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# The Decision to Import

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ABSTRACT

Why do some producers choose to use imported intermediate inputs while others do not? The decision matters for plant performance. In the data, plants that import are much larger and more productive than non-importers. This finding is robust to many statistical controls. Yet only a small fraction of plants choose to import. To try to account for these facts, we develop a simple model of an industry with heterogeneous firms. Each firm has a choice of two technologies: one uses only domestic inputs, while the other uses both domestic and imported inputs. The importer technology involves a fixed cost but offers increased efficiency of production. As a result, only the most efficient firms choose to import, and the fraction of firms that import increases with improvements in the terms of trade. Calibrated to recent data on Chilean manufacturing plants, the model successfully captures the large size difference between importers and non-importers.

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If producers that used imported intermediate inputs appeared no different from those that did not, then we might reasonably conclude that the decision to import was of little consequence for the organization of production in an economy. But this is not the case. Importers differ sharply from non-importers.

We document that, in recent surveys of Chilean manufacturing plants, plants that use imported raw materials are much larger and more productive than plants that do not. These findings are robust to a number of different statistical controls. Despite the large performance advantage associated with using imported inputs, only a small fraction of plants do.

Our interpretation of the data is that producers would prefer to use some imported inputs in production — perhaps because they are easier to process, are of higher quality, or offer some other productivity advantage — but that most do not because of barriers to international trade that take the form of fixed costs. We interpret these fixed costs as the costs of developing trade relationships with foreign input suppliers. It is only worthwhile for the largest, most efficient, and most profitable firms to invest in these trade relationships.

To formalize this story, we develop a simple model of an industry in which firms endogenously decide whether or not to use imported inputs. Our model has three main features. First, there is a continuum of heterogeneous firms that take efficiency draws from a probability distribution (along the lines of Hopenhayn (1992)). Second, after obtaining an efficiency draw, each firm has an endogenous choice of two technologies: a technology that uses only domestic inputs and a technology that uses both domestic and imported inputs. Third, adopting the technology that uses imported inputs requires payment of a fixed cost.

In the model, firms endogenously sort themselves into importers and non-importers. Due to the barrier created by the fixed cost of importing, only the plants with the highest efficiency draws become importers. These are also the largest plants. Quantitatively, we show that for plausible parameters the model can replicate the observed difference in size between importers and non-importers.

The importing behavior of plants has not yet been widely studied, but there is a growing literature. Using Colombian data, Kugler and Verhooven (2009) find evidence that plants import to obtain higher-quality inputs. Using Chilean data, Kasahara and Rodrigue (2008) find that switching from being a non-importer to being an importer can increase a plant's productivity. Amiti and Konings (2007), examining data from Indonesia, find that lowering tariffs on imported inputs can raise plant productivity through learning, variety, and quality effects. Halpern, Koren, and Szeidl (2005) find, analyzing Hungarian data, that imported inputs increase plant productivity through complementarity and quality channels.

Our findings on the differences between importers and non-importers are similar to findings on the differences between exporters and non-exporters. For instance, Bernard and Jensen (1999), Bernard et al. (2003), and Bernard, Jensen, and Schott (2005) have documented differences between exporters and non-exporters for the United States. These findings have led to a large literature on the decision to export. Roberts and Tybout (1997) made a seminal contribution to the empirical literature on this topic, as did Melitz (2003) to the theoretical literature. Both papers emphasize fixed costs of exporting.

A similarly large literature has not yet developed with respect to the decision to import. We aim to remedy this and view our work as complementary to that on the decision to export. While exporting and importing decisions may be related, we believe that the underlying considerations by firms are fundamentally different. The decision to export has to do with the demand characteristics of the foreign market, whereas the decision to use imported inputs has to do with the production process at the plant level.

**Data**

We use the annual census of manufacturing plants conducted by Chile's Instituto Nacional de Estadísticas during the period 2001 to 2006. Previous editions of the survey have been examined by Liu (1993), Levinsohn (1999), and Pavcnik (2002), among others. The data on imported inputs are limited in this survey: we only observe the extent to which plants use imported raw materials. As a result, we cannot analyze the effects of, for instance, imported capital equipment, which may be of greater importance. Nevertheless, the differences between importers and non-importers are striking.

The Chilean census involves a total of 8,014 different manufacturing plants over the period 2001 to 2006. Since our interest is in comparing importers and non-importers, we omit from our analysis the 1,078 plants that changed their import status during the period (see Kasahara and Rodrigue (2008) for an analysis of these types of plants). We categorize the remaining plants as follows. *Importers* are plants that used imported raw materials every year that they appeared in the census during the period; they are 13 percent of our sample. *Non-importers* are plants that did not use imported raw materials in any year that they appeared in the census during the period; they are 87 percent of our sample.

*Comparing Importers and Non-Importers*

We compare plant averages between importers and non-importers over the period 2001 to 2006. All monetary values are in terms of an inflation-adjusted unit of account, the Chilean Unidad de Fomento. Our findings are summarized in table 1. The table shows that, on average, importers are much larger than non-importers, whether measured by gross output, total materials used, value added, or employment. Importers are also more productive than non-importers. On average, importers have about 30 percent higher value added per worker.

Even within industries that process relatively homogeneous goods, such as agricultural goods, the differences between importers and non-importers are stark. Of the 20 industries at the two-digit ISIC level in our data, the following 5 are likely involved in processing agricultural goods: manufacture of food products and beverages, manufacture of textiles, tanning and dressing of leather, manufacture of wood and wood products, and manufacture of paper and paper products. In table 2, for each of these industries we report the share of plants that use imported raw materials and the extent to which importers differ from non-importers in gross output and value added per worker. The differences in size and productivity between importers and non-importers tend to be more pronounced in these industries than in the manufacturing sector as a whole.

*Statistically Controlling for Other Plant Characteristics*

To further test the robustness of our findings on the differences between importers and non-importers, we consider the extent to which these differences may be statistically accounted for by other plant characteristics. We control for the following: the region in which a plant is located (Chile has 13 regions), the industry to which a plant belongs (the data cover 20 manufacturing industries at the two-digit ISIC level), whether or not a plant exports, the capital intensity of a plant (measured as total assets per worker and sorted into deciles), and whether or not there is any foreign ownership of a plant. Specifically, we perform the following semi-logarithmic regression:

$$\log Y_i = \alpha + \beta \text{Importer}_i + X_i'\delta + \varepsilon_i , \qquad (1)$$

where $Y_i$ is the dependent variable for plant $i$, $\text{Importer}_i$ is a dummy variable for whether or not plant $i$ uses imported raw materials, $X_i$ is a vector of control dummy variables for plant $i$ consisting of the characteristics listed above, and $\varepsilon_i$ is an error term. We assume that $\varepsilon_i$ satisfies the usual properties. The coefficients to be estimated are $\alpha$, $\beta$, and $\delta$. Table 3 reports the estimated value of the coefficient $\beta$ for the following dependent variables: gross output, total materials, employment, assets, assets per worker, value added, and value added per worker. All differences between importers and non-importers are statistically significant at the one-percent level.

**Model**

We model an industry that consists of measure one of single-plant firms. The industry produces a homogeneous good, the price of which is normalized to one. The industry has access to two different inputs to production: a domestic input and a foreign input. The industry takes the prices of these inputs as given. There are no equilibrium price effects in the model so that the focus is on the decisions of firms.

*Technologies*

Each firm takes an efficiency draw from a probability distribution $G(\cdot)$. Each firm then has a choice of two technologies: the first technology uses only domestic inputs, while the second technology requires both domestic and foreign inputs. The technologies available to a firm with efficiency draw $a$ take simple functional forms.

The first technology, technology $N$ for *non-importer*, uses only domestic inputs. For a firm with draw $a$, technology $N$ is given by

$$y_N(a) = a d_N(a)^{\nu}, \tag{2}$$

where $y_N(a)$ is the quantity of output, $d_N(a)$ is the quantity of the domestic input, and $0 < \nu < 1$. The profits of a firm with draw $a$ using technology $N$ are

$$\pi_N(a) = y_N(a) - p_d d_N(a), \tag{3}$$

where $p_d$ is the price of the domestic input. Profit maximization implies that

$$d_N(a) = \left(\frac{a\nu}{p_d}\right)^{\frac{1}{1-\nu}}. \tag{4}$$

The second technology, technology $I$ for *importer*, uses both domestic and foreign inputs. For a firm with draw $a$, technology $I$ is given by

$$y_I(a) = a\eta\left(\mu d_I(a)^{\rho} + (1-\mu) f_I(a)^{\rho}\right)^{\nu/\rho}, \tag{5}$$

where $y_I(a)$ is the quantity of output, $d_I(a)$ is the quantity of the domestic input, $f_I(a)$ is the quantity of the foreign input, $\eta > 0$, $0 < \mu < 1$, and $\rho < 1$. The firm's elasticity of substitution between domestic and foreign inputs is $1/(1-\rho)$. The parameter $\eta$ determines the total factor productivity of technology $I$ relative to technology $N$. Operating technology $I$ requires a fixed cost of $\phi$ units of output, so the profits of a firm with draw $a$ using technology $I$ are

$$\pi_I(a) = y_I(a) - p_d d_I(a) - p_f f_I(a) - \phi, \tag{6}$$

where $p_f$ is the price of the foreign input. Profit maximization implies that

$$d_I(a) = (a\eta\nu)^{\frac{1}{1-\nu}} \left(\frac{\mu}{p_d}\right)^{\frac{1}{1-\rho}} \left(\mu^{\frac{1}{1-\rho}} p_d^{-\frac{\rho}{1-\rho}} + (1-\mu)^{\frac{1}{1-\rho}} p_f^{-\frac{\rho}{1-\rho}}\right)^{\frac{\nu-\rho}{\rho(1-\nu)}} \tag{7}$$

$$f_I(a) = (a\eta\nu)^{\frac{1}{1-\nu}} \left(\frac{1-\mu}{p_f}\right)^{\frac{1}{1-\rho}} \left(\mu^{\frac{1}{1-\rho}} p_d^{-\frac{\rho}{1-\rho}} + (1-\mu)^{\frac{1}{1-\rho}} p_f^{-\frac{\rho}{1-\rho}}\right)^{\frac{\nu-\rho}{\rho(1-\nu)}}. \tag{8}$$

*Cutoff for Importing*

A firm with efficiency draw $a$ chooses which technology to use according to the maximum of $\pi_N(a)$ and $\pi_I(a)$. Consistent with the data, we focus on the case where parameter values are such that both technologies are used in the industry. In this case, there is an efficiency cutoff for using technology $I$. A firm with draw $a$ uses technology $I$ if $a \geq \underline{a}$ and uses technology $N$ if $a < \underline{a}$, where $\underline{a}$ solves

$$\pi_N(\underline{a}) = \pi_I(\underline{a}). \tag{9}$$

In terms of parameters, the cutoff for importing is

$$\underline{a} = \frac{\phi^{1-\nu}}{\nu^{\nu}(1-\nu)^{1-\nu}\left(\eta^{\frac{1}{1-\nu}}\left(\mu^{\frac{1}{1-\rho}} p_d^{-\frac{\rho}{1-\rho}} + (1-\mu)^{\frac{1}{1-\rho}} p_f^{-\frac{\rho}{1-\rho}}\right)^{\frac{\nu(1-\rho)}{\rho(1-\nu)}} - p_d^{-\frac{\nu}{1-\nu}}\right)^{1-\nu}}. \tag{10}$$

This cutoff is increasing in $\phi$ and $p_f$ and decreasing in $\eta$ and $p_d$. If $\underline{a}$ decreases, then firms that were not previously importing switch technologies and start using imported inputs. The model captures, in a simple way, the technology switching that can occur in response to persistent changes in the trade environment.

In contrast to models with a representative firm, our model has both an intensive margin and an extensive margin of importing. The *intensive margin* captures changes in the use of the foreign input by firms that were previously importing. The *extensive margin* captures changes in the share of firms that import. With regard to exports, Ruhl (2004) and Chaney (2008) find that allowing for an extensive margin is important in accounting for changes following trade liberalization.

**Quantitative Analysis of the Model**

We calibrate our model to match important facts about the Chilean manufacturing sector. Then we determine the extent to which the model can account for the observed size differences between importers and non-importers.

*Calibration*

We begin by specifying the probability distribution for the efficiency draws. Figure 1 shows the distribution of plants by gross output. The result is suggestive of a Pareto distribution. Moreover, the Pareto distribution is used in many other studies involving trade and heterogeneous firms (see, for example, Chaney (2008)). Consistent with this, we suppose that each firm's efficiency is drawn from a Pareto distribution with cumulative distribution function $G(a) = 1 - a^{-\gamma}$, for $a \geq 1$, where the lower bound of one is a normalization and $\gamma > 2/(1-\nu)$. The restriction on $\gamma$ ensures that the variance of output in the model is finite.

Table 4 summarizes the calibration. We normalize units so that all of the prices in the model are initially equal to one. This leaves us with six parameters: $\rho$, $\nu$, $\mu$, $\phi$, $\eta$, and $\gamma$. Following Ruhl (2004), we set $\rho = 0.5$ to give an elasticity of substitution of 2. Following Atkeson and Kehoe (2005), we set $\nu = 0.85$. We set $\mu = 0.68$ so that expenditure on imported inputs is 15 percent of importers' gross output. We choose the values of $\phi$, $\eta$, and $\gamma$ jointly to match two facts: (i) importers are 13 percent of plants and (ii) the coefficient of variation for gross output of plants is 7.3. These two facts do not uniquely pin down the values of $\phi$, $\eta$, and $\gamma$. This is because a higher value of $\phi$ may be offset by a higher value of $\eta$. As a result, we include sensitivity analysis in table 5.

*Results*

To what extent can the model account for the observed size differences between importers and non-importers? As table 5 shows, the model matches the data if we set $\phi = 0.031$, $\eta = 1.66$, and $\gamma = 13.42$. For the cutoff firm, the fixed cost of importing is then equal to 2 percent of gross output and 19 percent of variable profits. We view these magnitudes as plausible. For sensitivity analysis, we also report the results for lower and higher values of $\phi$, $\eta$, and $\gamma$.

## Conclusion

In contrast to the decision to export, the decision to import has not yet been widely studied. We document the performance advantage associated with using imported inputs and offer a simple theoretical mechanism that can quantitatively account for this. Our results suggest that the importing behavior of plants is a fruitful area for future research, though more data analysis is needed. The simple model presented here may serve as a point of departure for other researchers. The roles of dynamics and uncertainty are natural extensions of the model. Further applications may include quantitative modeling of terms-of-trade shocks and trade liberalizations. The ultimate goal is to develop a model of trade that can quantitatively account for both the export and import decisions of firms. The challenge is to maintain transparency while doing so.

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| Statistic | Ratio of average importer to average non-importer |
|---|---|
| Gross output | 4.5 |
| Total materials | 4.4 |
| Employment | 4.0 |
| Assets | 7.5 |
| Assets per worker | 2.1 |
| Value added | 5.2 |
| Value added per worker | 1.3 |

**Table 1. Importer Premia**

| Industry | Ratio of average importer to average non-importer | | Importers as a percent of all plants |
|---|---|---|---|
| | Gross output | Value added per worker | |
| Manufacture of food products and beverages | 10.9 | 1.5 | 6 |
| Manufacture of textiles | 6.8 | 1.6 | 19 |
| Tanning and dressing of leather | 2.9 | 1.4 | 11 |
| Manufacture of wood and wood products | 4.2 | 2.4 | 4 |
| Manufacture of paper and paper products | 15.1 | 4.6 | 22 |
| All industries | 4.5 | 1.3 | 13 |

**Table 2. Importer Premia in Industries that Process Agricultural Goods**

| $Y_i$ | $\hat{\beta}$ |
|---|---|
| Gross output | 1.45*** |
| | (0.030) |
| Total materials | 1.55*** |
| | (0.033) |
| Employment | 0.92*** |
| | (0.023) |
| Assets | 1.93*** |
| | (0.047) |
| Assets per worker | 1.05*** |
| | (0.038) |
| Value added | 1.37*** |
| | (0.032) |
| Value added per worker | 0.44*** |
| | (0.022) |

Robust standard errors in parentheses; *** significant at 1%.

**Table 3.  Robustness Checks on Importer Premia**

| Parameter(s) | Value(s) | Explanation |
| --- | --- | --- |
| $p_d$, $p_f$ | 1, 1 | Normalization of units |
| $\rho$ | 0.5 | Ruhl (2004) |
| $\nu$ | 0.85 | Atkeson and Kehoe (2005) |
| $\mu$ | 0.68 | Chosen to match the fact that expenditure on imported inputs is 15% of importers' gross output |
| $\phi$, $\eta$, $\gamma$ | See table 5 | Chosen jointly to match 2 facts: (i) importers are 13% of plants and (ii) the coefficient of variation for gross output is 7.3 |

**Table 4. Calibration**

| Parameter values | | | Relative size of fixed cost for cutoff plant | | Ratio of average importer's gross output to average non-importer's | |
|---|---|---|---|---|---|---|
| $\phi$ | $\eta$ | $\gamma$ | As a percent of gross output | As a percent of variable profits | Model | Data |
| 0.008 | 1.63 | 13.41 | 1 | 5 | 3.9 | 4.5 |
| 0.031 | 1.66 | 13.42 | 2 | 19 | 4.5 | 4.5 |
| 0.064 | 1.70 | 13.44 | 4 | 39 | 5.2 | 4.5 |

**Table 5. Model vs. Data**

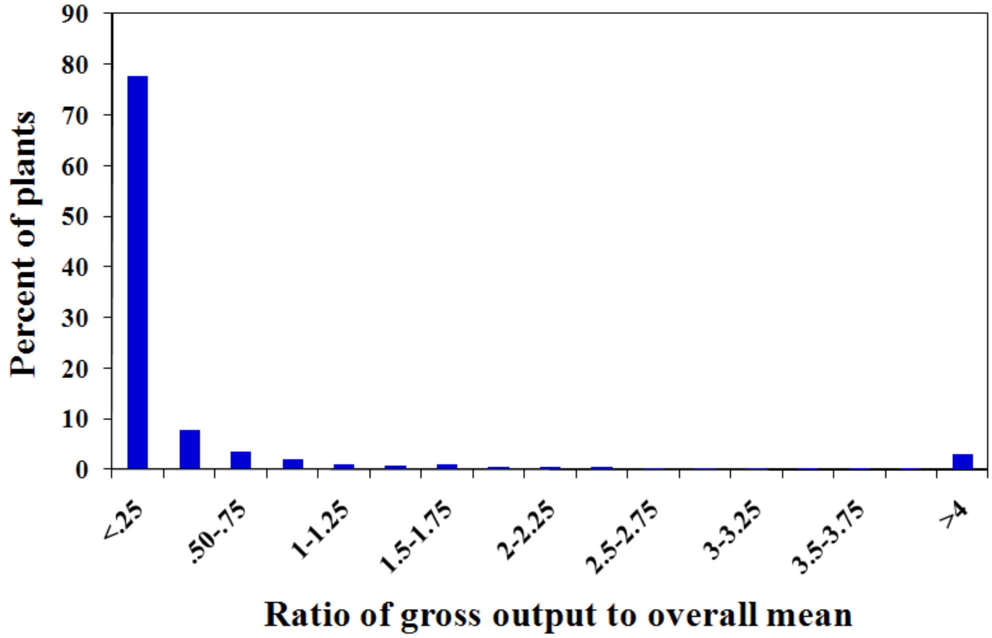


**Figure 1. Distribution of plants by gross output**