(36653)	(43167)	(44015)	(40152)	(36423)	(44501)			
$R\&D/SALES$	0.1068*	0.1160*	0.1057*	0.1725*	0.1174*	0.1165*	0.0732*	0.3148*	1.0000		
	(36861)	(25382)	(36653)	(36844)	(36849)	(36587)	(36423)	(36861)	(36861)		
$INV/SALES$	0.1170*	0.0661*	0.0442*	0.0888*	0.2524*	-0.0107	0.0254*	0.0830*	0.0782*	1.0000	
	(27412)	(19762)	(27194)	(27401)	(27400)	(27225)	(27103)	(23238)	(23238)	(27412)	
$IMPORT\ INTENSITY$	0.0137*	0.0942*	0.1170*	0.1551*	0.0219*	0.0851*	-0.0587*	0.0208*	0.0399*	-0.0089	1
	(26688)	(21967)	(28882)	(32551)	(31125)	(31182)	(29198)	(27159)	(25694)	(17601)	(31598)

Note. * denotes significance at 1%. Observations in parentheses. All variables are in log with the exception of export dummy, R&D dummy, and R&D intensity.

D Sector-wise results for selection and levels of exports

Table 12: Sectorwise results for selection into export markets: Probit estimation.

Sector	Exp	Prod	R&D	Inv	Obs.	Firms
Food, beverages, tobacco	0.727***	-0.021	0.058	0.017	1797	529
	(0.023)	(0.017)	(0.038)	(0.012)		
Textiles, wearing, leather	0.582***	0.003	0.107***	0.008*	2527	617
	(0.032)	(0.009)	(0.015)	(0.004)		
Wood, paper, printing	0.601***	-0.052	0.133**	0.011	676	183
	(0.044)	(0.037)	(0.062)	(0.015)		
Coke & petroleoum	0.719***	-0.087	0.062	0.005	176	40
	(0.088)	(0.061)	(0.082)	(0.025)		
Chemicals	0.605***	0.008	0.085***	0.016***	2687	627
	(0.029)	(0.017)	(0.016)	(0.005)		
Pharmaceuticals	0.584***	0.015	0.077***	0.013**	1300	311
	(0.044)	(0.015)	(0.021)	(0.007)		
Rubber & plastics	0.629***	0.030	0.063*	0.006	1282	294
	(0.041)	(0.022)	(0.033)	(0.011)		
Non-metallic minerals	0.697***	-0.033	0.082**	-0.000	823	182
	(0.044)	(0.038)	(0.040)	(0.013)		
Basic metals	0.597***	-0.027	0.122***	0.003	1781	463
	(0.029)	(0.021)	(0.029)	(0.008)		
Fabricated metal	0.645***	-0.067	0.179***	-0.001	572	141
	(0.059)	(0.048)	(0.052)	(0.015)		
Computer & electronic	0.619***	0.002	0.010	0.006	608	160
	(0.069)	(0.021)	(0.024)	(0.009)		
Electrical equipment	0.542***	-0.029	0.084***	0.007	917	222
	(0.050)	(0.018)	(0.024)	(0.009)		
Machinery	0.441***	-0.013	0.035**	0.007	1388	283
	(0.055)	(0.015)	(0.016)	(0.005)		
Transport equipment	0.504***	0.005	0.076***	0.012	1518	331
	(0.045)	(0.009)	(0.018)	(0.008)		

Note: Productivity is the proxy for efficiency. We obtain similar results when we use unit labour costs as a proxy for efficiency as well.

Table 13: Sectorwise results for levels of exports: Heckman estimation.

Sector	Prod	R&D	Inv	Obs.	Firms
Food, beverages, tobacco	0.168	0.615**	-0.041	1797	529
	(0.221)	(0.308)	(0.076)		
Textiles, wearing, leather	-0.084	0.504***	0.043	2527	617
	(0.076)	(0.182)	(0.036)		
Wood, paper, printing	-0.233	0.027	0.220***	676	183
	(0.252)	(0.410)	(0.083)		
Coke & petroleoum	2.658***	0.171	-0.061	191	40
	(0.619)	(0.582)	(0.118)		
Chemicals	1.275***	0.310*	0.077*	2687	627
	(0.168)	(0.175)	(0.040)		
Pharmaceuticals	1.838***	0.400**	0.264***	1300	311
	(0.279)	(0.169)	(0.052)		
Rubber & plastics	1.139***	0.623**	0.120**	1282	294
	(0.325)	(0.256)	(0.057)		
Non-metallic minerals	1.096***	0.576*	0.110*	823	182
	(0.321)	(0.294)	(0.061)		
Basic metals	-0.181	0.452**	0.113**	1781	463
	(0.152)	(0.228)	(0.049)		
Fabricated metal	0.474***	0.323	-0.019	572	141
	(0.170)	(0.351)	(0.106)		
Computer & electronic	-0.781**	0.327	0.383***	608	160
	(0.338)	(0.308)	(0.102)		
Electrical equipment	-0.355**	0.560**	0.093	917	222
	(0.161)	(0.251)	(0.084)		
Machinery	0.007	-0.006	0.067	1388	283
	(0.222)	(0.196)	(0.063)		
Transport equipment	-0.044	0.264	-0.044	1518	331
	(0.097)	(0.193)	(0.070)		

Note: Productivity is the proxy for efficiency. We obtain similar results when we use unit labour costs as a proxy for efficiency as well.

E Table 9 and 10 without import intensity

Table 14: Export Market Participation: for the same observations as in table 9, without import intensity variable

	(1) Probit RE	(2) Probit RE	(3) Probit	(4) Probit	(5) Probit RE	(6) Probit RE	(7) Probit	(8) Probit
Productivity	-0.018	-0.154***	-0.039*	-0.071***				
	(0.061)	(0.055)	(0.023)	(0.026)				
R&D Dummy	1.195***	0.834***	0.594***	0.366***	0.915***	1.115***	0.570***	0.353***
	(0.093)	(0.089)	(0.036)	(0.040)	(0.090)	(0.099)	(0.037)	(0.041)
Investment	-0.013	0.010	0.049***	0.033**	0.008	-0.014	0.052***	0.037***
	(0.023)	(0.023)	(0.012)	(0.013)	(0.023)	(0.023)	(0.012)	(0.013)
Domestic Sales	0.208***	0.108***	0.085***	0.079***	0.171***	0.218***	0.085***	0.068***
	(0.037)	(0.030)	(0.012)	(0.014)	(0.036)	(0.035)	(0.011)	(0.012)
Lag. Exp. Dum.		0.217***		1.594***		0.177**		1.583***
		(0.075)		(0.039)		(0.077)		(0.040)
Unit Labour Cost					0.051	0.133**	0.087***	0.063***
					(0.044)	(0.059)	(0.022)	(0.024)
Observations	11685	11685	11658	11658	11615	11615	11588	11588
Pseudo R^2			0.093	0.277			0.093	0.275
Number of firms	1874	1874			1862	1862		

Note. Robust standard errors clustered at the firm-level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 15: Levels of Exports: for the same observations as in table 10, but without import intensity

	(1) OLS	(2) FE	(3) Heckman	(4) OLS	(5) FE	(6) Heckman
Productivity	0.2271***	0.1864***	0.3218***			
	(0.0749)	(0.0610)	(0.0763)			
R&D Dummy	0.6321***	0.0176	0.4188***	0.6860***	0.0236	0.4269***
	(0.1106)	(0.1054)	(0.1120)	(0.1105)	(0.1072)	(0.1139)
Investment	0.0611**	0.0168	0.0503*	0.0426	0.0135	0.0300
	(0.0288)	(0.0194)	(0.0281)	(0.0280)	(0.0194)	(0.0279)
Domestic Sales	0.5739***	0.2511***	0.4523***	0.6154***	0.2670***	0.5651***
	(0.0444)	(0.0812)	(0.0453)	(0.0393)	(0.0920)	(0.0381)
Unit Labour Cost				-0.2398***	-0.0228	-0.2668***
				(0.0819)	(0.0744)	(0.0793)
Observations	10125	10125	12786	10077	10077	12695
R^2	0.350	0.214		0.352	0.211	
Pseudo R^2						
Number of firms		1596			1588	

Note. Robust standard errors clustered at the firm-level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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