Sourcing and Sophistication Decisions: Importing Behavior of Indian Plants

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Abstract

In this paper we use detailed product-level data on imports by Indian manufacturing plants to analyze the importance of sunk costs of importing. Further we analyze the determinants of the size and the sophistication of a plants' import basket. We use dynamic panel models that allow for binary or fractional dependent variables and plant un-observables that may be correlated with independent variables. We find significant evidence of sunk costs of international trade in the importing behavior of Indian plants. We also find significant hysteresis in import share and the sophistication of the import basket which we interpret as evidence of sunk costs incurred by the plant when it optimizes its production process to the use of imported/higher quality inputs. Further, we find evidence that non-sunk costs of international trade – in particular input tariffs – affect the probability that a plant imports as well as its share of foreign inputs in total inputs. Input tariffs do not affect the sophistication of a plants' input basket. This finding is important for policy makers – lowering tariffs may not necessarily encourage plants to purchase high quality inputs that are needed to produce new and higher quality final products. We find evidence of agglomeration economies that accrue to plants that locate in state-industry cells that contain a large proportion of importers. That is, a plant can benefit from information provided by currently-importing plants and make use of established networks. These economies raise the probability that a plant imports, its import share and the sophistication of its input basket.

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Section 1. Introduction

In this paper, we use detailed product-level data on imports by Indian manufacturing plants to analyze the underlying microeconomic determinants of import flows and their quality. In particular, we first assess the relative importance of various types of costs –sunk and iceberg – of engaging in international trade. We also assess the effect of plant and policy variables on the sophistication level of the import baskets of Indian plants.

Two important findings emerging from recent research motivate our analysis. First, in an influential paper Haussmann, Hwang and Rodrik (2007) find that the sophistication of a country's export basket matters for the country's growth prospects. That is, what you export matters. Second, a large literature provides empirical evidence that imported input use and greater input quality are associated with greater productivity and efficiency particularly in the export market.[5] Li, Feng and Swenson (2012) study the connection between individual firm imports and exports and find that Chinese firms that expand their intermediate input imports also expand their export volumes and increased their export scope. Thus it is imperative to analyze the determinants of import participation and of the sophistication of the import basket at the firm-level. Since what you import affects what you export, what you import matters.

Several other stylized facts also motivate our analysis. The global economy is increasingly more integrated as businesses attain significant cost-savings and quality upgrades by fragmenting production across national borders. Thus a significant proportion of the growth in world trade

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[5] Amiti and Konings(2007), Blalock (2012), Farinas and Marin-Marcos (2010), (Bas (2010, 2011)), Tucci (2005), Driffield and Kambhampati (2003).

flows can be attributed to growth in trade of inputs.[6] Further recent research shows the importance of foreign inputs as conduits of knowledge and that this technological diffusion can raise productivity and efficiency of importers.[7] In addition while empirical evidence is mounting that there are significant sunk costs of entering international markets-- in particular, of exporting[8]--- there is little evidence on the effect of sunk costs on *importing* behavior.[9] Lastly, there are strict complementarities between the international activities of individual producers. There exists a large and positive correlation between exporting and importing behavior.[10] Further, exporting plants import more than importing plants export. Tucci (2005) shows that among importers in India 80% were exporters while only 40% of exporters were importers. Further, the average exporter imported 70% of its inputs compared to 35% for the average non-exporting importer. Thus studying importing behavior, in the absence of data on exporting behavior, can give us key insights into exporting behavior.

In this paper we establish some stylized facts about the importing behavior of 9500 formal plants in Indian manufacturing for the period 1998 to 2007. We then proceed to model the import

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[6] Hummels et al. (2001) estimate that such specialization accounted for around 20% of exports of 10 OECD countries and four emerging economies and grew by 30% between 1970 and 1990.

[7] Previous research has shown theoretical and empirical linkages between the expansion of variety and higher quality provided by imported inputs and greater productivity and efficiency of importing firms. Recently Macgarvie (2006) finds that knowledge diffusion (measured by patent citations) is greater for firms that import than those that export. That is, importing firm patents are significantly more likely to be influenced by technology in the exporting country than are the patents of firms that do not import from that country.

[8] Eaton, Eslava, Kugler and Tybout (2008), Das, Roberts and Tybout (2007), Roberts and Tybout (1997), Clerides et al. (1998).

[9] See Muuls and Pisu (2009).

[10] Bernard et al (2007) for the US, Muuls and Pisu (2009) for Belgium, Manova and Zhang (2009) for China and Tucci (2005) for India.

participation decision of Indian plants. The span of data provides sufficient cross-sectional and inter-temporal variation to estimate a dynamic panel model that controls for plant-level unobservables. Additionally, we assess the importance of plant-level characteristics – size, age, ownership structure, productivity, financial structure and the quality of its final product – on its participation in international trade (i.e. its decision to import or not) and on its share and quality of foreign inputs relative to those of domestic inputs. We also analyze the importance of industry-level input tariffs on participation and import share. Third, we assess the determinants of the level of sophistication of each plants' import basket. We find evidence of significant sunk costs of importing in Indian manufacturing. We also find hysteresis in the intensive margin (share of foreign inputs) and in the sophistication of the input basket. We interpret this as evidence of another type of sunk cost – that incurred by a plant when it optimizes its production process to the use of imported/ sophisticated inputs. Further, we find evidence that non-sunk costs of international trade – in particular input tariffs – affect the probability that a plant imports input and the share of foreign input in total input. Input tariffs do not affect the sophistication of a plants' input basket. This finding is important for policy makers – lowering tariffs may not necessarily encourage plants to purchase high quality inputs that are needed to produce new and higher quality final products. We find evidence of agglomeration economies that accrue to plants that locate in state-industry cells that contain a large proportion of importers. That is, a plant can benefit from information provided by currently-importing plants and make use of established networks. These economies raise the probability that a plant imports, its import share and the sophistication of its input basket.

India presents an interesting case to analyze for several reasons. With the ascension of Chinese manufacturing in world trade, the Indian manufacturing sector has been under increasing strain (in both internal and external markets). The sector, under increasing competition both from imports, as well as from higher labor costs (due to competition with other sectors), lack of infrastructure and other policy failures has to think of innovative margins to survive. An important margin – hitherto unexplored for India – is input sourcing and input quality.[11] Additionally, evidence of churning or relatively rapid entry-exit from international markets can be used to assess the importance of the fixed costs of international trade (Melitz (2003)). This project will be one of the first to assess the importance of fixed costs of international trade faced by Indian plants. These estimates will be very useful for policy makers and academics alike. These questions become even more interesting with the historical perspective that Indian industrial policy was extremely discouraging of imported input use. It is interesting to see whether this is reflected in current input choices made by Indian plants. Further, Indian manufacturing has been increasingly capital-intensive. The project will answer whether this is reflected in greater use of increasingly sophisticated intermediate inputs which are likely to be complementary to capital.

Before we move to substantive analysis, we would like to point out some caveats attached to the data used in our analysis. Panel data for manufacturing plants in India have only recently been made available. These data cover formal/organized sector plants of a certain size (see Section 3 for more details) and span the years 1998-2007. Trade flow data for each plant is restricted to imports. That is, we are not able to measure the volume of exports at the plant level or even

[11] The literature has explored several margins -- productivity (Sharma (2006), Bollard, Klenow and Sharma (2010), Khandelwal and Topalova (2010)), location (Fernandes and Sharma (2010), Ghani, Kerr and O'Connell (2011)), product scope (Goldberg et al(2009, 2010a, 2010b).

distinguish exporters from non-exporters. Lastly, we are unable to identify whether the plant is wholly or fully foreign owned.

Section 2. Literature

Our analysis is a natural progression of, and a contribution to some key themes that have emerged in recent literature. First, a large and growing body of literature following Melitz (2003) has emphasized the importance of plant-level heterogeneity and sunk costs of engaging in international trade. In particular, Antras and Helpman (2004) combine the modeling of plant heterogeneity with a model of incomplete contracts to analyze a firm's choice of organization and location of production. One important prediction of their model is that more productive plants will tend to import inputs (rather than buy them domestically or produce them within the firm).[12] Other papers in this literature have systematically identified sunk costs using regression analysis, with the focus on exporting behavior (Roberts and Tybout (1997), Clerides et al. (1998), Bernard and Jensen (2004), Das, Roberts and Tybout (2007)). Recently Muuls and Pisu (2009) estimate the sunk costs of importing using Belgian data. This literature tests the hypothesis that in the presence of sunk costs, there is hysteresis in foreign (export or import) market participation and hence, the coefficient on the lagged dependent variable can be interpreted as a measure of importance of sunk costs.

Another sub-set of literature brings in endogenous quality choice in models with plant heterogeneity. Using specific firm-product level data from Colombia, Kugler and Verhoogen (2009) show that larger firms produce high quality goods by relying on high-quality inputs

[12] Several papers find evidence of this link: Tucci (2005), Macgarvie (2006), Muuls and Pisu (2009), Amiti and Wei (2009) and Farinas and Marin-Marcos (2010).

imported from abroad. Further for the case of multi-product firms, papers like Fernandes (2009) and Goldberg (2009, 2010a, 2010b) analyze the effect of greater imported input use on final product quality and product scope. More recently Li, Feng and Swenson (2012) study the connection between individual firm imports and exports and find that firms that expand their intermediate input imports also expand their export volumes and increased their export scope. The authors conclude that *"….product upgrading facilitated by technology or quality embedded in imported inputs helped Chinese firms to increase their scale and breadth of their participation in export markets.*"

These findings attain greater significance when combined with the findings of Haussmann, Hwang and Rodrik (2007) that the sophistication of a country's export basket matters for the country's growth prospects. In particular, *"….Specializing in some products will bring higher growth than specializing in others. In this setting, government policy has a potentially important positive role to play in shaping the production structure—assuming of course that it is appropriately targeted on the market failure in question."* It thus becomes imperative to analyze the determinants of a firms' choice of the quality or sophistication of its imported inputs – particularly in relation to changes in policy for example, input tariffs -- since this has been shown to affect the quality and scope of exports.

A large literature explicitly investigates the determinants-- other than sunk costs-- of foreign outsourcing. For the case of US foreign trade zones, Swenson (2000) finds that exchange rate fluctuations are important determinants of input imports. Eun and Wang (2009) find that for US firms there is a negative and statistically significant relationship between the degree of international outsourcing and the debt ratio. Lopez and Yadav (2010) point out the possibility of spillovers. That is, the agglomeration of importers in some regions may generate important information that can be used by other firms. For the case of India, Bass and Berthou (2012) use firm-level data (from the Prowess data base, for the period 1996-2006) and find that a firm's imports of capital goods are affected by financial constraints – more liquid and less leveraged firms are more likely to import capital goods but not intermediate inputs. Intuitively, uncollateralized external financing is more costly than internal financing in the presence of informational asymmetries and this produces a positive correlation between a firms' net worth and its investment decisions.

Tucci (2005) models import and export participation using data on 188 Indian firms surveyed by the World Bank Investment Climate Survey for the period 1997 – 2002 and finds that capital intensity and skill intensity are positively related to export participation but negatively to import participation. Further, firms that export as well as younger firms seem more likely to participate in international trade (though the coefficient on age is insignificant). Thus this study provides preliminary evidence that export and import participation are intricately linked. Further, Tucci (2005) finds that sources of inputs and destination of exports matter. The more similar the sources and destinations, the greater the productivity of the firm. This finding can be interpreted to mean that sunk costs of international trade matter. Similar geographic location of source and destination may reduce the sunk costs of finding trading partners and hence may improve productivity. However the results of this paper must be treated with caution since they are based on very few observations.

We contribute to this growing literature on trade participation by Indian manufacturing plants/firms. First we use a panel of approximately 9500 formal plants for the period 1998 to 2007 and thus have sufficient cross-sectional and inter-temporal variation. We also have detailed data (at the 6-digit level) on the products imported by plants using which we can construct an index of sophistication of the plants' imports. Secondly, we are able to control for a variety of time-varying and time-invariant plant characteristics that are not available in other data sources. Thirdly, we explicitly model the dynamic nature of participation in international trade and hence are able to assess the relative importance of the sunk trade costs facing Indian plants. Lastly, we take into account several unique features of the Indian growth experience that are also likely to affect input sourcing. First, Chamarbagwala and Sharma (2010) provide evidence of increasing demand for skilled workers in Indian manufacturing due to capital-skill complementarities and industrial reforms in the 1980s and 1990s. If there are complementarities between the use of capital and imported inputs then technological progress would lead to an increase in imported input use and quality. Secondly, during our period of analysis (1997-2007) the main tariff reductions were in consumer goods categories, as India gradually complied with WTO rules. This is also the time period when the Indian economy experienced a growth acceleration that was not confined to the manufacturing sector (Bollard, Klenow and Sharma 2010). With increasingly affluent consumers at home and more competition from foreign imports, consumer goods industries may have increased their use of imported inputs to produce cheaper/better quality products.

Section 3. Data and Methodology

3.1 We use plant-level data from the Annual Survey of Industries (ASI) conducted by the Central Statistical Organization (CSO), a department of the Ministry of Programme Planning and Implementation of the Government of India. The survey covers all factories registered under the Factories Act of 1948 (defined as units employing 20 or more workers) which corresponds to the formal sector in Indian manufacturing. The ASI frame can be classified into 2 sectors: the `census sector' and the `sample sector'. Units in the census sector are covered with a sampling probability of one while units in the sample sector are covered with sampling probabilities lower than one.[13] We use a panel data version of these data for the period 1997 to 2007 (recently released by the ASI. Previous versions of the data suppressed the plant identifier) which cover the `census sector'. These data contain information on the products produced by the plant, as well as detailed product-level information on the inputs (both domestic and foreign) used by the plant. Data on trade policy are obtained from Harrison, Martin and Nataraj (2011).

3.2 Methodology

ASI plant-level data allow us to identify the value and quantity of each intermediate input purchased by the plant, and whether it was imported or not. We define the following 3 measures, where *i* indexes the plant, *j* indexes industry, *k* indexes products and *t* year.

$$(1) \qquad M_{it} = 1 \; if \; plant \; i \; imports \; any \; inputs, 0 \; else$$

$$(2) \qquad Foreign\ Share_{ijt} = \frac{Value\ of\ all\ Imported\ inputs\ purchased\ by\ i}{Value\ of\ all\ inputs\ purchased\ by\ i}$$

$$(3) \qquad Sophistication_{ijt} = \frac{\sum_k QLT^k * FOREIGN\ PURCHASE_{it}^k}{\sum_k QLT^k * ALL\ PURCHASE_{it}^k}$$

The variable QLT^K measures the quality of product *k* that is purchased by firm *i*. To calculate this measure, we propose to use a new technique. Following Abdon, Felipe and Kumar (2010) we proxy the sophistication of product *k* by the "sophistication" of the country that produces it as measured by its income. Intuitively, products produced by richer countries embody higher productivity and better technology and hence these products have higher quality.

[13] See Sharma(2008) for details about ASI data.

$$QLT^k = \sum_c Proportion\ of\ world\ output\ of\ k\ produced\ by\ country\ c$$
$$*\ GDP\ of\ country\ c$$

Since quality is a weighted average of national incomes (measured in 1999 US dollars), $Sophistication_{ijt}$ is measured in US dollars and provides a plant-specific measure of the quality of the input basket imported by the plant.

Following the literature that examines the determinants of imports and exports, a regression equation like the following is estimated.

(1) $$\Pr(Import_{it} = 1 |\, x_{it}, Import_{it-1}, u_{it}) = \alpha_0 + \rho Import_{it-1} + \beta x_{it} + u_{it}$$
$$where\ Import_{it} = 1\ if\ firm\ i\ is\ importing\ at\ time\ t$$

Thus a large and significant ρ provides evidence of large sunk costs of participating in import markets.

We contribute to this literature by also modeling the share of foreign inputs in each plants' total input purchases as well as the sophistication of a plants imported inputs. In addition to plant and industry-level explanatory variables, we also include the lagged dependent variable while modeling import share and sophistication. Intuitively plants that import a lot or import very sophisticated inputs may have their production process geared towards imported/high quality inputs and this may lead to hysteresis in their demand for imported and high quality inputs. We estimate the following equations.

(2) $$Share_{it} = \frac{Value\ of\ Foreign\ Inputs}{Value\ of\ All\ Inputs}_{it} = \alpha_0 + \rho Share_{it-1} + \beta x_{it} + u_{it}$$

(3) $$Sophistication_{it} = \alpha_0 + \rho Sophistication_{it-1} + \beta x_{it} + u_{it}$$

The vector *x* contains controls for various plant characteristics detailed below.

- Plant size: plant size is associated with several characteristics like greater productivity, capital-intensity of technology and economies of scale which in turn are positively associated with participation in foreign markets (Bernard, Jensen, Redding and Schott (2011)).
- Age: older plants may be more likely to import, import more and import better quality inputs since they have had time to establish international networks and test quality of suppliers. However, younger plants (Bernard, Jensen, Redding and Schott (2011)) may be more agile and more likely to use newer technology which may depend on sourcing inputs from abroad.
- Plant ownership structure: foreign owned plants are more likely to import inputs, publicly owned plants may be less likely (Manova and Zhang (2009)).
- Plant financial structure: the sources of internal or external financing that are available to the plant are likely to be an important determinant of the ability to import and also of the quality of imports (Eun and Wang (2009)).
- Plant productivity (lagged): this is a direct prediction of the Antras and Helpman (2004) model.
- Quality of a plants final product (lagged): greater product quality may have been achieved by importing higher quality inputs.

3.3 Econometrics

The estimation of dynamic panel models with limited dependent or binary variables and plant unobservables that may be correlated with independent variables is a challenge. Linear probability models suffer from the drawback that predicted probabilities may lie outside of the unit interval. Fixed effects (to control for plant-level unobservables) are not implemented for techniques like probit and tobit by standard software packages. In any effect, their inclusion provides inconsistent estimates.

Suppose we wish to model a plants' decision to import inputs with the following equation.

$$\Pr(Y_{it} = 1 | \, x_{it}, Y_{it-1}, c_i) = \Phi(\alpha_0 + \rho Y_{it-1} + \beta X_{it} + u_{it})$$

$$\textit{where } x' \textit{sare exogenous variables and } \Phi \textit{ is the standard normal}$$

Without the lagged dependent variable and with the X's completely exogenous, we can use –a random effect probit model to estimate this equation consistently. But with the lagged dependent variable, $E(u_{it}, Y_{it-1}) \neq 0$. So we need to include fixed effects rather than random effects. There is also the initial conditions problem while using maximum likelihood to estimate these models: since we don't observe the stochastic process from the start we can't treat Y_0 – the first observation of the dependent variable – as fixed.

We follow Wooldridge (2005, 2008) in modeling the plant unobservable as a function of plant variables including the initial importing status of the plant (Y_{i0} = 1 if plant imported in t=1, 0 else) and of the plant-level averages of X_{it} (denoted by $\bar{X_\iota}$) .

$$c_i | \, Y_{i0}, X_i \sim Normal\ (a_0 + a_1 Y_{i0} + \bar{X}_i a_2, {\sigma_a}^2) \textit{ where}$$

$$Y_{it} = \Phi(\alpha_0 + \rho Y_{it-1} + \beta X_{it} + a_0 + a_1 Y_{i0} + \bar{X}_i a_2 + u_{it})$$

In that case our estimation equation takes the following form. Note that the remaining plant fixed effect is now orthogonal to the other explanatory variables. The following equation can be estimated by random effects probit.

$$\Pr(Y_{it} = 1 | \, x_{it}, Y_{it-1}, c_i) = \Phi(\alpha_0 + \rho Y_{it-1} + \beta X_{it} + \ a_0 + a_1 Y_{i0} + \bar{X}_i a_2 + \zeta_{it})$$

Another important feature of the Wooldridge (2005, 2008) approach is that it can be applied to fractional dependent variables, in particular those with many zeros (this is likely to be the case with $Share_{it}$ since a large number of plants do not import any inputs). Papke and Wooldridge (1996) point out the functional form issues that arise with fractional response variables. A linear functional form may miss potentially important non-linearities. Further the log-odds transformation fails when we observe responses at the corners. Even in cases where the response lies strictly within the unit interval it is hard to recover the expected value of the fractional response from a linear model of the log-odds ratio. Papke and Wooldridge (2008) propose the pooled fractional probit (PFP) estimator that provides consistent estimates of the lagged dependent variable when the dependent variable is a fraction and is implemented in a similar manner to the probit procedure.

$$Share_{it}(x_{it}, Share_{it-1}, c_i) = \Phi(\alpha_0 + \rho Share_{it-1} + \beta X_{it} + a_0 + a_1 Y_{i0} + \bar{X}_i a_2 + \zeta_{it})$$

Section 4. Stylized facts

1. *Participation in foreign (in particular, import) markets is low and declines over the time period 1998-2007.*

- Table 1 shows that in India 27% of all formal manufacturing plants imported inputs in 1998 and this ratio steadily declined to 16% in 2007. These figures are lower than others reported for India (Tucci (2005) reports that 38% of plants in their data import inputs).

2. *Over the same time period, the intensity of use of imported inputs is growing. That is, even as the percentage of plants using imported inputs has shrunk, import usage has gone up.*

- Table 1 shows that input usage has risen over time. In 1998, the average importing plant imported 18% of its inputs and this figure has steadily risen to 25% in 2007. Further, the whole manufacturing sector imported 29% of its inputs in 1998 and this figure has steadily risen to 47% in 2007.

3. *Import participation rates vary by plant characteristics like ownership (very heavily skewed towards privately owned plants) and age (highest in middle aged plants, see* Table 2*). However patterns in import intensity (share of foreign inputs in total inputs) are harder to identify across these characteristics.*

4. *Import participation and intensity vary across Indian states and across industries, sometimes in surprising ways.*

- Table 3 shows that more industrialized states (those with larger manufacturing sectors for example, Maharashtra, Tamil Nadu, Gujarat and Andhra Pradesh) have lower but more stable import participation rates compared to less industrialized states (Rajasthan, Bihar, Uttar Pradesh and West Bengal). More industrialized states also tend to have greater intensity of importer input use than most other states.
- Table 4 shows that the sharpest declines in import participation and intensity of import use have occurred in industries which had the highest participation rates in 1998. Almost every <u>other</u> industry's total imported input usage (as a share of total input use) and average imported input use has risen over time.

5. *Similar to China, imported input use in Indian manufacturing is highly concentrated and this trend is intensifying over time.*

- Table 5 shows that plants in the 90th percentile of import volume accounted for 78% of all imports in 1998 and this figure rose to 91% in 2007. There is a sharp drop off in imported input use from the 90th to the 75th percentile. Below that, imported input use is almost neglible.

6. *There is significant amount of churning in the import status of Indian manufacturing plants.*

- Table 6 shows that ~15% of importing plants and ~8% of non-importing plants changed their importing status between 1998 and 1999. The percentage of firms transitioning into importing steadily increases between 1998 and 2003 and then falls sharply. Since some of this movement can be due to entry-exit of plants from the panel, in panel B of the table we restrict our attention to the balanced panel of 2890 that exist for all 10 years. The percentage of previous non-importers transitioning into importers is lower but still quite significant for the balanced panel.

7. *Indian manufacturing plants that import inputs have more sophisticated final products and more sophisticated domestic inputs compared to non-importing plants.*

- Figure 1 shows the sophistication profile of importers and non-importers. The sophistication level of final products produced by importers (as measured by weighted average per capita GDP of countries that produce these products) is much larger than that of non-importers (though surprisingly neither grows much over time).

- Importers use more sophisticated domestic inputs compared to non-importers. The sophistication of domestic inputs rises substantially in the initial years and then flattens out (or even falls a little) after 2003.
- Figure 2 and Figure 3 show the sophistication index for imported inputs for the 6 most sophisticated industries and the 6 least sophisticated industries. These figures show that there is significant cross-sectional variation across industries. These figures also show a decline in import sophistication between 2003 and 2007 for almost all industries.

Section 5. Results

5.1 Import Status

Despite the obvious drawbacks, we begin by estimating Equation (1) as a linear probability model and present the results in Table 7. All columns include year fixed effects and robust clustered standard errors (to account for serial correlation within a plant). The first column treats the plant-unobservable as a random effect. The coefficient on the lagged dependent variable is large, positive and statistically significant. That is, Indian plants face large sunk costs in importing inputs and this creates hysteresis in their import behavior. The coefficient on input tariffs faced by the industry (a measure of non-sunk trade costs) is also large and significant but is positive – a rise in input tariffs seems to lead to a rise in the probability that a firm will import. In line with evidence from other countries, large plants (with greater labor demand) and more productive plants have a higher probability of being importers. Further plants that use more skilled labor (which is a proxy for capital-intensity of the plants' technology) are also more likely to import. That is, the presence of capital-skill complementarities raises the probability that a plant imports some inputs. As expected younger plants, privately owned plants and plants located in urban areas are more likely to be importers.

While the estimates in Column (1) provide a useful benchmark these are unlikely to be consistent – in the presence of a lagged dependent variable, the assumptions of a random effects model do not hold. In Column (2) we model the plant-unobservable as a fixed effect and continue to find evidence of large sunk costs associated with importing even though the coefficient on lag import status is much smaller than in the random effects model. Additionally the sign on input tariffs changes – once we allow for plant unobservables to be correlated with the independent variables plants facing greater input tariffs are less likely to import. Larger and more productive plants are more likely to import but greater skilled labor use no longer affects the probability of importing.

To see how important is the effect serial correlation within a plant, in Column (3) we do not cluster the standard errors by plant id. The significance of all the results is unchanged – that is, serial correlation does not seem to be a big problem.

There is significant amount of entry of plants into and exit out of our sample. If entrants (younger firms) are more likely to import then our results may be affected. In the last column of Table 7 estimates Equation (1) for the sub-set of 2890 plants that are present in the data in each year during 1998-2007. All our results are robust for the balanced panel.

Now that we have some benchmark results, we go on to estimate Equation (1) as a probit model. Column (1) of Table 8 shows the marginal effects calculated from the coefficient estimates of a random effects probit model. In Column (2) we implement the procedure outlined in Wooldridge

(2008) are model the plant unobservables as fixed within a probit model.[14] We find statistically significant evidence of large sunk costs (plants that imported last year are more likely to import this year) and of non-sunk trade costs (lower input tariffs are associated with a higher probability of imports) in both models. However the marginal effect of lag import status estimated by the fixed effects model is half of the marginal effect estimated by the random effects model. Almost all the other marginal effects – other than for plant size, productivity and share of skilled workers – are similar between the random effects and the fixed effects model. Thus it is important to account for plant unobservables that may be correlated with independent variables particularly when the coefficient of interest is the one of the lag dependent variable.

5.2 Import Share

Now we proceed to estimate Equation (2). Table 9 presents the OLS estimates and presents the marginal effects calculated from the coefficients of pooled probit model. In the first three columns we do not include the lag dependent variable and find that a large and significant of input tariffs on plants' import share once we account for the fractional nature of the dependent variable (Columns 1-3). Surprisingly, plant size, productivity and skill share does not affect its import share once we model plant unobservables as fixed effects. Younger plants, those located in urban areas and privately owned plants have much larger import shares.

In Columns 4-6 of Table 9 and we include the lag value of the import share. We find a large statistically significant coefficient on this variable in all specifications. This shows that the intensive margin of imported inputs also shows hysteresis. This may be due to inflexibilities in

[14] The procedure outlined in Wooldridge (2008) is implemented by inserting plant-level means of independent variables and the initial importing status in 1998 into a random effects probit model. We also insert time-invariant plant characteristics in this model.

the production process that force the plant to pay another kind of sunk costs. Once a plant decides to use imported inputs, its production process needs to be optimized to these inputs (the costs of this optimization are likely to be large and non-recoverable) and this makes it harder for the plant to stop using imported inputs. Additionally, there may not exist domestic substitutes to imported inputs making the plant even more dependent on foreign supply. Note that all these results are robust to restricting our sample to importing plants only.

5.3 Alternate Specifications

In Table 11 we present two alternative specifications. In Columns (1) and (3) we include dummy variables that indicate the length of separation of the plant from the foreign market. We find that if the plant last imported 2 (3) years ago then the probability of importing this year rises (Column 1). Consistent with Roberts and Tybout (1997) these coefficients can be interpreted as discounts from the full sunk costs faced by a new trader (in our case, a new importer) and are positive and decline over time. However, separation from the foreign market reduces the import share of the plant (Column 3, coefficient on "Last exported 3 years ago").

In the spirit of Bernard and Jensen (2004) and Lopez and Yadav (2010) we would like to test whether there are agglomeration economies that accrue to plants located in industries and states where other plants also import. Intuitively suppose a plant is located in an industry or a geographic area where a lot of plants import then the plant has access to networks and information that make it easier for the plant to become an importer. To proxy for these agglomeration economies, we include the proportion of plants that import within a state-industry cell as well as the average import share of the state-industry cell. We find that a cluster of importing plants in a state-industry cell raises the probability that a plant in that cell will import and raises the average import share of the plant. However the agglomeration economies seem to stem only from the extensive margin (proportion of plants that import) rather than the intensive margin in the state-industry cell (average import share in state-industry cell).

5.4 Sophistication of Imported Inputs

Now we model the sophistication of the import basket of each plant. In Column 1 of Table 12 we find that the compared to import status or import share, the sophistication of imports is much more affected by plant-level variables. Larger plants, more productive plants and plants that use more skilled labor have more sophisticated imported input baskets.

Surprisingly, input tariffs (which strongly affected both import status and import share) do not affect the sophistication level.

In Column (2) we include lag import sophistication and find a strong positive relationship. Thus there is hysteresis in the quality of products that the plant sources from abroad.

It is also likely that the quality/sophistication of the final product basket affects a plants' demand for sophisticated inputs. When we include lag final product sophistication in Column 3 we find this to be true. More sophisticated final products are associated with more sophisticated import baskets.

In a recent paper Halpern, Koren and Szeidl (2011) raise the possibility that imported and domestic inputs may be complements. That is, a plant can raise its productivity by combining high quality imported inputs with domestically available inputs. In order to test for this, in Column 4 we include lag domestic input sophistication level and find a significant positive effect. Thus plants that use more sophisticated domestic inputs also use more sophisticated foreign inputs.

In the last column of Table 12 we include agglomeration measures including the average sophistication level in the state-industry cell in which the plant is located. We find that the proportion of importers in the cell significantly raises the sophistication level of a plants imports. However the average import share or average sophistication level does not have an effect. Thus the networks and information provided by a cluster of importing plants matters for the importing behavior of the plant.

Section 6. Conclusion

In this paper we analyze the determinants of importing behavior and of the sophistication/ quality of inputs imported by Indian manufacturing plants. Insofar as more and higher quality imports lead to new and higher quality final products to be produced it is essential to analyze who imports, how much they import and what they import.

We find evidence of significant sunk costs of importing in Indian manufacturing. Consistent with literature we find that younger, more productive and capital-intensive plants are more likely to import.

We also find hysteresis in the intensive margin (share of foreign inputs) and in the sophistication of the input basket. We interpret this as evidence of another type of sunk cost – that incurred by a plant when it optimizes its production process to the use of imported/ sophisticated inputs. These costs make it difficult for the firm to change the quantity or quality of inputs that it purchases from abroad.

Further, we find evidence that non-sunk costs of international trade – in particular input tariffs – affect the probability that a plant imports input and the share of foreign input in total input. Input tariffs do not affect the sophistication of a plants' input basket. This finding is important for policy makers – lowering tariffs may not necessarily encourage plants to purchase high quality inputs that are needed to produce new and higher quality final products.

We find evidence of agglomeration economies that accrue to plants that locate in state-industry cells that contain a large proportion of importers. That is, a plant can benefit from information provided by currently-importing plants and make use of established networks. These economies raise the probability that a plant imports, its import share and the sophistication of its input basket.

Section 7. Table and Figures

Table 1: Import Participation and Usage Intensity, by Plant Ownership

			Share of plants importing raw materials							
Ownership	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Public (Central or State/Local Gov't.)	0.21	0.19	0.19	0.16	0.16	0.16	0.16	0.20	0.20	0.26
Quasi-Private	0.30	0.30	0.24	0.21	0.24	0.28	0.37	0.29	0.35	0.37
Wholly Private	0.28	0.31	0.26	0.24	0.29	0.31	0.29	0.24	0.21	0.21
Other	0.05	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00
Total	***0.27***	***0.26***	***0.22***	***0.21***	***0.26***	***0.28***	***0.28***	***0.21***	***0.18***	***0.16***

			Total Imports as share of Total Input Use							
Ownership	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Public (Central or State/Local Gov't.)	0.37	0.43	0.41	0.41	0.40	0.47	0.48	0.52	0.69	0.60
Quasi-Private	0.22	0.22	0.20	0.22	0.26	0.28	0.30	0.47	0.44	0.56
Wholly Private	0.26	0.27	0.29	0.38	0.36	0.33	0.37	0.38	0.45	0.46
Other	0.11	n/a	0.31	n/a	n/a	n/a	0.39	0.39	0.10	0.18
Total	***0.29***	***0.31***	***0.32***	***0.38***	***0.37***	***0.36***	***0.38***	***0.41***	***0.47***	***0.47***

			Import Share of Average Importer (conditional on import participation)							
Ownership	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Other	0.11		0.31				0.02	0.24	0.04	0.15
Public (Central or State/Local Gov't.)	0.22	0.26	0.21	0.23	0.26	0.26	0.26	0.22	0.27	0.22
Quasi-Private	0.19	0.18	0.21	0.17	0.29	0.20	0.15	0.23	0.28	0.34
Wholly Private	0.20	0.21	0.21	0.22	0.22	0.22	0.24	0.27	0.27	0.28
	0.18	0.21	0.24	0.21	0.26	0.22	0.17	0.24	0.22	0.25

Table 2: Import Participate and Usage Intensity, by Plant Age

Share of plants importing raw materials

Age Category	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
1-10%/0-2y	0.24	0.07	0.08	0.08	0.09	0.11	0.12	0.10	0.07	0.08
11-25%/3-5y	0.27	0.29	0.25	0.24	0.28	0.26	0.26	0.18	0.16	0.16
26-50%/6-13y	0.25	0.29	0.27	0.24	0.30	0.33	0.33	0.27	0.25	0.22
51-75%/13-26y	0.26	0.28	0.24	0.23	0.30	0.31	0.31	0.26	0.26	0.26
76-90%/27-44y	0.34	0.38	0.31	0.30	0.34	0.34	0.36	0.29	0.27	0.26
91-100%/45-200y	0.26	0.31	0.23	0.23	0.23	0.26	0.26	0.24	0.25	0.25
Total	***0.27***	***0.26***	***0.22***	***0.21***	***0.26***	***0.28***	***0.28***	***0.21***	***0.18***	***0.16***

Imports as share of raw materials for importers (conditional on import participation)

Age Category	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
1-10%/0-2y	0.48	0.39	0.33	0.74	0.68	0.45	0.53	0.47	0.48	0.57
11-25%/3-5y	0.32	0.43	0.45	0.49	0.39	0.55	0.56	0.56	0.49	0.49
26-50%/6-13y	0.32	0.31	0.30	0.28	0.33	0.35	0.39	0.41	0.56	0.58
51-75%/13-26y	0.29	0.30	0.29	0.29	0.23	0.21	0.22	0.23	0.30	0.31
76-90%/27-44y	0.27	0.32	0.34	0.33	0.35	0.36	0.37	0.42	0.51	0.48
91-100%/45-200y	0.16	0.23	0.28	0.30	0.32	0.35	0.39	0.45	0.45	0.43
Total	0.29	0.31	0.32	0.38	0.37	0.36	0.38	0.41	0.47	0.47

Table 3: Import Participation and Usage Intensity, by States

State	Share of Plants Importing Inputs 1998	2003	2007	Total Imports as share of Total Inputs Use 1998	2003	2007	Import Share of Average Importer 1998	2003	2007
Chandigarh	0.57	0.36	0.06	0.40	0.20	0.36	0.29	0.34	0.33
Goa	0.46	0.67	0.30	0.22	0.37	0.48	0.16	0.25	0.37
Maharashtra	0.45	0.45	0.31	0.24	0.28	0.33	0.21	0.21	0.28
Haryana	0.41	0.35	0.18	0.20	0.15	0.11	0.17	0.17	0.23
Rajasthan	0.41	0.27	0.13	0.14	0.15	0.30	0.10	0.13	0.19
Pondicherry	0.41	0.39	0.14	0.15	0.42	0.48	0.13	0.23	0.41
WB	0.37	0.30	0.20	0.44	0.51	0.58	0.17	0.21	0.24
Daman & Diu	0.36	0.28	0.23	0.23	0.39	0.42	0.32	0.30	0.41
Himachal Pradesh	0.36	0.42	0.15	0.12	0.19	0.18	0.19	0.12	0.25
D&N Haveli	0.35	0.38	0.23	0.52	0.20	0.24	0.29	0.25	0.39
Gujrat	0.33	0.35	0.27	0.37	0.49	0.70	0.25	0.24	0.33
Karnataka	0.33	0.29	0.17	0.51	0.51	0.58	0.27	0.26	0.32
Kerela	0.31	0.30	0.22	0.40	0.14	0.58	0.28	0.40	0.43
MP	0.31	0.26	0.10	0.16	0.21	0.22	0.14	0.15	0.20
Bihar	0.30	0.12	0.05	0.15	0.43	0.50	0.13	0.14	0.15
Orissa	0.30	0.25	0.13	0.29	0.30	0.35	0.17	0.26	0.25
Delhi	0.24	0.27	0.09	0.21	0.15	0.30	0.24	0.14	0.17
Andhra Pradesh	0.23	0.26	0.17	0.41	0.48	0.55	0.23	0.25	0.27
Punjab	0.21	0.16	0.05	0.12	0.15	0.20	0.16	0.13	0.20
Tamil Nadu	0.19	0.27	0.17	0.32	0.36	0.45	0.23	0.22	0.28
J&K	0.19	0.16	0.07	0.03	0.09	0.14	0.04	0.00	0.16
UP	0.19	0.23	0.15	0.20	0.27	0.43	0.18	0.22	0.24
A&N Islands	0.18	0.00	0.00	0.36			0.23		
Assam	0.02	0.01	0.01	0.03	0.03	0.02	0.13	0.06	0.08
Manipur	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Meghalaya	0.00	0.02	0.13	0.00	0.66	0.14	0.00	0.00	0.18
Nagaland	0.00	0.00	0.01	0.00	0.00	0.05	0.00	0.00	0.05
Tripura	0.00	0.00	0.00	0.00	0.51			0.51	

Table 4: Import Participation and Usage Intensity, by Industry

NIC	Name	Share of plants importing inputs			Total Imports as share of Total Input Use			Import Share of Average Importer		
		1998	2003	2007	1998	2003	2007	1998	2003	2007
17	MANUFACTURE OF TEXTILES	0.80	0.80	0.12	0.14	0.16	0.15	0.11	0.15	0.15
19	TANNING AND DRESSING OF LEATHER; MANUFACTURE OF LUGGAGE, HANDBAGS SADDLERY, HARNESS AND FOOTWEAR	0.80	0.50	0.26	0.19	0.18	0.20	0.16	0.15	0.20
30	MANUFACTURE OF OFFICE, ACCOUNTING AND COMPUTING MACHINERY	0.80	0.80	0.12	0.66	0.63	0.57	0.46	0.52	0.55
32	MANUFACTURE OF RADIO, TELEVISION AND COMMUNICATION EQUIPMENT AND APPARATUS	0.80	0.50	0.26	0.38	0.39	0.40	0.38	0.40	0.40
18	MANUFACTURE OF WEARING APPAREL; DRESSING AND DYEING OF FUR	0.67	0.46	0.23	0.34	0.25	0.24	0.45	0.31	0.19
21	MANUFACTURE OF PAPER AND PAPER PRODUCTS	0.67	0.59	0.27	0.18	0.22	0.27	0.17	0.16	0.25
24	MANUFACTURE OF CHEMICALS AND CHEMICAL PRODUCTS	0.67	0.50	0.19	0.34	0.30	0.41	0.28	0.28	0.29
31	MANUFACTURE OF ELECTRICAL MACHINERY AND APPARATUS N.E.C.	0.67	0.46	0.23	0.29	0.29	0.31	0.21	0.22	0.29
34	MANUFACTURE OF MOTOR VEHICLES, TRAILERS AND SEMI-TRAILERS	0.67	0.59	0.27	0.13	0.20	0.18	0.18	0.18	0.21
23	MANUFACTURE OF COKE, REFINED PETROLEUM PRODUCTS AND NUCLEAR FUEL	0.56	0.40	0.21	0.51	0.61	0.79	0.45	0.58	0.58
36	MANUFACTURE OF FURNITURE; MANUFACTURING N.E.C.	0.56	0.40	0.21	0.47	0.61	0.60	0.40	0.43	0.44
27	MANUFACTURE OF BASIC METALS	0.52	0.40	0.24	0.23	0.27	0.35	0.18	0.20	0.26
20	MANUFACTURE OF WOOD AND OF PRODUCTS OF WOOD AND CORK,EXCEPT FURNITURE;MANUFACTURE OF ARTICLES OF STRAW AND PLATING MATERIALS	0.40	0.19	0.10	0.28	0.44	0.41	0.18	0.26	0.44
33	MANUFACTURE OF MEDICAL, PRECISION AND OPTICAL INSTRUMENTS, WATCHES AND CLOCKS	0.40	0.19	0.10	0.49	0.34	0.41	0.25	0.28	0.29
22	PUBLISHING, PRINTING AND REPRODUCTION OF RECORDED MEDIA	0.38	0.40	0.28	0.54	0.44	0.50	0.55	0.21	0.26
35	MANUFACTURE OF OTHER TRANSPORT EQUIPMENT	0.38	0.40	0.28	0.22	0.09	0.10	0.16	0.12	0.14
26	MANUFACTURE OF OTHER NON-METALLIC MINERAL PRODUCTS	0.34	0.23	0.17	0.15	0.14	0.16	0.15	0.16	0.22
25	MANUFACTURE OF RUBBER AND PLASTIC PRODUCTS	0.33	0.21	0.11	0.21	0.19	0.24	0.22	0.18	0.28
16	MANUFACTURE OF TOBACCO PRODUCTS	0.33	0.15	0.05	0.11	0.06	0.03			
29	MANUFACTURE OF MACHINERY AND EQUIPMENT N.E.C.	0.33	0.15	0.05	0.19	0.22	0.22	0.19	0.16	0.23
15	MANUFACTURE OF FOOD PRODUCTS AND BEVERAGES	0.03	0.04	0.03	0.18	0.27	0.33	0.16	0.25	0.36
28	MANUFACTURE OF FABRICATED METAL PRODUCTS, EXCEPT MACHINERY AND EQUIPMENTS	0.03	0.04	0.03	0.23	0.18	0.42	0.16	0.21	0.32
14	OTHER MINING AND QUARRYING	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 5: Distribution of Imports Across Plants

Import Volume (sum across plants in percentile range, in Int'l USD @ PPP)

Plant Import Volume Percentile Range	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
0-10th	8	8	10	10	11	12	16	16	18	19
11-25th	88	88	97	102	116	123	149	158	186	192
26-50th	702	735	896	860	963	1,028	1,201	1,331	1,517	1,609
51-75th	2,800	2,917	3,805	3,807	3,877	4,320	5,221	5,980	6,921	7,551
76-90th	5,257	5,369	7,420	7,186	7,439	8,324	11,092	13,280	15,044	17,283
90-100th	30,790	40,601	57,068	73,011	86,485	97,380	139,576	173,292	246,079	285,090
Total Volume	***39,645***	***49,719***	***69,296***	***84,976***	***98,892***	***111,185***	***157,256***	***194,057***	***269,765***	***311,745***
Total # of plants	***2,091***	***1,990***	***3,439***	***3,384***	***3,193***	***3,409***	***3,930***	***4,574***	***4,775***	***5,192***

Distribution of Imports Across Percentiles

Plant Import Volume Percentile Range	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
0-10th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11-25th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26-50th	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
51-75th	0.07	0.06	0.05	0.04	0.04	0.04	0.03	0.03	0.03	0.02
76-90th	0.13	0.11	0.11	0.08	0.08	0.07	0.07	0.07	0.06	0.06
90-100th	0.78	0.82	0.82	0.86	0.87	0.88	0.89	0.89	0.91	0.91
Total Volume	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 6: Transition to and from Import Participation (%)

Panel A: All Operating Plants

Initial Status	Importing in t		Not Importing in t		Total Non-Importers in t	Total Importers in t
Year	Importing in t+1	Not Importing in t+1	Not Importing in t+1	Importing in t+1		
1998	84.90	14.43	90.86	8.11	1,850	1,053
1999	86.93	12.41	87.35	10.70	1,953	1,056
2000	81.55	16.51	78.83	16.88	2,305	1,187
2001	81.07	17.82	71.50	25.52	2,747	1,257
2002	84.11	14.83	79.01	17.76	2,663	1,227
2003	83.35	15.43	77.50	19.41	2,942	1,309
2004	79.91	14.79	85.49	6.41	3,680	1,548
2005	73.10	19.24	81.01	6.51	6,708	1,985
2006	75.58	18.14	83.85	6.29	9,455	2,244
2007	0.00	100.00	-	100.00	11,449	2,645

Panel B: Balanced Panel

Initial Status	Importing in t		Not Importing in t		Total Non-Importers in t	Total Importers in t
Year	Importing in t+1	Not Importing in t+1	Not Importing in t+1	Importing in t+1		
1998	84.97	14.37	91.25	7.72	1,850	1,053
1999	88.10	11.61	91.67	8.01	1,953	1,056
2000	87.84	12.07	92.20	7.69	2,305	1,187
2001	87.96	11.94	94.97	4.92	2,747	1,257
2002	89.42	10.38	93.95	5.95	2,663	1,227
2003	90.40	9.60	95.24	4.60	2,942	1,309
2004	86.95	12.95	95.01	4.88	3,680	1,548
2005	87.21	12.79	95.70	4.20	6,708	1,985
2006	87.33	12.46	94.98	4.77	9,455	2,244
2007	0.00	100.00	-	100.00	11,449	2,645

Note: Column 2 shows the percentage of importers in year t that continued importing in year t+1. Column 3 shows the percentage of importers in year t that became non-importers in year t+1. Column 4 shows the percentage of non-importers in year t that remained non-importers in t+1. Column 5 shows the percentage of non-importers in year

Table 7: OLS Estimates – Import Status

	Dependent Variable: Import Status			
	Random Effects	Fixed Effects	Fixed Effects	Fixed Effects - Balanced Panel
	1	2	3	4
Lag import status (0/1)	0.7135***	0.1841***	0.1841***	0.2368***
	(0.0066)	(0.0123)	(0.0063)	(0.0138)
Lag ln(labor demand)	0.0316***	0.0347***	0.0347***	0.0451***
	(0.0016)	(0.0063)	(0.0050)	(0.0081)
Lag industry input tariff	-0.0435***	0.0185**	0.0185**	0.0208**
	(0.0038)	(0.0080)	(0.0080)	(0.0087)
Lag TFP	0.0163***	0.0126***	0.0126***	0.0183***
	(0.0013)	(0.0031)	(0.0029)	(0.0039)
Lag share of workers skilled	0.1327***	0.0415	0.0415	0.0368
	(0.0154)	(0.0327)	(0.0296)	(0.0427)
Lag product sophistication	-0.0006	-0.0002	-0.0002	-0.0008
	(0.0009)	(0.0010)	(0.0010)	(0.0010)
age	-0.0005***			
	(0.0001)			
Privately Owned Plant	0.0487***			
	(0.0062)			
Urban location	0.0136***			
	(0.0033)			
_cons	-0.2241***	-0.1611**	-0.1611***	-0.3041***
	(0.0243)	(0.0664)	(0.0599)	(0.0870)
N	33406	34730	34730	21580
R-sq		0.0385	0.0385	0.0627

Note: ***, **, and * indicate significance at 1%, 5%, and 10% confidence levels, respectively. Column 1 models plant unobservables as random effects. The other columns model plant unobservables as fixed effects. All columns include year fixed effects. Robust clustered standard errors are reported except in Column (3). The sample period is 1999-2007.

Table 8: Dynamic Panel Probit Estimates – Import Status

	Dependent Variable: Import Status		
	Random Effects	**Fixed Effects**	**Fixed Effects- Balanced**
	(1)	(2)	(3)
Lag import status (0/1)	0.6613***	0.3320***	0.2599***
	(0.0094)	(0.0164)	(0.0156)
Lag ln(labor demand)	0.0323***	0.0049	0.0298***
	(0.0018)	(0.0047)	(0.0070)
Lag industry input tariff	-0.0510***	-0.0342***	-0.0475***
	(0.0049)	(0.0054)	(0.0095)
Lag TFP	0.0195***	-0.0054*	0.0152***
	(0.0015)	(0.0031)	(0.0045)
Lag share of workers skilled	0.1070***	0.0006	-0.0138
	(0.0148)	(0.0291)	(0.0408)
age	-0.0006***	-0.0008***	-0.0005***
	(0.0001)	(0.0001)	(0.0001)
Privately Owned Plant	0.0462***	0.0462***	0.0520***
	(0.0067)	(0.0078)	(0.0095)
Urban location	0.0125***	0.0111***	0.0164***
	(0.0031)	(0.0037)	(0.0055)
N	33406	33406	21086
Year FE	Yes	Yes	Yes

Note: ***, **, and * indicate significance at 1%, 5%, and 10% confidence levels, respectively. Column 1 models plant unobservables as random effects. The other columns model plant unobservables as fixed effects. All specifications include year fixed effects. The sample period is 1999-2007. The table reports the marginal effect (and its standard error) of each coefficient.

Table 9: OLS Estimates - Import Share

	Dependent Variable: Share of Imported Inputs					
	Random Effects	**Fixed Effects**	**Fixed Effects-Balanced Panel**	**Random Effects**	**Fixed Effects**	**Fixed Effects-Balanced Panel**
	(1)	(2)	(3)	(4)	(5)	(6)
Lag import Share				0.7123***	0.2422***	0.3552***
				(0.0110)	(0.0215)	(0.0229)
Lag ln(labor demand)	0.0152***	0.0036	0.0034	0.0062***	0.0023	0.0019
	(0.0013)	(0.0022)	(0.0028)	(0.0007)	(0.0019)	(0.0020)
Lag industry input tariff	-0.0100***	0.0010	0.0037	-0.0082***	0.0012	0.0031
	(0.0024)	(0.0029)	(0.0033)	(0.0014)	(0.0024)	(0.0025)
Lag TFP	0.0126***	0.0059***	0.0061***	0.0057***	0.0047***	0.0045***
	(0.0010)	(0.0012)	(0.0014)	(0.0006)	(0.0011)	(0.0011)
Lag share of workers skilled	0.0426***	0.0047	-0.0042	0.0288***	0.0024	-0.0112
	(0.0107)	(0.0129)	(0.0163)	(0.0066)	(0.0117)	(0.0132)
Lag Product Sophistication	-0.0008***	-0.0004	-0.0003	-0.0005**	-0.0004	-0.0004
	(0.0003)	(0.0003)	(0.0003)	(0.0002)	(0.0003)	(0.0003)
Plant Age	-0.0003***			-0.0002***		
	(0.0001)			(0.0000)		
Privately Owned Plant	0.0100***			0.0072***		
	(0.0027)			(0.0020)		
Urban location	0.0021			0.0027**		
	(0.0021)			(0.0013)		
Constant	-0.1948***	-0.0247	-0.0333	-0.0775***	-0.0201	-0.0267
	(0.0180)	(0.0248)	(0.0314)	(0.0097)	(0.0214)	(0.0233)
N	33406	34730	21580	33406	34730	21580
R-sq		0.0028	0.0031		0.0596	0.1246

Note: ***, **, and * indicate significance at 1%, 5%, and 10% confidence levels, respectively. Columns 1 and 4 models plant unobservables as random effects. The other columns model plant unobservables as fixed effects. All columns include year fixed effects and robust clustered standard errors. The sample period is 1999-2007.

Table 10: Pooled Fractional Probit Estimates- Import Share

	Dependent Variable: Share of Imported Inputs					
	Random Effects	**Fixed Effects**	**Fixed Effects-Balanced**	**Random Effects**	**Fixed Effects**	**Fixed Effects-Balanced**
	(1)	(2)	(3)	(4)	(5)	(6)
Lag import share				7.8572***	7.3321***	7.5647***
				(0.1004)	(0.1003)	(0.1218)
Lag ln(labor demand)	0.4594***	0.1067	0.0920	0.2553***	-0.0565	0.0138
	(0.0296)	(0.0707)	(0.0825)	(0.0161)	(0.0599)	(0.0522)
Lag industry input tariff	-0.8925***	-0.4899***	-1.0178***	-0.6227***	-0.4332***	-0.6258***
	(0.0963)	(0.1039)	(0.1748)	(0.0657)	(0.0675)	(0.0814)
Lag TFP	0.4868***	0.0576	0.1988***	0.1714***	-0.0327	0.0758*
	(0.0314)	(0.0434)	(0.0471)	(0.0174)	(0.0453)	(0.0460)
Lag share of workers skilled	1.2977***	0.3408	-0.0341	0.8499***	0.0061	-0.2455
	(0.2548)	(0.2839)	(0.3170)	(0.1457)	(0.3184)	(0.2984)
age	-0.0127***	-0.0139***	-0.0077***	-0.0057***	-0.0066***	-0.0042***
	(0.0018)	(0.0021)	(0.0021)	(0.0008)	(0.0009)	(0.0009)
Privately Owned	0.5183***	0.3666**	0.4042***	0.3627***	0.3083***	0.3618***
	(0.1367)	(0.1440)	(0.1497)	(0.0699)	(0.0716)	(0.0662)
Urban location	0.2372***	0.1361**	0.1638*	0.1065***	0.0647*	0.0849**
	(0.0595)	(0.0646)	(0.0859)	(0.0315)	(0.0337)	(0.0400)
N	33406	33406	21086	33406	33406	21086

Note: ***, **, and * indicate significance at 1%, 5%, and 10% confidence levels, respectively. Columns 1 and 4 models plant unobservables as random effects. The other columns model plant unobservables as fixed effects. All columns include year fixed effects and robust clustered standard errors. The sample period is 1999-2007. The table reports the marginal effect (and its standard error) of each coefficient.

Table 11: Alternate Specifications

	Dependent Variable: Import Status		Dependent Variable: Import Share	
	Seperation from International Market	Agglomeration Effects	Seperation from International Market	Agglomeration Effects
	(1)	(2)	(3)	(4)
Lag Import Status (0/1)	0.6361***	0.4000***		
	(0.0155)	(0.0168)		
Lag import share			7.6822***	6.4238***
			(0.1133)	(0.0891)
Last imported 2 years ago	0.1018***		0.1750	
	(0.0070)		(0.1134)	
Last imported 3 years ago	0.0523***		-0.5648***	
	(0.0089)		(0.1594)	
Share of Importing Plants in State-Industry Cell		0.1293***		0.6350***
		(0.0102)		(0.0583)
Average Import Share in State-Industry Cell		0.0001		0.0000
		(0.0001)		(0.0014)
Lag industry input tariff	-0.0450***	-0.0215***	-0.5760***	-0.1891***
	(0.0062)	(0.0075)	(0.0770)	(0.0649)
Plant Age	-0.0004***	-0.0006***	-0.0056***	-0.0036***
	(0.0001)	(0.0001)	(0.0009)	(0.0008)
Privately Owned Plant	0.0373***	0.0476***	0.3526***	0.2177***
	(0.0088)	(0.0103)	(0.0706)	(0.0642)
Urban location	0.0132***	0.0083*	0.0711*	0.0163
	(0.0040)	(0.0047)	(0.0381)	(0.0299)
N	19027	23698	19027	23698

Note: ***, **, and * indicate significance at 1%, 5%, and 10% confidence levels, respectively. All columns model plant unobservables as fixed effects. All columns include year fixed effects and robust clustered standard errors. The sample period is 1999-2007. The table reports the marginal effect (and its standard error) of each coefficient.

Table 12: Sophistication of Imported Inputs

	Dependent Variable: Sophistication of Imported Inputs				
	OLS, Fixed Effects	**OLS, Fixed Effects**	**OLS, Fixed Effects**	**OLS, Fixed Effects**	**OLS, Fixed Effects**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Lag ln(labor demand)	0.4721***	0.3905***	0.4643***	0.4585***	0.5559***
	(0.0647)	(0.0594)	(0.0650)	(0.0577)	(0.0826)
Lag industry input tariff	-0.0233	0.0402	-0.0020	0.0474	-0.1358
	(0.0864)	(0.0790)	(0.0858)	(0.0873)	(0.1272)
Lag TFP	0.1860***	0.1443***	0.1757***	0.1826***	0.2261***
	(0.0310)	(0.0292)	(0.0316)	(0.0324)	(0.0411)
Lag share of workers skilled	0.7581**	0.6394**	0.7630**	0.5990*	0.7659*
	(0.3383)	(0.3171)	(0.3382)	(0.3371)	(0.4506)
Lag Import Sophistication		0.1422***			
		(0.0103)			
Lag Final Product Sophistication			0.0238**		
			(0.0107)		
Lag Domestic Input Sophistication				0.0242**	
				(0.0097)	
Share of Importing Plants in State-Industry Cell					0.9172***
					(0.2892)
Average Import Share in State-Industry Cell					0.0004
					(0.0004)
Average Import Sophistication in State-Industry Cell					0.0000
					(0.0000)
N	34730	34730	34730	27897	24625
R-sq	0.0124	0.0337	0.0127	0.0112	0.0195

Note: ***, **, and * indicate significance at 1%, 5%, and 10% confidence levels, respectively. All columns model plant unobservables as fixed effects. All columns include year fixed effects and robust clustered standard errors. The sample period is 1999-2007.

Figure 1: Sophistication Profile of Average Plant - by Import Status

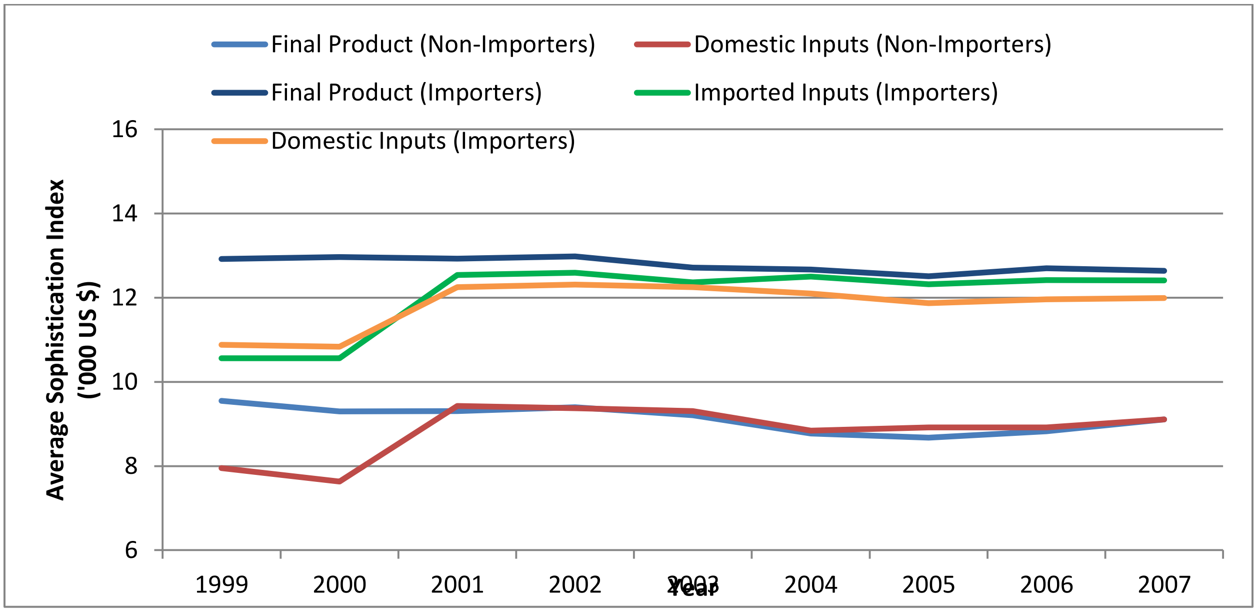


Figure 2: Imported Input Sophistication Index: Top 6 Industries

NIC 22: Publishing, printing and reproduction of recorded media, NIC 29: Machinery and Equipment, NIC 23: Coke, refined petroleum products and nuclear fuels, NIC 19: Tanning and dressing of leather, manufacture of leather products, NIC 32: Radio, Television and communication equipment and apparatus, NIC 28: Fabricated metal products (except machinery and equipment)

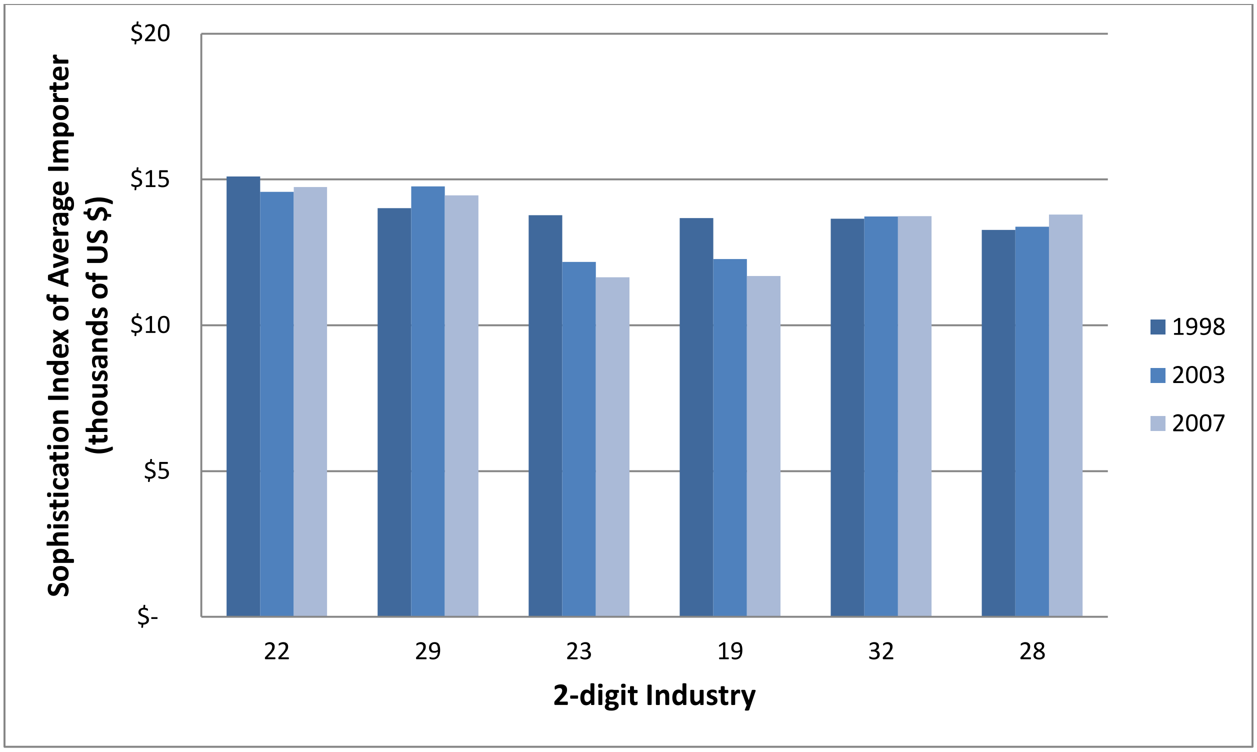
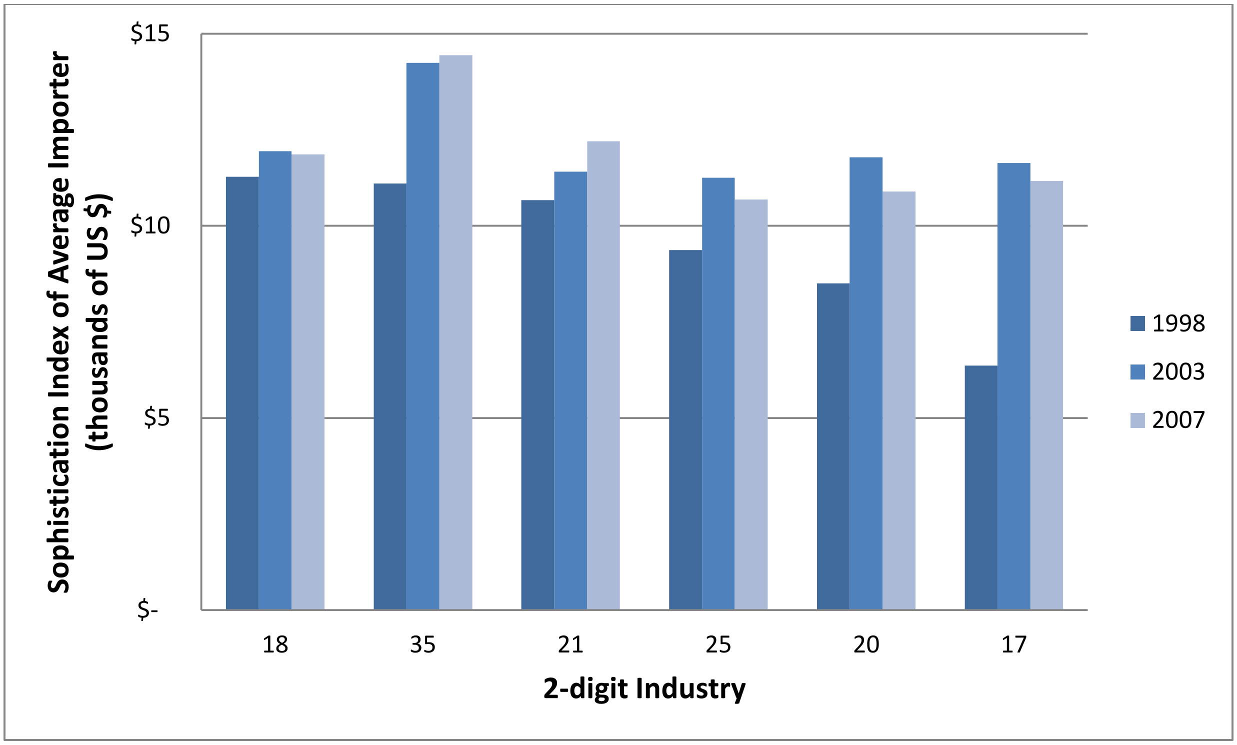


Figure 3: Imported Input Sophistication Index: Bottom 6 Industries

NIC 18: Wearing Apparel, NIC 35: Other Transport Equipment, NIC 21: Paper and paper products, NIC 25: Rubber and plastic products, NIC 20: Wood and wood products, except furniture, NIC 17: Textiles



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