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The Decision to Import*

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ABSTRACT

Why do some producers choose to use imported inputs while others do not? We show that producers that import are larger and more productive than those that do not. We then propose a theoretical mechanism that can account for these facts: a combination of heterogeneous firms and fixed costs of importing. In our model, firms have a choice of two technologies: a technology that uses only domestic inputs and a technology that uses both domestic and foreign inputs. As a result, firms can switch technologies in response to changes in the terms of trade or in barriers to importing.

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Introduction

Why do some producers choose to use imported inputs while others do not? Imported inputs may be desirable to producers for a number of different reasons: they may be cheaper, they may be of higher quality, or their use may increase a producer's total factor productivity.

If producers that used imported intermediate inputs appeared no different from producers 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 along a number of dimensions.

This suggests that changes in the terms of trade and in barriers to importing can lead to changes in a country's organization of production and social welfare.

To try to account for these facts and to gain insight into producers' importing decisions, we develop a simple model. Given the evidence, a theoretical mechanism that appears promising in accounting for producers' import decisions is the combination of heterogeneous firms and fixed costs of importing. We incorporate these features into our model. We interpret the fixed cost of importing as the cost of developing trade relationships with foreign input suppliers.

Our model is simple. There is a small open economy. The economy produces a single good for consumption and export. The rest of the world produces an input that the small open economy cannot. Production is carried out by a continuum of heterogeneous

firms, all behaving competitively and producing a homogeneous good using decreasing-returns-to-scale technologies. This form of industrial organization is along the lines of Lucas (1978) and Hopenhayn (1992).

The crucial feature of our model is that each firm has a choice of two different technologies: one technology uses only domestic inputs, while the other technology uses both domestic and foreign inputs. The fixed cost of adopting the import technology is higher.

The qualitative properties of the model are quite intuitive. Due to the fixed cost of importing, firms endogenously sort themselves into importers and non-importers, where the importers are larger and more productive. Changes in the terms of trade, or in barriers to importing, can cause firms to switch technologies and can lead to a reallocation of resources across firms. An improvement in the terms of trade, for instance, causes some non-importing firms to switch technologies and become importing firms. The least productive firms are driven out. Social welfare improves.

Quantitatively, we then show that, despite the model's simplicity, it does a good job of replicating data on the differences between importers and non-importers.

The decision to import has not yet been widely studied, but there is a growing literature. Using Colombian data, Kugler and Verhooven (2009) find evidence that firms may import to obtain higher-quality inputs. Using Chilean data, Kasahara and Rodrigue (2008) find evidence that use of imported inputs may increase plant productivity. Ramanarayanan (2006) studies the roles of dynamics and uncertainty on the decision to

import. Kasahara and Lapham (2008) connect the decision to import with the decision to export and find complementarities.

Our findings on the differences between importers and non-importers are similar to findings on the differences between exporters and non-exporters. See, for example, Bernard, Eaton, Jensen, and Kortum (2003) and Bernard, Jensen, and Schott (2005). 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. 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.

Evidence from the Data

Lacking direct evidence on the reasons behind producers' import decisions, we draw inferences from data on outcomes for importers relative to non-importers. Detailed producer-level data that includes information on imported inputs is, of course, difficult to obtain. The Chilean government's annual census of manufacturing plants is well known and has been examined by a number of researchers, one of the most prominent being Pavcnik (2002). We obtained recent versions of this survey, for the years 2001 to 2006, from Chile's Instituto Nacional de Estadistícas. During this period, the Chilean economy was stable and barriers to importing were relatively low. Though the data on imported inputs are limited in this survey — we only observe the extent to which plants use imported raw materials — the results are still illuminating.

The census involves a total of 8,014 different manufacturing plants over the period 2001 to 2006. We categorize these plants as follows. *Importers* are plants that use imported raw materials every year during the period; they are 11.5 percent of all plants. *Non-importers* are plants that never use imported raw materials during the period; they are 75 percent of all plants. *Switchers* are plants that use imported raw materials in at least one year but not every year during the period; they are 13.5 percent of all plants.

The data are striking in how sharply importers differ from non-importers. Even switchers are remarkably different from non-importers. We examine plant averages across the different categories over the period 2001 to 2006. Our findings are summarized in Table 1, where all nominal values were converted to real values using the Chilean Unidad de Fomento (UF).

As Table 1 shows, importers are much larger than non-importers. They are roughly four times as large by output, total materials used, value added, and employment. In terms of value added per worker, importers are about 30 percent more productive than non-importers.

Theoretical Model

We consider a small open economy. This economy produces a single good that is used for consumption and export. The rest of the world produces an input to production that the small open economy cannot. There is a representative consumer in the small open economy that maximizes consumption of the domestically produced good. The representative consumer is endowed with D units of a domestic input to production and

derives income from supplying this input to firms. Because the economy is small relative to the rest of the world, it takes the terms of trade — the price of the imported good relative to the price of the exported good — as given.

There is a continuum of heterogeneous firms in the small open economy. (We use the term *firm* to denote the unit of production, but there is no distinction in the model between the firm and the plant.) Each firm takes a technology draw from a probability distribution. Each firm then endogenously chooses among the following: not to operate, to operate using a technology that requires only domestic inputs, or to operate using a technology that requires both domestic and foreign inputs.

A firm with technology draw a has a choice of two technologies. The first technology, technology n for *non-importer*, uses only domestic inputs:

$$y_n(a) = a d_n(a)^{\nu}, \tag{1}$$

where $d_n(a)$ is the quantity of the domestic input, $y_n(a)$ is the quantity of output, and $0 < \nu < 1$. The fixed cost of operating this technology is ϕ_n units of the domestic input. Profits are

$$\pi_n(a) = y_n(a) - w d_n(a) - w\phi_n, \tag{2}$$

where w is the price of the domestic input and the price of output serves as the numéraire. The second technology, technology i for *importer*, uses both domestic and foreign inputs:

$$y_i(a) = a\eta\left(\mu d_i(a)^{\rho} + (1-\mu) f_i(a)^{\rho}\right)^{\nu/\rho}, \tag{3}$$

where $d_i(a)$ is the quantity of the domestic input, $f_i(a)$ is the quantity of the foreign input, $y_i(a)$ is the quantity of output, $\eta > 0$, $0 < \mu < 1$, and $\rho < 1$. The elasticity of substitution between domestic and foreign inputs is $1/(1-\rho)$. Operating this technology requires a fixed cost of ϕ_i units of the domestic input, where $\phi_i > \phi_n$. Profits are

$$\pi_i(a) = y_i(a) - wd_i(a) - pf_i(a) - w\phi_i, \tag{4}$$

where p is the exogenously given terms of trade.

Because there are fixed costs of operating, a firm may choose not to produce at all. A firm with technology draw a chooses whether to operate or not and, if so, which technology to use according to the maximum of $\{0,\ \pi_n(a),\ \pi_i(a)\}$.

Clearing in the goods market requires that

$$C + X = Y, \tag{5}$$

where C is the quantity consumed, X is the quantity exported, and Y is the quantity produced. International balance of payments requires that

$$X = pF, \tag{6}$$

where F is the quantity imported.

We develop the model and its properties in greater detail in Gibson and Graciano (2009). What follows is an overview.

Qualitative Properties of the Model

Consistent with the data, we focus on the case where parameter values are such that not all firms operate and not all firms import. Consistent with many other studies

involving heterogeneous firms, we assume that the distribution of technology draws is Pareto, with lower bound θ and shape parameter γ. Under these assumptions, the model has an analytical solution.

The model's main qualitative properties are quite intuitive. Suppose that the terms of trade improve (that is, that p decreases). This has three major effects: (1) some non-importers that previously operated choose to exit, (2) many firms that were not previously importing switch technologies so that they can use imported inputs, and (3) social welfare improves. The model captures, in a simple way, the process of reallocation and technology switching that can occur in response to changes in the terms of trade.

Quantitative Properties of the Model

Our model is quite stylized. Despite this, the model can do a good job of quantitatively capturing relevant facts in the data. Here we discuss a plausible parameterization of our model and compare the outcome to data from the Chilean manufacturing surveys. The results are summarized in Table 2. To begin with, we take the average terms of trade, 2001 to 2006, from IMF data and set $p = 1.24$.

Given that our interest is not in absolutes but in the differences between importers and non-importers, we can normalize certain parameters. These parameters include the endowment of the domestic input, D, and the lower bound on the Pareto distribution, θ.

Static models of trade with representative firms often use a high elasticity of substitution between domestic and foreign inputs. In our setup, since firms have a choice

of technologies, the aggregate elasticity is driven by the extensive margin, the share of firms that choose to import. We assume that, if a firm decides to use the import technology, then it has fairly inelastic demand for imported inputs. We somewhat arbitrarily choose ρ so that the elasticity of substitution between domestic and foreign inputs at the firm level is 0.1. The aggregate elasticity is determined endogenously by the technology choices of firms.

The parameters ν and γ jointly determine the degree of heterogeneity across firms. We choose these parameters to try to match the coefficient of variation for plants' gross output, 7.3. As Table 2 shows, we are not able to match this value, but we get somewhat close by setting $\nu = 0.75$ and $\gamma = 8$.

In the data, 11.5 percent of plants use imported raw materials, and the plants that do have gross output that is 4.5 times larger than those that do not. We use these facts to pin down the fixed cost of using the import technology relative to the fixed cost of using the non-import technology, ϕ_i / ϕ_n, and the relative total factor productivity associated with using the import technology, η. We find that setting $\phi_i / \phi_n = 1.6$ and $\eta = 1.9$ gets the model reasonably close to the data. Finally, we try to match imported inputs as a share of gross output for importers by setting $\mu = 0.8$.

As Table 2 shows, the model — despite its stark assumptions — does a surprisingly good job of accounting for important facts in the data on Chilean manufacturing plants.

As a numerical experiment, we use the model to quantitatively assess the impact of decreasing p by 10 percent (an improvement in the terms of trade). The increase in welfare is small, only 0.8 percent. This is due, in large part, to the increased share of the domestic input that is used for payment of fixed costs rather than production. But the improvement in the terms of trade gives large changes in output and in the share of plants that import: output increases by 23 percent, and the share of plants that import increases from 11 percent to 50 percent. More quantitative experiments are discussed in Gibson and Graciano (2009).

Conclusion

The decision to import has not yet been widely studied, in contrast to the decision to export. Our results suggest that this is a fruitful area for future research, though more data is needed. The simple model presented here may serve as a starting point for other researchers. Further research will include quantitative modeling of terms-of-trade shocks and trade liberalizations. The roles of dynamics and uncertainty are also natural extensions of the model. The ultimate goal is to develop a model 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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Table 1. Chilean Manufacturing Plants, 2001-2006 Averages, in Thousands of Chilean UFs

Type of Plant	Gross Output	Total Materials	Imported Raw Materials	Imported Raw Materials as a Share of Gross Output, %	Value Added	Workers	Value Added per Worker	Number of Plants
All	404	187	31	8	198	75	2.64	8014
Non-Importers	235	102	0	0	105	46	2.28	6018
Importers	1051	453	178	17	545	182	3.00	918
Switchers	665	359	59*	9*	348	122	2.86	1078

*Average over years when importing only.

Table 2. Model vs. Data

Statistic	Data	Model
Terms of Trade	1.24	1.24
Coefficient of Variation for Gross Output	7.3	6.6
Importers' Share of Gross Output, %	31	38
Ratio of Importers' Gross Output to Non-importers'	4.5	5.2
Share of Plants that Import, %	12	11
Imported Inputs as a Share of Gross Output, %	17	11