

# Trade Adjustment in Large Crises\*

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### Abstract

We use detailed transactions-level customs data covering the universe of Argentine imports from 1996-2008 to characterize trade adjustment during crises and explore the resulting impact on domestic productivity. This period includes a dramatic nominal exchange rate depreciation and trade balance reversal. We find that the extensive margin, when defined as the entry and exit of firms into import status or when defined as the inclusion or exclusion of product categories (HS6 or HS10), plays a small role in understanding import adjustment during the crisis. However, *at the firm level*, the extensive margin plays an important role as firms (on net) drop products that constituted a significant share of their previous imports. The weighted average of Feenstra correction measures for the firm level imported input cost index between 1999 and 2003 ranges from about 1.04 to 1.09, implying this might account for a significant share of the measured decline in productivity during such episodes. The share of imports shifts towards the end-use category “industrial supplies and materials” during the crisis. We evaluate these patterns using a general equilibrium model with heterogeneous firms that import differentiated varieties of inputs. We show that some of the predictions of the model are consistent with evidence in the data and implies measured productivity declines for importing firms.

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# 1 Introduction

Episodes of large crises such as the Argentine crisis in 2002, the East Asian crisis in 1997-98, and the Mexican crisis in 1994 are associated with large reversals in the trade balance. The dollar value of imports in Argentina, for instance, dropped by 80 percent and the trade balance climbed from -1 to 18 percent of GDP between 2000 and 2002. A second striking feature of these episodes is the large measured productivity decline associated with the large declines in output.<sup>1</sup>

Despite the dramatic nature of such events, little is known about the mechanics of trade adjustment at the firm and product level.<sup>2</sup> Consequently, we lack a detailed understanding of exactly what are the costs associated with trade balance reversals. Consumer welfare might deteriorate due to the reduced number and quality of imported final good varieties. Additionally, as described in the influential works of Romer (1990) and Romer (1994), measured productivity can decline if producers switch from foreign to domestic intermediates when they are not perfect substitutes.

A large and growing theoretical literature in trade and macro argues for the importance of the extensive margin, whether defined as changing firms or changing products at business cycle frequencies. Ghironi and Melitz (2005) build a model to highlight the impact of firm entry and exit decisions on business cycle moments. Corsetti, Martin, and Pesenti (2008) explore the role of the extensive margin in understanding current account adjustments. A relevant question then is how empirically important is the extensive margin at business cycle frequencies? A dramatic crisis event can help shed light on this question.

This paper aims to explore the importance of intensive and extensive margin trade adjustment during crises and the macroeconomic implications of their impact on domestic productivity. To do this, we evaluate detailed firm-level customs data covering the universe of import transactions for Argentina over the period 1996-2008. This period includes a dramatic nominal exchange rate depreciation and trade balance reversal. We combine this trade data with operating and financial information on the largest Argentine firms. One of our main findings is that the extensive margin, when defined as the entry and exit of firms into

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<sup>1</sup>Meza and Quintin (2006) document that productivity declined by 8.6% in Mexico in 1994, by 15.1% in Thailand and by 7.1% in South Korea during the East Asian crisis. Other papers like Aguiar and Gopinath (2007) also emphasize the decline in productivity during emerging market downturns.

<sup>2</sup>Burstein, Eichenbaum, and Rebelo (2005) evaluate supermarket data for Argentina during the 2002 crisis to present evidence on flight from quality in consumer goods. However, there is little evidence on the imported goods and importing firms.

import status or when defined as the inclusion or exclusion of product categories (HS6 or HS10), plays a small role in understanding import adjustment during the crisis. However, *at the firm level*, the extensive margin plays an important role as firms drop products that constituted a significant share of their previous imports. The weighted average of Feenstra correction measures for the firm level imported input cost index ranges from about 1.04 to 1.09, implying a significant decline in measured productivity. We evaluate the trade adjustment patterns using a general equilibrium model with heterogeneous firms that import differentiated varieties of inputs. Firms decide whether to import and, if so, which range of input varieties to import. We show that some of the predictions of the model are consistent with evidence in the data and imply that measured productivity declines for importing firms.

To elaborate, the extent of the external margin of adjustment is strikingly large when measured in terms of the *number* of firms or products. The number of importing firms dropped from over 15,000 to less than 7,000 in a span of only four quarters. The number of distinct 10-digit Harmonized Tariff Schedule (HTS) product codes imported dropped from about 13,000 to 10,000 over the same period. Measured by the *volume* of trade, however, country-level extensive margin adjustment is strikingly small. On average, the net contribution of new importers entering and old importers exiting trade accounts for only about 10 percent of the time-series variation in total import volume. This finding holds when looking at the quarterly or annual frequency, when defining the extensive margin by the changing set of firms or by the changing set of imported 10-digit HTS categories of goods, when looking at normal times as well as during the crisis and recovery, and when separately considering each end-use category.

The finding that the economy-wide product entry and exit margin plays a small role contrasts with the evidence related to trade liberalizations in some countries. Goldberg, Khandelwal, Pavcnik, and Topalova (2009) find that following India's trade liberalization, 66 percent of the increase in imports can be explained by imports of new HTS 6 categories.<sup>3</sup> Our findings are, however, in line with the calculations of Arkolakis, Demidova, Klenow, and Rodriguez-Clare (2008), who find that following a trade liberalization in Costa Rica the product extensive margin plays a small role. Even in a crisis as large as Argentina's, with an 80% drop in imports, the firm extensive and product extensive margin plays a small role.

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<sup>3</sup>There is a large and growing empirical literature on the impact of trade liberalization on a country's welfare and productivity. Papers such as Amiti and Konings (2007) on Indonesian firms and Halpern, Koren, and Szeidl (2009) on Hungarian firms evaluate the role of imported intermediate inputs on the gains from trade liberalization. These empirical analyses are not about trade shocks at business cycle frequencies, however, and instead focus on lower frequency events such as trade liberalizations.

This result follows from the high degree of concentration in international trade among a few key firms and sectors. The largest 5 percent of importing firms typically does not change importing status over time and contributes approximately 85 percent of Argentina's imports.<sup>4</sup> Similarly, Argentina is unlikely to stop purchasing any of the largest 5 percent of imported 6-digit HTS categories, and these categories cumulatively account for about 60 percent of imports. Due to this high degree of concentration, even a major event such as an 80 percent drop in imports cannot be explained in an economically important way by firm entry and exit nor by product entry and exit. This is the case even when we define a product as the combination of a HTS 10 digit code and its country of origin. The high concentration in firm and product shares relates to the findings in Bernard, Jensen, and Schott (2009) and the small extensive margin is consistent with the findings in Bernard, Jensen, Redding, and Schott (2009) for U.S. data, but is far more surprising given the dramatically larger shock episode in the Argentine experience.<sup>5</sup>

A virtue of our data is that we observe imports by firm and consequently, we can evaluate the extent to which individual firms (as opposed to the macroeconomy) add and drop products. When we define the extensive margin to include within-firm changes in the mix of imported categories and exporting countries, it begins to play a significant role. As an illustration, Figure 1 shows sample import activity of three large Argentine industrial manufacturing companies, all in the top 50 importers in Argentina: BGH S.A., Siderca S.A.I.C., and Siderar S.A.I.C. All three companies imported heavily in key intermediate input categories before the crisis, but stopped importing these inputs during the crisis.

BGH imported industrial cooling fans and anti-vibration materials, largely from Motorola, during most quarters in 2000 and 2001.<sup>6</sup> With the onset of the crisis and after the exchange rate shock, however, imports of those goods dropped to zero for 6 quarters, only to return in late 2003. Siderca, after importing more than \$2 million of tools for steel-cutting lathes in 2001 and spending more than \$200,000 on imported tools for aluminum smelting and mixing, exited those import markets completely in 2002 and early 2003. By late 2003, they returned to importing in those sectors and by 2004 spent almost \$9 million on those im-

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<sup>4</sup>As discussed below, we can rule out the possibility that the largest importers are simply huge distributors or import/export brokers.

<sup>5</sup>Also see di Giovanni and Levchenko (2009) who argue that this can imply the welfare impact of high entry costs into production is small.

<sup>6</sup>This paragraph includes translations of Argentine product code descriptions from Spanish into English, which may result in minor errors. The companies and the codes for their respective imports are: BGH (482390, 591110), Siderca (270119, 261900), and Siderar (842890, 721049, 270119).

ported goods. Finally, Siderar’s imports included large volumes of bricks and combustibles, laminated steel sheets, and lifting equipment before the crisis. These branded products were largely from foreign design and manufacturing companies such as the Rima Group, Techint Italimpianti, and Vai Cosim. All three categories of imports showed zero volume starting with the onset of the crisis and devaluation, though several returned as large import categories after the crisis abated. Though these products disappeared from the import bundle of BGH, Siderca, and Siderar, this would not be observable in aggregate data, as other Argentine firms continued to make purchases in these categories. We refer to this margin as the “within-firm extensive margin.”

This within-firm extensive margin explains a bit less than half of the 61 percent decline in imports in the crisis year of 2002. By comparison, the firm entry and exit margin and the product entry and exit margin each explain only about 1 percent of the decline. We perform a calculation ala Feenstra (1994) using an elasticity of substitution of 6 and find that the extensive margin implies an import input cost index that is higher than that implied by a standard index calculation. The weighted average (across importers) correction to the import input cost index is 9 percentage points. Excluding large and small estimates from our calculations still typically leaves the correction above 4 percentage points. The scale of these corrections is up to several times larger than if the same calculations were done using aggregate data.

This finding highlights the importance of firm level data in understanding the impact of trade adjustments. While the evidence based on product categories alone suggests a small impact on the economy through the extensive margin, the within firm analysis suggests an important role. This finding also supports the assumption in Mendoza and Yue (2009) that there is an efficiency loss stemming from the shift from foreign to domestic intermediate input use during large crises.

The relevance for aggregate productivity of any dynamics related to imports, of course, depends on the degree to which producers use imported inputs in production. Argentina’s input output tables from 1997, the last update available prior to the crisis, shows that in major industries, imports constitute a large share of intermediate use. Table 1 lists the share of total inputs that are imported for 10 large manufacturing industries.

A typically ignored feature of the crisis relates to which goods, as determined by their end use, experienced the largest drop in trade. We find that end-use sectors such as “automobile vehicles, parts and engines” and “consumer goods” registered a decline in their

share of imports. On the other hand, “industrial supplies and materials” registered a large increase in its share, which jumped from 30 to 45 percent. Consistent with this, the share of importers whose primary sector is “materials” rose during the crisis while those in the “consumer discretionary sector” declined. This finding is indicative of the higher elasticity of substitution for consumer goods, while intermediate inputs are more likely to lack a domestic counterpart and therefore face a more inelastic demand.<sup>7</sup> Our findings about the importance of the within-firm extensive margin holds even when we restrict attention to the sectors that are end-use “industrial supplies and materials” and “capital goods”.

We use information on unit values for detailed product categories imported by each firm to determine any changes in the quality of imported products during the crisis. We first document that pre-crisis products with higher unit values accounted for larger shares of firms’ imports, consistent with the higher prices reflecting higher quality. This is the case even for goods in the materials and capital goods end-use categories. During the crisis, average unit values declined by 20 percent, suggesting a sizeable decline in the quality of imported goods.

We construct a general equilibrium model with heterogeneous importing firms, a non-traded goods sector, a final goods sector and an export sector. There is a per period fixed cost to being an importer and a per period fixed cost for each variety of input imported. This gives rise to both a firm extensive and intensive margin of adjustment and a within firm intensive and extensive margin of adjustment as firms decide which set of input varieties to import. We evaluate the impact on the economy of a negative terms-of-trade shock and an interest rate shock. The trade adjustment that follows is shown to take place entirely at the intensive margin by large firms that continue to import following the crisis. However, there is an important within firm adjustment that generated measured declines in productivity. Also, as expected, sectors whose output are more substitutable with domestic products demonstrate the biggest decline in imports.

The impact of imported intermediate inputs on domestic productivity is a theme that has arisen in several recent work such as Goldberg, Khandelwal, Pavcnik, and Topalova (2009). A decline in productivity in the intermediate input sector can generate an amplified effect on the economy owing to linkages across sectors through the intermediate input channel. This is highlighted in a recent paper by Jones (2009). Our goal in future versions of the paper is to evaluate the amplification channel and how it impacts the economy both in the short

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<sup>7</sup>Clearly, there are other possible explanations for the differential response.

term and the long-term.

We focus on Argentina due to the availability of long-dated and detailed transaction-level data surrounding an acute sudden stop and exchange rate shock. The global financial crisis of 2008-2009 was also associated with a sharp drop in world trade and near or complete current account reversals in many economies. Our analysis therefore has broader relevance and can help answer the question of how trade adjusts, and the impact of this adjustment on the macroeconomy, during business cycles and crisis episodes.

## 2 The Argentine Crisis: 2001-2002

Argentina, after eight years of growth averaging just under 6 percent per year, entered a recession in 1999, with GDP, consumption, and investment all declining in real terms. As shown in Figure 2(a), the recession worsened sharply in the fourth quarter of 2001, with real GDP ending the first quarter of 2002 more than 16 percent below its level a year earlier. This decline was coupled with a rapid and massive currency depreciation. Figure 2(b) shows the nearly 300 percent nominal depreciation of the Argentine peso relative to the dollar, and Figure 2(c) shows that the import price index, when denominated in U.S. dollars, barely moved. We would expect such a change in the relative price of Argentina's production to have a massive impact on trade flows.

Figure 2(d) plots the trade balance as a share of GDP and shows that small deficits before the recession spike sharply and temporarily upward into a surplus of roughly 20 percent. This change can be attributed to the nearly 80 percent drop in dollar imports from 2000 to 2002, which impacted imports from all trading partners. Figure 8 shows the share of imports of the largest 5 trading partners immediately before the crisis. Though there is a secular shift in share away from U.S. imports and toward Brazilian imports, its top two suppliers, it is not clear if the crisis of 2001-2002 itself had a large impact on the composition of Argentina's trading partners.

While the deterioration of the exchange rate and subsequent decline in trade flows are surely endogenous to fundamental macroeconomic changes, the speed and sharpness of this adjustment makes it a desirable episode to study trade adjustment. Compared to trade liberalizations, for example, most firms had less time to prepare for such a rapid change in relative prices. Further, the shock is so large that small adjustment frictions, such as menu or search costs, are likely swamped by the benefit of re-optimizing. These characteristics

make the Argentine crisis an excellent episode for studying trade adjustment in crises more generally.

### 3 A Model of Multi-Input Firms and Trade

To better motivate our empirical investigation, we now present a simple model of multi-input firms and trade. We start with a partial equilibrium small open economy model in which world prices are taken as given. The partial equilibrium environment allows for closed form solutions under certain functional form assumptions and is useful for building intuition. In section 6, we present a general equilibrium version of the model that we will ultimately use to quantitatively match the firm and product dynamics observed in the data and to evaluate the macroeconomic impact of shocks to the terms of trade, level of productivity, and real interest rate.

The key feature of the partial equilibrium model is that it will generate entry and exit patterns for heterogeneous importers as well as decisions by these importers of which products to import. These margins can be directly mapped to what we observe in the data. Further, a naive measurement of TFP in the model that fails to properly account for changing input use by firms will appear as a decline in TFP. Hence, following Feenstra (1994), we can explicitly derive in the model the adjustment to productivity measurements that we will ultimately calculate in the data.

There is a measure  $N$  of heterogeneous domestic firms that produce for the local market and are indexed by  $i$ . Entry into the import market entails a fixed cost. This is consistent with the evidence in Bernard, Jensen, and Schott (2009) and Koren and Szeidl (2009) who document that firms that import are larger and more productive than non-importers. Firms produce using foreign inputs and they decide on both the quantity of each foreign input and the number of foreign inputs to purchase, subject to an additional fixed cost for each imported variety. We evaluate the response of each firm to a shock that increases the price of foreign inputs relative to domestic prices (along the lines of an exchange rate devaluation). The analysis of the response of the extensive and intensive margins of trade is comparable to that in Chaney (2008), with the difference that we evaluate the decisions of firms on what inputs to use as opposed to what products to sell in different markets. The latter decisions effect measured productivity in the economy.



### 3.1 Production and Demand

Each firm produces a unique variety of the final good sold to domestic consumers (or domestic producers). The production function for each producer  $i$  is  $Y_i = a_i X_i$ , where  $a_i$  is a firm-specific productivity parameter and  $X_i = \left[ \int_{j \in \Omega_i} (b_j f_{i,j})^\mu dj \right]^{\frac{1}{\mu}}$  is a CES bundle of foreign intermediate inputs of heterogeneous qualities  $b_j > 0$ , where  $0 < \mu < 1$ . Firm  $i$ 's purchases of a foreign intermediate variety  $j$  are denoted by  $f_{i,j}$ , and  $\Omega_i$  is the set of all intermediates  $j$  imported by firm  $i$ . This production function implies the firm's unit cost is  $C_i = P_{X_i}/a_i$ , where  $P_{X_i} = \left[ \int_{j \in \Omega_i} \left( \frac{p_j}{b_j} \right)^{\frac{\mu}{\mu-1}} dj \right]^{\frac{\mu-1}{\mu}}$  is the standard CES price index and  $p_j$  denotes the price of input  $f_j$  and is the same across purchasers. The firm is a price taker in the market for intermediate inputs.

Firm  $i$ 's demand for good  $j$  conditional on importing it is:

$$f_{i,j} = \left( \frac{p_j}{b_j} \right)^{\frac{1}{\mu-1}} \frac{1}{b_j} P_{X_i}^{\frac{1}{1-\mu}} X_i,$$

and we denote its total spending on imported good  $j$  as:  $m_{i,j} = p_j f_{i,j}$ . The share of firm  $i$ 's import spending that goes to product  $j$  is:

$$s_{i,j} = \left( \frac{p_j}{b_j} \frac{1}{P_{X_i}} \right)^{\frac{\mu}{\mu-1}}. \quad (1)$$

Inputs varieties with a lower quality adjusted price have a higher share in the total expenditure on varieties. An implication is that if goods with higher prices have higher shares in the firm's import bundle, these goods must also have higher quality. Section 5 offers empirical evidence that higher priced goods have higher import shares, suggesting they are of higher quality.

Each firm faces a constant elasticity demand for its output, given by  $Y_i = P_i^{-\sigma} P^\sigma D$ , where  $P$  is the aggregate price index and  $D$  is spending for the aggregate domestic economy. Given this section's partial equilibrium environment, the firm takes  $P^\sigma D$  as given and we drop these terms for the remainder of the analysis. This leads to constant markup pricing:  $P_i = C_i \sigma / (\sigma - 1)$ . Equating demand and production yields  $X_i = k_1 a_i^{\sigma-1} P_{X_i}^{-\sigma}$ , where  $k_1 = \sigma^{-\sigma} (\sigma - 1)^\sigma$ , and we can thus express firm  $i$ 's spending on imported good  $j$  as:

$$m_{i,j} = k_1 s_{i,j} a_i^{\sigma-1} P_{X_i}^{1-\sigma}, \quad (2)$$

and its total import spending as:  $m_i = k_1 a_i^{\sigma-1} P_{X_i}^{1-\sigma}$ . Given constant markup pricing, this implies the firm's operating profit function (before subtracting any fixed costs) is:

$$\Pi_i = \frac{k_1}{\sigma - 1} a_i^{\sigma-1} P_{X_i}^{1-\sigma}. \quad (3)$$

Profits are increasing in the firm's productivity and decreasing in the input price index.

### 3.2 Choice of Inputs and Firm entry and exit

Each firm  $i$  chooses the set of goods  $\Omega_i$  that it will import and use as intermediate inputs. Firms are required to pay a fixed cost  $\lambda$ , denominated in units of labor at wage rate  $w$ , for each variety it imports. We assume import prices are an increasing and concave function of quality:

$$p_j = P^* b_j^\psi,$$

where  $0 < \psi < 1$  and  $P^*$  scales the level of all imports relative to domestic prices. Since the only thing that matters for demand of good  $j$  is the quality adjusted price,  $p_j/b_j$ , firms that import any intermediates will start with the highest quality good and continue importing lower quality goods until the additional benefit equals the additional fixed cost for the marginal variety,  $\underline{b}_i = \min_{j \in \Omega_i} \{b_j\}$ . We assume the quality parameter  $b$  follows a Pareto distribution with shape parameter  $\beta > 1$ :<sup>8</sup>

$$G(b) = 1 - b^{-\beta}.$$

[Note: in this version of the paper, quality is not indexed by firm, so all firms share the same ordering in terms of which inputs are most important. The empirical evidence presented below suggests this is not the case and thus the distribution of product quality will be firm specific in future drafts.] We can now re-express the cost index for intermediates as:

$$P_{X_i} = P^* \left( \frac{\beta}{\delta} \right)^{\frac{\mu-1}{\mu}} \underline{b}_i^{\frac{\delta(1-\mu)}{\mu}},$$

where  $\delta = \beta - \frac{(1-\psi)\mu}{1-\mu} > 0$ . Clearly, the lower is  $\underline{b}_i$ , the larger is the set of imported varieties  $\Omega_i$  and the lower is the import price index  $P_{X_i}$ . Substituting into the expression for firm

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<sup>8</sup>As is standard in the CES setup, we addition we require that  $\beta > (1-\psi)\mu/(1-\mu)$  to ensure that the import price index is well behaved.

$i$ 's demand for good  $j$  generates a distribution of within-firm imports  $m_{i,j}$  that is Pareto with shape parameter  $\frac{\beta(1-\mu)}{\mu(1-\psi)}$  and scale parameter  $\underline{m}_i$ , which is the value of imports by firm  $i$  of the good with cut-off quality  $\underline{b}_i$ . Note that, as in Chaney (2008), the size distribution of within-firm imports is more homogenous the more homogenous is the underlying Pareto distribution for quality and the lower is the elasticity of substitution across the inputs in the production function. Additional input varieties decrease the production cost, and hence, they are added until the marginal benefit equals to the fixed cost of importing another good:

$$\frac{d\Pi_i}{d\underline{b}_i} = -w\lambda G'(\underline{b}_i).$$

which results in an expression for  $\underline{b}_i$ :

$$\underline{b}_i = \left(\frac{w\lambda}{k_2}\right)^{\frac{1}{\theta}} \left(\frac{a_i}{P^*}\right)^{\frac{1-\sigma}{\theta}}, \quad (4)$$

where  $k_2 = k_1 \frac{(1-\mu)}{\mu} \left(\frac{\beta}{\delta}\right)^{\frac{\beta-\theta}{\delta}-1}$  and  $\theta = \frac{\delta(1-\mu)(1-\sigma)}{\mu} + \beta$ . Substituting this value of the marginal imported variety, we can re-write the input cost index  $P_{X_i}$  as:

$$P_{X_i} = (P^*)^{\frac{\beta}{\theta}} (a_i)^{1-\frac{\beta}{\theta}} \left(\frac{\beta}{\delta}\right)^{\frac{\mu-1}{\mu}} \left(\frac{w\lambda}{k_2}\right)^{\frac{\delta(1-\mu)}{\theta\mu}}. \quad (5)$$

To ensure that the second order conditions for maximization are satisfied we require  $\theta > 0$ .<sup>9</sup> The higher the productivity of the firm, the lower is the cut-off  $\underline{b}_i$  and therefore lower is the input cost index  $P_{X_i}$ . The cut-off is increasing in wages and fixed costs and in  $P^*$ . As long as  $w$ ,  $\lambda$  and  $P^*$  are finite, in the absence of any entry costs to being an importer, each firm will import a positive amount.

We have fully defined the operations of firms that import, and so we can now evaluate which firms will opt to enter the import market by paying a per period fixed cost  $f$  in terms of wages. A firm will enter the import sector if its productivity is sufficiently high that profits exceed total fixed costs:  $\Pi_i - (1 - G(\underline{b}_i))\lambda w - fw > 0$ . Using equations (3), (4), (5), we solve for the productivity cutoff in the case of an interior solution,

$$\underline{a} = \left(\frac{fw}{k_4}\right)^{\frac{1}{\frac{1}{\theta}\beta(\sigma-1)}},$$

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<sup>9</sup>A sufficient condition for  $\theta > 0$  is  $\sigma - 1 < \mu/(1 - \mu)$ .

where  $k_4 = \left[ \frac{k_3}{\sigma-1} - \left[ \left( \frac{w\lambda}{k_2} \right)^{\frac{1}{\theta}} \left( \frac{1}{P^*} \right)^{\frac{1-\sigma}{\theta}} \right]^{-\beta} \lambda w \right]$ . For the profits of the firm net of input fixed costs to be positive for some  $i$ , i.e., for  $\Pi_i - (1 - G(\underline{b}_i))\lambda w > 0$  we require  $k_4 > 0$ . Summing up all imports from the least productive firm that imports to the most productive in the economy, we can express total imports as:

$$\begin{aligned} M &= \int_{i \in \Psi} m_i di = \int_{\underline{a}}^{\infty} m_i(a) dG(a) \\ &= \int_{\underline{a}}^{\infty} k_3 a^{\frac{1}{\theta} \beta (\sigma-1)} dG(a), \end{aligned}$$

where  $\Psi$  is the set of firms that import and  $k_3 = k_1 \left[ (P^*)^{\frac{\beta}{\theta}} \left( \frac{\beta}{\delta} \right)^{\frac{\mu-1}{\mu}} \left( \frac{w\lambda}{k_2} \right)^{\frac{\delta(1-\mu)}{\theta\mu}} \right]^{1-\sigma}$ .

In order to generate closed form expressions, we assume firm productivity  $a_i$  follows a truncated Pareto distribution with shape parameter  $\phi$ :

$$G(a) = 1 - \frac{a^{-\phi} - a_H^{-\phi}}{1 - a_H^{-\phi}},$$

where  $a_H$  is such that  $\underline{b}_i$  is interior even for the most productive firm. Given the Pareto assumption, the size distribution of importers is also truncated Pareto with shape parameter  $\frac{\phi\theta}{\beta(\sigma-1)}$ , scale  $\underline{m}$ , and upper bound  $m_H$ , which corresponds to imports by the firm with productivity  $a_H$ . We will be able to use these analytical results to calibrate parameters from the distribution of across- and within-firm import volumes observed in the data.

### 3.3 Trade Elasticities

Now, as in Chaney (2008), we derive analytical expressions for how trade adjusts to changes in the price of imports. We start within a given firm and measure what we refer to as the sub-intensive and sub-extensive margins. The sub-intensive margin is simply a volume adjustment by a continuing importer of a continuing imported variety. The sub-extensive margin captures the volume of imports of varieties that are added or dropped by continuing importers. Next, we characterize the traditional intensive and extensive margins, defined as the amount of trade adjustment due to continuing and entering/exiting firms, respectively.

### 3.3.1 Within firm Intensive/Extensive Margins and Elasticities

We start by writing each firm's imports as the sum over all imported varieties:

$$m_i = \int_{\underline{b}_i}^{\infty} m_{i,j}(b_j) dG(b_j),$$

and differentiate with respect to a proportional change in all import prices. This allows us to break down the intensive margin response of trade volumes into changes in existing firm-product imports (sub-intensive) and changes in the range of products (sub-extensive) imported:

$$\frac{dm_i}{dP^*} = \underbrace{\int_{\underline{b}_i}^{\infty} \frac{dm_{i,j}}{dP^*} dG(b_j)}_{\text{sub-intensive margin}} - \underbrace{\bar{m}_i G'(\underline{b}_i) \frac{d\underline{b}_i}{dP^*}}_{\text{sub-extensive margin}}.$$

To evaluate the expression for the sub-intensive margin, we consider a fixed set of goods. Using equation (2), we have

$$\frac{dm_{i,j}}{dP^*} = (1 - \sigma) \frac{m_{i,j}}{P^*}.$$

Note that since all prices change by the same amount, the import shares across varieties does not change, allowing us to write:

$$\int_{\underline{b}_i}^{\infty} \frac{dm_{i,j}}{dP^*} dG(b_j) = \frac{\beta}{\theta} (1 - \sigma) \frac{m_i}{P^*}. \quad (6)$$

There are two components to the sub-intensive margin. One is the direct impact on imports of the increase in  $P^*$  keeping  $P_X$  constant and the other results from a change in  $P_X$  as  $\underline{b}$  adjusts. Similar algebra shows that the sub-extensive margin can be written as:

$$-\bar{m}_i G'(\underline{b}_i) \frac{d\underline{b}_i}{dP^*} = -\delta \frac{m_i}{P^*} \frac{\sigma - 1}{\theta}. \quad (7)$$

Since  $(\sigma - 1)/\theta > 0$  when  $P^*$  increases  $\underline{b}$  increases.

Multiplying (6) and (7) by  $P^*/m_i$ , we get that the elasticity of the sub-intensive margin is:

$$\frac{\beta}{\theta} (\sigma - 1),$$

and the elasticity of the sub-extensive margin is:

$$\frac{\delta}{\theta} (\sigma - 1).$$

Both sub-elasticities are increasing in  $\sigma$ . That is, conditional on the good continuing to be imported, the volume imported will decline more sharply for inputs used by products whose final demand is more elastic. Note that the role  $\sigma$  plays here is to effect the level of profits, which is why it has a similar effect on the sub-intensive and sub-extensive margin, which represents within firm adjustments.

The elasticity of substitution across inputs,  $1/(1 - \mu)$ , impacts the elasticity of the sub-extensive margin negatively. ( $\delta$  is a decreasing function of  $\mu$  and  $\theta$  is an increasing function of  $\mu$ ). When  $\mu$  is high, the shares on imported inputs are concentrated in the highest  $b$  inputs and the share of inputs close to the margin is small, so impact on trade volumes of a given change in the cut-off is small. A higher  $\mu$  also reduces the elasticity of the sub-intensive margin because the channel through which  $\mu$  effects the sub-intensive margin is through the effect of a change in  $\underline{b}$  on the price index  $P_X$ . The higher is  $\mu$  the smaller is the effect of a change in the cut-off on  $P_X$  and consequently the lower the elasticity of the response.

### 3.3.2 Firm entry and exit elasticities

The two sub-elasticities measured above characterize changes in the volume of trade by firms that continue to import at least some varieties, but aggregate trade volumes also reflect an extensive margin that arises from firms entering or exiting the pool of importers. We characterize these margins by differentiating aggregate trade flows with respect to the import price:

$$\frac{dM}{dP^*} = \underbrace{\int_{b_i}^{\infty} \frac{dm_i(a)}{dP^*} dG(a)}_{\text{intensive margin}} - \underbrace{\bar{m}G'(\underline{a}) \frac{d\underline{a}}{dP^*}}_{\text{extensive margin}}.$$

It can be shown that the elasticity of the intensive margin is given by:

$$\frac{\beta}{\theta}(\sigma - 1),$$

and the elasticity of the extensive margin given by:

$$\left( \phi - \frac{1}{\theta} \beta (\sigma - 1) \right) - M_i \frac{k_3 \phi}{1 - a_H^{-\phi}} a_H^{\frac{1}{\theta} \beta (\sigma - 1) - \phi}.$$

Consider the case when  $a_H$  is large so that the second term approximates 0. The elasticity of the sub-extensive margin is then inversely related to the Pareto shape parameter ( $\frac{\phi \theta}{\beta(\sigma - 1)}$ ) for the across importer size distribution. The more homogenous is the across importer size

distribution the larger is the extensive margin response.

Similar to the result in Chaney (2008) the elasticity of demand effects the intensive and extensive margin with opposite signs, and the sum of these effects is independent of  $\sigma$ . The importance of the extensive margin relies negatively on  $\phi$ . Recall that a higher  $\phi$  implies that a few very large firms do most of the importing and shifts in the cut-off have a very small impact on overall imports.

These expressions suggest that different structural parameter values, across countries or sectors, will produce heterogeneity in the types of responses to large shocks. In particular, the type of adjustment witnessed – whether it be significant churn in imported product variety, large entry or exit by firms, or predominantly intensive margin adjustment – will contain information relevant for evaluating the impact of such adjustment on the macroeconomy.

### 3.4 Measured decline in productivity

In addition to containing information on key structural parameters, a characterization of the extensive, sub-intensive and sub-extensive margins allows for better estimation of changes in productivity in importing firms. As known from Feenstra (1994), the impact of adjustments at the sub-extensive margin will imply that conventional price indices will incorrectly measure the unit cost of the firm. That is, given our assumption that production is a CES aggregation of inputs, we can write the true change in the unit cost of the firm as:

$$\frac{P_{X_{i,t}}}{P_{X_{i,t-1}}} = PI_{i,t} \cdot F_{i,t},$$

where  $PI_{i,t}$  is the conventionally measured price index using the set of input varieties  $I_i$  that were imported by firm  $i$  in both periods  $t$  and  $t - 1$ , and

$$F_{i,t} = \left[ \frac{\lambda_{i,t}}{\lambda_{i,t-1}} \right]^{\frac{\mu}{\mu-1}}, \quad (8)$$

where  $\lambda_{i,r} = \left( \int_{j \in I_i} p_{jt} f_{ijt} dj \right) / \left( \int_{j \in I_{i,r}} p_{jt} f_{ijt} dj \right)$  and  $I_{i,r}$  is the set of varieties imported by firm  $i$  in period  $r$ .

When there is a decline in the (weighted) number of varieties that a firm uses in period  $t$  relative to period  $t - 1$ , this implies a naive measure of its input costs will be too low, or that  $F_i > 1$ . Even when  $a_i$  has not changed between periods  $t$  and  $t - 1$ , failure to account for  $F_i$  may generate a measured change in productivity because of the incorrect imputation

of the inputs used  $X_i$ .

For example, true economic input growth can be related to measured input growth as follows:

$$\begin{aligned}\frac{X_{i,t}}{X_{i,t-1}} &= \frac{\int p_{i,t} f_{i,t} di}{P_{X_{i,t}}} \frac{P_{X_{i,t-1}}}{\int p_{i,t-1} f_{i,t-1} di} \\ &= \frac{\int p_{i,t} f_{i,t} di}{P_{I,t} F} \frac{P_{I,t-1}}{\int p_{i,t-1} f_{i,t-1} di} = \frac{X_{i,t}^M}{X_{i,t-1}^M} \frac{1}{F_{i,t}}\end{aligned}$$

where  $X_i^M$  represents  $i$ 's measured change in spending on inputs. The change in output for each firm (assuming there are no measurement issues in deflating output) is then

$$\log Y_{i,t} - \log Y_{i,t-1} = \log X_{i,t}^M - \log X_{i,t-1}^M - \log F_{i,t},$$

and the measured change in productivity is:

$$\Delta a_{it}^M = (\log Y_{i,t} - \log X_{i,t}^M) - (\log Y_{i,t-1} - \log X_{i,t-1}^M) = -\log F_{it}.$$

Even if a firm's underlying technology does not change, if  $F_i > 1$  and the statistician does not account for this, she will impute a decline in productivity. Analyses using aggregated data has suggested that this mechanism can account for only a very limited amount of the observed decline in productivity in countries during large crises. Below, we present firm-level data which allows for a much larger quantitative impact.

## 4 Data

We now describe the data we have on firms and trade adjustment during the Argentine crisis. We bring together two databases: customs data for Argentina from The Datamyne, a private vendor, and operating and financial information on the largest Argentine firms from the Capital IQ database. We describe the data below.

### 4.1 Detailed Trade Data from Customs

Our data are collected by the customs agency in Argentina, which publicly releases most of the information it collects from import and export shipping manifests. The data vary somewhat in coverage over time, but give detailed information for each trade shipment, generally



including the name of the importer, the date of declaration, the quantity, weight, price, and value of the good, along with detailed information at levels at least as disaggregated as the 10-digit HTS classification. Argentina additionally adds its own code with an 11th digit and a letter (as the 12th character, A-Z) to the HTS classification, so these products can often be easily distinguished at a 12-digit level. Significant additional information is also available, such as the brand, model, and other characteristics of subitems within any given 10- or 12-digit category. The data also identifies the source or destination country, the currency of invoicing, freight value, insurance, taxes, and several other information fields that are further described in Appendix A.

We obtained the data from a private provider of trade statistics called The Datamyne, which receives daily an electronic feed from the customs authorities. Though The Datamyne does not add or edit any information on its own, it takes significant measures to ensure the information is fully and accurately transmitted from the customs authority and it is among the few such data providers that has received International Standards Organization (ISO) certification, reflecting the reliability of its quality control systems.<sup>10</sup> Subject to the few exceptions detailed below, we obtained data on all imports of goods for Argentina for the period 1996-2008.

Figure 4(a) compares the total value in our dataset of Argentina’s imports with the value reported in the International Financial Statistics database provided by the IMF. The data line up extremely well, including at high frequency, with the only exception being a period from mid 1997 to early 1999, when our data are missing about 1/3 of the imports. Unfortunately, these data were not provided to The Datamyne by Argentine customs and we have not been able to add them. Further, we compare reporting on these flows to their counterparts in data collected by the Foreign Trade Division of the U.S. Census Bureau. Figure 4(b) demonstrates that though some discrepancies clearly exist, the basic patterns captured in the U.S. bilateral trade data are also reflected in our micro data set.

Economy-wide, imports come from more than 100 countries, include more than 15,000 hts codes, and often reflect more than 100,000 different country and product code combinations. The smallest importers may trade with only one partner, but some importers are supplied by over 40 different countries and themselves import in over 1,000 categories. Table 2 lists these and related summary statistics for imports in 2000 and 2003.

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<sup>10</sup>See <http://www.iso.org> for details on the International Standards Organization’s certification procedures and requirements.

## 4.2 Capital IQ Database

We match the firm names in our trade data with the Capital IQ database to allow us to learn more about the importers themselves. Capital IQ contains operating and financial information on about 4500 firms in Argentina, including public, private, domestic, and multinational firms. Our trade data includes dramatically more firms, but given the concentration of trade and Capital IQ information among the largest firms, we are able to match firms accounting for about 60 percent of Argentina’s imports. Roughly two-thirds of these matches contain information on the firm’s primary sector.

Table 3 lists the largest 50 importers for the period 1996-2008, along with their primary industry and primary sector, as reported in the Capital IQ database.<sup>11</sup> 7 of the largest 8 importers, themselves responsible for a bit less than 10 percent of total imports in a typical year, are all Argentine subsidiaries of foreign automobile manufacturers. Outside of these 7, however, many industries are represented with no obvious concentrations or patterns. Prior to seeing these individual company names, one might have been concerned that the lack of extensive margin was driven by the existence of several large importer/exporter or trading firms, which aggregated demand from many domestic producers. Though most of the companies are recognizably not trading firms or distributors, we formalize this analysis using the data on primary industry of importing firms. Of those imports by firms with primary industry data, only about 10 percent go to firms classified as "Distributors", "Food Distributors", "Healthcare Distributors", "Technology Distributors", or "Trading Companies and Distributors." This percentage is an upper-bound on the share of imports that might be spuriously aggregated and is fairly stable throughout the dataset.

## 5 Empirical Findings

We now detail several notable characteristics of our panel of data. Our findings including important moments of both the cross-section and the time-series, and generally would not be observable in aggregated data sets.

***Finding 1: Total imports are high concentrated in the largest importing firms and products.***

Figure 5(a) shows the cumulative distribution function for Argentine importers and shows

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<sup>11</sup>We exclude Argentina’s Central Bank, which is credited in the data with some import flows associated with its extension trade credit.

that trade flows are extremely concentrated, with the largest 5 percent of trading firms contributing approximately 85 percent of trading volumes. The net exit or entry of firms must mechanically change the shape of this distribution, but the scale of these changes appears quite small. The distribution of import shares remains very similar over time, including when comparing the periods before and after the crisis.

Similarly, we can assess the concentration of products, measured by HS6 codes. Figure 5(b) shows the cumulative distributions of HS6 codes for Argentine imports. Concentration in import categories has in fact increased, though it is unclear how large one should consider this change.

Figure 6 shows the linear relationship between the log of the rank of importers (by size) in 2000 and the log of their total imports. The largest firms attributing 80 percent of all Argentine imports are included and a slope coefficient of about -1 fits these data well. This implies that firm import size follows a Pareto distribution with a shape coefficient of about 1. We will use this observation to calibrate the productivity distribution in model presented above.

***Finding 2: The share of products coded as end-use "industrial supplies and materials" rose from 30 to 45 percent during the crisis. The share of importers whose primary sector was "materials" rose during the crisis while those in the "consumer discretionary sector" declined.***

We now match our trade data with additional information on the types of goods traded and firms conducting this trade to better characterize the drop in imports in 2002. First, we match our HTS codes with 1-digit end-use codes to break down trade into the following categories: Foods, Feeds, and Beverages; Industrial Supplies and Materials; Capital Goods, Except Automotive; Automobile Vehicles, Parts and Engines; Consumer Goods (Non-food), Except Automotive; and Other. The evolution of import shares in these categories are plotted in Figure 7(a). We fail to match all HTS categories to end-use codes, so the totals do not necessarily add to 100 percent. While categories are relatively stable during most years in the sample, "industrial supplies and materials" exhibits a dramatic increase in its share during the crisis, jumping from about 30 percent of imports to about 45 percent in only 2 quarters. After the crisis abates, its share reduces somewhat, though remains elevated relative to the pre-crisis sample.

Consistent with the surge in import share of the end-use category "industrial supplies and materials," the "materials" sector dramatically increases its share of imports during

the crisis as depicted in Figure 7(b). This is largely offset by a decline in the consumer discretionary sector, which includes companies in the automotive industry.

These findings may be indicative of the higher elasticity of substitution for consumer goods, while intermediate inputs are more likely to lack a domestic counterpart and therefore face a more inelastic demand. [We do not yet attempt in our model to match cross-sector facts such as these, but plan to do so.]

***Finding 3: The extensive margin defined as the entry and exit of firms or the entry and exit of products plays a small role in understanding trade adjustment during the crisis.***

As discussed previously, Argentina experienced a dramatic shock to its nominal exchange rate and a rapid reversal of its small trade deficit into a huge surplus. It is no surprise, therefore, that the number of firms that imported any goods in each quarter dropped by more than one half, nor that the number of imported product categories dropped by nearly one fourth. Figure 8 shows the number of importers and number of imported 10-digit HTS categories for 1996-2008, excluding the period in the late 1990s for which the data is incomplete.<sup>12</sup> It is clear that when considering the *number* of firm and product exits from importing activity, extensive margin adjustment is remarkably salient. This appears true in the run-up to the recession, during the crisis, and throughout the recovery.

In evaluating the importance of this margin, however, one must consider the scale of the activity that is entering or exiting. Models such as Melitz (2003) predict a large reallocation of market share from exiting firms toward firms that continue to trade. There is little evidence that this is the case for importers in Argentina.

We can more formally disaggregate the intensive margin from the margins of entry and exit of importers as follows:

$$\frac{\Delta M_t}{M_{t-1}} = \underbrace{\left( \sum_{i \in \Psi_{t-1} \cap \Psi_t} \frac{M_{i,t} - M_{i,t-1}}{M_{t-1}} \right)}_{\text{Intensive Margin}} + \underbrace{\left( \sum_{i \in \Psi_t, i \notin \Psi_{t-1}} \frac{M_{i,t}}{M_{t-1}} - \sum_{i \in \Psi_{t-1}, i \notin \Psi_t} \frac{M_{i,t-1}}{M_{t-1}} \right)}_{\text{Extensive Margin}}, \quad (9)$$

where  $M_{i,t}$  is firm  $i$ 's total (fob) spending on imports,  $M_t = \sum_{i \in \Psi_t} M_{i,t}$  are total imports in the economy,  $\Delta M_t = M_t - M_{t-1}$ , and  $i \in \Psi_t$  is the set of all importing firms in period  $t$ . As

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<sup>12</sup>We identify each firm by its CUIT, which is the company's tax identification number. This is a more stable and reliable indicator of each firm than the "name" field, which is more prone, for example, to typographical errors.

in the model above, the first term on the right hand side of (9) is the intensive margin and captures the increase in imports from existing importers. The second term is the extensive margin and captures the volume of imports from new importers, net of the volume lost from those that left trade in period  $t$ . Figures 9(a) and 10(a) show, for definitions of  $t$  as quarters and as years, the breakdown of aggregate movements in trade by intensive and extensive margins. It is striking how small a share of changes in aggregate trade flows is attributable to the entry or exit of firms. For example, imports in 2002 were about 60 percent below their already depressed levels in 2001 and these flows were generated by about half as many importing firms. The extensive margin's contribution to the 60 percent decline was less than 5 percentage points.

We can do the equivalent exercise for products, where we use the same disaggregation (9), but redefine  $\Psi_t$  to be the set of all imported product categories in period  $t$ . Figures 9(b) and 10(b) use the 6-digit HTS definition, Figures 9(c) and 10(c) use the 10-digit definition, and Figures 9(d), 9(e), 10(d), and 10(e) define goods as the interaction of each of those classifications with the exporting country. Argentina implemented revisions to the HTS in 1996/1997 (unclear which month), May 2002, and May 2007. This potentially biases *upward* our calculation of the extensive margin's importance. We use the concordance in Pierce and Schott (2009) to attempt to solve this problem, but can only apply this procedure for the 6-digit codes. Pierce and Schott base their concordance on U.S. data and 6-digits is the most disaggregated level at which the codes are internationally comparable. These adjustments make little quantitative or qualitative difference. As with the extensive margin of importers, the extensive margin of imported products is also quantitatively miniscule. (One exception is 1997, when the changing code definitions clearly impacts the 10-digit disaggregation.)

Another way to consider the import of the intensive and extensive margin in explaining the time series behavior is to look at the trade patterns for 1996-2008 of a constant set of goods or importers chosen to include all goods of firms involved in trade in a particular year. Figure 11(a) compares total imports as well as those contributed by firms that had positive imports in 1999, prior to the crisis. Figures 11(b)-11(e) show the same comparison, but for the 6- and 10-digit categories (as well as for the interactions of those category with exporting country) that were imported in 1999. Again, the 6-digit categories are adjusted to account for changing category definitions in the goods, while the 10-digit category is not. Only the constant panel with 10-digit categories imported in 1999 (with and without interaction) shows any divergence from total Argentine imports, and this partly (and perhaps primarily)

reflects the HTS revisions from 2002. All these constant panels closely track the level, scale, and high frequency pattern of the decline in trade during Argentina’s crisis. The exit of imported products is virtually irrelevant for the long-term change in imports through the crisis – from late 1998 to early 2002 – and that new products explain at most about a quarter of import growth from 2002 to late 2006.

One might wonder if there is heterogeneity in the import of the extensive margin across end-use categories. The answer is: not much. If looking at the quarterly frequency, one does note a bit more of a contribution of the extensive margin during the crisis for all sectors except auto, which has less. But the plots that consider firm entry or exit between years, restore the conclusion that across all good types, the extensive margin of firm entry or exit is of very little importance. The difference between quarterly and annual totals likely reflects delays by some importers of a quarter or more that eventually return to import activity within a year. As before, we also consider a definition of the extensive margin as exiting or entering import good categories. The extensive margins for the 6-digit HTS definition is extremely small for all end-use categories. The 10-digit HTS definition does reveal some importance of the extensive margin early in the sample. This largely reflect the changed definition of HTS codes in 1996/1997, as well the incompleteness of our data for some of 1997-1999. In the crisis and subsequent period, even at the 10-digit level, the extensive margin’s contribution hovers close to zero for all end-use categories.

These results are, to our knowledge, the first to demonstrate the tiny scale of extensive margin adjustment, given these definitions, in the face of a such a massive shock. Our results that, in the aggregate, high-volume products are not dropped by the economy, suggests that the principal impact of trade adjustment is not, for example, a loss of varieties in final consumption. The largest importing firms continue to import and, at the country level, the largest imported products continue to enter Argentina’s economy.

***Finding 4: In contrast to finding 3, the within-firm extensive margin plays a sizeable role in aggregate adjustment.***

Though the extensive margin of importers or goods at the economy level plays little role in aggregate adjustment, the within-firm extensive margin of existing importers changing their product mix matters much more. This is depicted in Figures 12 and 13, where the extensive margin is now defined as changes in the value of within-firm imports accounted for by changes in the composition of HTS codes or HTS codes interacted with exporting country. This role for the within-firm extensive margin is equally evident for each of the

end-use categories. Figure 14 compares a constant panel of importer-products or importer-product-country combinations defined in 1999 to movement in total imports. All these plots demonstrate that while the intensive margin remains the primary driver of import dynamics at these frequencies, churning of products within continuing exporters also plays an important quantitative role.

The first three columns of Table 4 quantify the importance of the extensive margin by listing the fraction of the 61 percent annual decline in dollar imports in 2002 explained by the different definitions of the intensive and extensive margin. When the extensive margin is defined as entering/exiting firms or products (whether HTS 6 or HTS 10) at the country level, it explains none of the decline. The extensive margin’s share increases only marginally when we include the supplier country in the definition of the product. On the other hand, when defined “within firm,” the extensive margin explains a large share ranging from 26 to 44 percent of the decline, depending on the product definition.

Why might this matter? As discussed above, the failure to properly account for changing inputs can lead to an incorrect estimate of a firm’s cost bundle index, which can imply incorrect estimates of its total factor productivity (TFP). To get a sense for the scale of this issue, we implement the correction (8) for the overall economy, using the various definitions of the extensive margin.

Assuming an elasticity of substitution equal to 6,  $1/(\mu-1) = 6$ , as used in the calculations of Arkolakis, Demidova, Klenow, and Rodriguez-Clare (2008), and with  $t = 2003$  and  $t - 1 = 1999$ , the estimated corrections are given in the last column of Table 4. When the extensive margin is defined at the country-level by looking at new products or product and country combinations in aggregate imports, the correction ranges from 0.7 percent to 2.8 percent. These corrections range from small to moderate and imply that the true price index increased by more than would be captured by a naive calculation. The implication is that, without correcting for the decline in varieties, input costs and TFP would be underestimated. Making these country-level adjustments would remedy this, though by a limited amount. On the other hand, when the extensive margin is defined as changes in products within a given firm, the correction implies that the true price index is 4.4 to 5.6 percentage points higher, a far more significant correction.

The correction factor  $F$ , however, is most naturally interpreted at the firm or consumer level. As calculated in the bottom 4 rows of Table 4, it is instead a weighted aggregation of

each firm's own  $F_i$ .<sup>13</sup> Hence, we also measure the Feenstra correction over this period, firm-by-firm. Table 5 lists the average of firm-level corrections  $F_i$ , where each firm observation is weighted by its share in the sum of total trade in 1999 and 2003. The first column of the table lists the correction when done with aggregate data and gives the same factors as in rows 2 through 5 of table 4. The second through fourth columns give the weighted-average of firm-level correction factors including all firms, after excluding the top and bottom 5 percent of outliers, and after excluding the top and bottom 20 percent of outliers, respectively. The results in column 2 suggest some large-volume firms have very high correction factors, but even after factoring out the outliers, the average correction in the third column is still more than twice the average of the correction one might make using only aggregate data, and the fourth column is about 2/3 larger than the average factor from aggregate data. Correction factors differ somewhat across specifications, product definitions, and treatment of the outliers, but the general conclusion is that naive input cost estimates (with a CES production function) need to be increased to reflect the loss of input variety, and the scale of this correction when done using aggregated data may be less than half as large as would be indicated using richer micro data.

Mendoza and Yue (2009) suggest that this channel can be at work during sudden stop episodes as firms drop foreign intermediate varieties and thus raise their effective cost of production. However owing to lack of data, they do not provide evidence of this. Arkolakis, Demidova, Klenow, and Rodriguez-Clare (2008) evaluates the effect of trade liberalization in Costa Rica on increased import variety over the period 1986-1992. They find that the gains from importing a larger variety of goods following the liberalization is small because imports are concentrated in a few products. They estimate the Feenstra (1994) correction factor to be 0.997 for consumer goods and 1 for intermediate goods.

In the Argentine sudden stop crisis, we find similarly that when changes in varieties are defined at the product and exporting country level, the gains are small. However, when we apply this definition within the firm, the correction factors are much larger and economically important. This is consistent with heterogeneity across firms in the kinds of products im-

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<sup>13</sup>In particular,  $F^{1-\varepsilon}(s^{t-1}, s^t) = \left( \sum_{i \in \Psi(s^t) \cap \Psi(s^{t-1})} \frac{\alpha_i(s^t)}{\alpha_i(s^{t-1})} \frac{\tilde{\alpha}_i(s^{t-1}, s^t)}{F_i^{1-\varepsilon}(s^{t-1}, s^t)} \right)^{-1}$  where  $\alpha_i(s^t)$  is firm  $i$ 's share of total imports in period  $t$  (by firms that import in both periods).  $\tilde{\alpha}_i(s^{t-1}, s^t)$  is firm  $i$ 's share in period  $t-1$  after subtracting any imports in products that weren't also imported by that same firm in period  $t$ . Finally,  $F_i(s^{t-1}, s^t)$  is the firm-level Feenstra correction. (It is clear this measure must exclude entering and exiting firms, since they do not have a well-defined Feenstra correction.) Note that with perfect symmetry,  $F(s^{t-1}, s^t) = F_i(s^{t-1}, s^t)$ .



ported. While from the economy’s perspective there is at least some firm that continues to import a product that was previously imported in significant amounts, each firm finds itself concentrating its purchases in a smaller subset of products during the crisis and dropping products that previously were a significant fraction of their import bundle. This was the case, for instance, for the companies BGH, Siderca, and Siderar, which each dropped large categories of imported inputs during the crisis as shown in Figure 8. This analysis also reiterates the virtues of having firm level data.

***Finding 5: Unit values decline during the crisis. This is consistent with a decline in quality because the share of imports is increasing in unit value.***

We compare changes in unit values over time for given combinations of importing firms, HTS 10-digit codes, and exporting countries. Identifying changes within such a narrow category means our measure will not reflect large compositional changes across categories. Rather, our measure will pick up changes in the prices of existing goods or, more likely, small substitutions of one good for another highly similar good. Specifically, we regress the log of the median price for each quarter and each firm-product-country combination on a fixed effect for this combination and on quarterly time effects. Given unit value data can be quite noisy, we exclude outliers by eliminating combinations with prices that vary over time with a standard deviation greater than half of their means. Figure 15(a) shows these time fixed effects, estimated separately for each end-use category, for the unweighted case, and figure 15(b) reports results when the regressions are weighted by import volume.

There is some heterogeneity across end-use categories, but all lines in both plots demonstrate a downward trend in unit values from 1999 through late-2002, which starts recovering in 2003. The scale of the decline is quite large in both cases, averaging about 15 percent across the unweighted cases and about 25 percent for the weighted estimates. These figures can be interpreted as evidence of a change in markups, a change in quality, or both.

To ensure that the decline can be interpreted as a decline in quality of imported goods, we demonstrate that higher prices are associated with higher market shares within narrow good categories. To the extent the elasticity of demand is greater than one, this should only be the case when the higher unit values reflect higher quality (as opposed to, say, higher cost for equal quality). Specifically, we run the following regression:

$$\ln(imports_{i,j}) = \alpha + \beta * \ln(unit\_value_{i,j}) + f.e._j + \varepsilon_{i,j}$$

where each shipment is represented by  $i$  and where  $j$  indexes the product type. We run this regression separately for each year and vary the definition of product type to include 6-digit HTS, 10-digit HTS, and interactions of those codes with the exporting country. The coefficients  $\beta$  from these regressions are almost all positive and highly significant across many different specifications, including ones that separate each end-use category and others that use total imports for each product type as weights.

In sum, we show how Argentina's imports contracted rapidly during their sudden stop of 1999-2002. The declines were not homogeneous across product types – industrial supplies and materials represented an increasing share of imports, offset by the declining share of consumer goods. Though large numbers of firms ceased participation in import markets and certain products were no longer imported, the only quantitatively important extensive margin came from continuing importers dropping some narrowly defined products, even as other firms continued to import those products. As a result, import price indices, even when corrected for the number of varieties exiting Argentina's import bundle, may lead to understatement of importing firms' productivity losses. Finally, even for products that continued to be imported by continuing importers, we offer novel evidence that the quality of these imports declined sharply over this period.

## 6 Illustrative GE Model

In this section we present an illustrative general equilibrium model of a small open economy subject to terms of trade shocks and interest rate shocks. We extend the environment in section 3 to include a non-traded sector and an export sector along side the import sector. We do this to see how trade adjustment, well captured in the partial equilibrium setup, has repercussions for objects that are important for the macroeconomy, such as output, wages, and productivity.

We consider the response to large terms of trade movements and interest rate shocks. The goal of this section ultimately will be to numerically calibrate the model to the key moments in the data identified above and to allow for feedback from imported inputs into the domestic production sector.

We show that, consistent with our empirical results, the traded sector mainly responds to large shocks along the intensive margin when the data is calibrated to match the size distribution of importers in the data. At the same time the within firm sub-extensive margin

can be highly significant. The less substitutable is the output of the import sector with domestic produced goods the smaller is the decline in imported inputs in that sector following a decline in the terms of trade.

In each period of time  $t$ , the economy experiences one of finitely many events  $s_t$ . We denote by  $s^t = (s_0, \dots, s_t)$  the history of events up through and including period  $t$ . As of period 0, the probability of any particular history  $s^t$  is  $\pi(s^t)$ .

## 6.1 Final goods sector

The final goods sector combines the output of the import sector,  $Y_M(s^t)$ , with that of the non-traded good sector,  $Y_N(s^t)$ , to produce a final good that is domestically consumed (not traded):

$$Y(s^t) = \left( (\omega Y_N(s^t))^{\mu_c} + ((1 - \omega) Y_M(s^t))^{\mu_c} \right)^{\frac{1}{\mu_c}},$$

where  $\omega$  is the preference parameter for domestically produced non-traded inputs relative to imported inputs and  $1/(1 - \mu_c)$  is the elasticity of substitution across non-traded inputs and imported inputs.  $Y_M(s^t)$  is a CES aggregate of input varieties  $y_{mi}(s^t)$  produced by the import sector:

$$Y_M(s^t) = \left[ \int_i y_{mi}(s^t)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}}.$$

The final good producer chooses  $Y_N(s^t)$  input of non-traded goods and  $y_{mi}(s^t)$  input of each variety of the import sector to maximize:

$$P(s^t)Y(s^t) - P_N(s^t)Y_N(s^t) - \int_i p_{mi}(s^t)y_{mi}(s^t)di,$$

where  $P_N(s^t)$  is the price of the non-traded good and  $p_{mi}(s^t)$  is the price of the import sector variety  $i$ . Perfect competition implies that the price of the final good at time  $t$  is:

$$P(s^t) = \left( (\omega P_N(s^t))^{\frac{\mu_c}{\mu_c-1}} + ((1 - \omega) P_M(s^t))^{\frac{\mu_c}{\mu_c-1}} \right)^{\frac{\mu_c-1}{\mu_c}},$$

where

$$P_M(s^t) = \left[ \int_i p_{mi}(s^t)^{1-\sigma} \right]^{\frac{1}{1-\sigma}}.$$

The demand for the non-traded sector input is,

$$Y_N(s^t) = \omega^{\frac{\mu_c}{\mu_c-1}} \left( \frac{P_N(s^t)}{P(s^t)} \right)^{\frac{1}{\mu_c-1}} \cdot Y(s^t)$$

The demand for the import sector is,

$$Y_M(s^t) = (1 - \omega)^{\frac{\mu_c}{\mu_c-1}} \left( \frac{P_M(s^t)}{P(s^t)} \right)^{\frac{1}{\mu_c-1}} \cdot Y(s^t),$$

and the demand for individual varieties is

$$y_{mi}(s^t) = \left( \frac{p_{mi}(s^t)}{P_M(s^t)} \right)^{-\sigma} Y_M(s^t). \quad (10)$$

## 6.2 Non-traded good sector

The output of the non-traded sector is produced using a linear technology:

$$Y_N(s^t) = e^{z(s^t)} L_N(s^t),$$

where  $z(s^t)$  is log of economy wide productivity. We assume that this sector is also perfectly competitive and therefore price of the non-traded good is,

$$P_N(s^t) = \frac{w(s^t)}{e^{z(s^t)}},$$

where  $w(s^t)$  is the wage rate.

## 6.3 Import sector

The import sector is a monopolistically competitive sector with heterogenous firms that differ in their productivity. (This section will be similar to that in section 3 so we present it briefly.) Each firm in this sector produces a unique variety that is sold to the final good sector. The production function for each producer  $i$  is:

$$y_{mi}(s^t) = e^{Z(s^t)} a_i X_i(s^t),$$

where  $a_i$  is firm-specific productivity and  $X_i(s^t)$  is a CES aggregate of foreign intermediate inputs given by,

$$X_i(s^t) = \left[ \int_{j \in \Omega_i} (b_j f_{i,j}(s^t))^\mu dj \right]^{\frac{1}{\mu}},$$

with  $0 < \mu < 1$ , and quality parameter  $b_j > 0$ .  $f_{i,j}$  denotes firm  $i$ 's purchase of a foreign intermediate variety  $j$ , and  $\Omega_i$  is the set of all intermediates  $j$  imported by firm  $i$ . The firm is a price taker in the market for intermediate inputs. Each firm  $i$  maximizes

$$p_{mi}(s^t) y_{mi}(s^t) - \int_{j \in \Omega_i} p_j(s^t) f_{ij}(s^t) dj$$

$p_j$  denotes the price of input  $f_j$  and is the same across purchasers. Firm  $i$ 's demand for good  $j$  conditional on importing it is:

$$f_{i,j} = \left( \frac{p_j}{b_j} \right)^{\frac{1}{\mu-1}} \frac{1}{b_j} P_{X_i}^{\frac{1}{1-\mu}} X_i,$$

where

$$P_{X_i} = \left[ \int_{j \in \Omega_i} \left( \frac{p_j}{b_j} \right)^{\frac{\mu}{\mu-1}} dj \right]^{\frac{\mu-1}{\mu}}.$$

and so its total spending on imported good  $j$  is:

$$m_{i,j} = p_j f_{i,j} = s_{i,j} P_{X_i} X_i,$$

where good  $j$ 's share of firm  $i$ 's spending on imports is:

$$s_{i,j} = \left( \frac{p_j}{b_j} \frac{1}{P_{X_i}} \right)^{\frac{\mu}{\mu-1}}. \quad (11)$$

Given the constant elasticity of demand faced by firm  $i$  The price set by firm  $i$  is then a constant mark-up over its marginal cost,

$$p_{mi}(s^t) = \frac{P_{X_i}(s^t)}{e^{Z(s^t)} a_i}$$

Each firm decides whether to import in a given period and the set of goods  $\Omega_i$  it will import conditional on becoming an importer. Firms are required to pay a fixed cost  $f$  denominated in units of labor to become an importer and a fixed cost  $\lambda$ , also denominated in units of

labor, for each variety it imports. We assume import prices are an increasing and concave function of quality,

$$p_j = P^* b_j^\psi$$

where  $\psi < 1$ . The lower is  $\underline{b}_i$ , the larger is the set of imported varieties  $\Omega_i$  and the lower is the import price index  $P_{X_i}$ .

Conditional on paying the fixed cost to be an importer the firm chooses  $\underline{b}_i$ ,

$$\underline{b}_i = \arg \max_{\underline{b}} [\Pi_i(\underline{b}(s^t), a_i) - w(s^t)\lambda(1 - G(\underline{b}(s^t)))]$$

The corresponding profits are  $\Pi(\underline{b}_i(s^t), a_i)$ . The decision of whether to become an importer or not is then given by choosing

$$\max\{\Pi(\underline{b}_i(s^t), a_i) - w(s^t)\lambda(1 - G(\underline{b}(s^t))) - fw(s^t), 0\}$$

$\underline{a}(s^t)$  is the cut-off productivity such that all firms with  $a > \underline{a}(s^t)$  will become an importer and those with  $a < \underline{a}(s^t)$  will not produce. with

## 6.4 Export sector

The export sector is a perfectly competitive sector that produces a good exclusively for export. The production function is linear in labor.

$$Y_T = e^{z(s^t)} L_T(s^t)$$

and there is an exogenously given downward sloping world demand for the good,

$$Y_T(s^t) = P_E(s^t)^{-\sigma_e}$$

, where

$$P_E(s^t) = \frac{w(s^t)}{e^{z(s^t)}}$$

and  $\sigma_e$  is the world elasticity of demand for the export sector good.

## 6.5 Consumers Problem

The representative consumer in this economy consumes the final good and has access to an internationally traded non-state contingent bond  $B$  that pays out in terms of the import good. They supply labor inelastically to the import sector, the export sector and the non-traded good sector. They are assumed to own all the firms so any profits from the various sectors go to the consumers. The consumer maximizes

$$\sum_{t=0}^{\infty} \beta^t \Pi(s^t) U(C(s^t))$$

subject to the inter-temporal budget constraint.

$$P(s^t)C(s^t) + Q(s^t)P^*(s^t)B(s^{t+1}) = \Gamma(s^t) + P_E(s^t)Y_T(s^t) + P_{NT}(s^t)Y_{NT}(s^t) + P^*(s^t)B(s^t)$$

$P(s^t)$  is the price of the final good.  $\Gamma(s^t)$  are the aggregate profits of the import sector inclusive of wage payments for fixed costs and exclusive of payments for imported inputs.

$$\Gamma(s^t) = \frac{P_M(s^t)Y_M(s^t)}{\sigma}$$

$P_{NT}Y_{NT}(s^t)$  is the income from the non-traded sector and  $P_E(s^t)Y_T(s^t)$  is income from the export sector.  $Q(s^t)$  is the price of the bond in period  $t$  in units of the import good that pays off one unit of the import good in period  $t + 1$ .

The consumer's bond Euler equation is given by

$$\frac{U'(C(s^t))}{P(s^t)} Q(s^t) P^*(s^t) = \beta E_t P^*(s^{t+1}) \frac{U'(C(s^{t+1}))}{P(s^{t+1})} \quad (12)$$

The equation for the bond price is given by,

$$\frac{1}{Q(s^t)} = 1 + r^*(s^t) + \rho [\exp(-B(s^{t+1}) + B^*) - 1]$$

which ensures stationarity of the linearized model.  $B^*$  is the exogenously specified steady state level of assets.

## 6.6 Market clearing conditions

There is an inelastic supply of labor normalized to 1 unit that is used for production in the non-traded sector, in the export sector and to fixed costs in the import sector. Labor market clearing requires that,

$$\int_{\underline{a}(s^t)} [\lambda(1 - G(\underline{b}_i(s^t)) + f] dG(a) + \frac{Y_N(s^t)}{e^{z(s^t)}} + \frac{Y_T(s^t)}{e^{z(s^t)}} = 1 \quad (13)$$

The first terms on the left hand side includes the payment of fixed cost  $\lambda$  for each variety that is imported and the fixed cost  $f$  for the entry cost into import markets. The final and the non-traded sector goods markets clearing conditions are

$$\begin{aligned} C(s^t) &= Y(s^t) \\ Y_N(s^t) &= e^{z(s^t)} L_N(s^t) \\ y_{mi}(s^t) &= e^{Z(s^t)} a_i X_i(s^t) \quad \text{for every } a > \underline{a}(s^t) \end{aligned}$$

## 6.7 Exogenous shock processes

The two shock processes we consider are:

1. Shocks to the terms of trade:  $P^*(s^t) = P^* e^{\tau(s^t)}$ ,  $P^* = 1$

$$\tau(s^t) = \rho_\tau \tau(s^{t-1}) + \varepsilon_{\tau au}(s^t) \quad (14)$$

2. Shocks to the interest rate:  $r^*(s^t) = r^* e^{rs(s^t)}$ ,  $r^* = 1/(1 - \beta)$

$$rs(s^t) = \rho_r rs(s^{t-1}) + \varepsilon_{rs}(s^t) \quad (15)$$

## 6.8 Numerical Example

In this section we present a numerical example of the effect of the various shocks. We first consider the case of a permanent unanticipated increase in  $P^*(s^t)$ . We compare the two steady states in this case.

To simulate the model we assume the following function form for the utility function:

$$U(C) = \frac{C^{1-\gamma}}{1-\gamma}$$



Firm productivity  $a_i$  is assumed to be drawn from a truncated Pareto distribution with shape parameter  $\phi$

$$G(a) = 1 - \frac{a^{-\phi} - a_H^{-\phi}}{1 - a_H^{-\phi}}$$

$$dG(a) = \frac{\phi a^{-(\phi+1)}}{1 - a_H^{-\phi}}$$

The quality/taste parameter  $b$  follows a Pareto distribution with shape parameter  $\beta_m$ :

$$G(b) = 1 - b^{-\beta_m}.$$

where  $\beta_m > (1 - \psi)\mu / (1 - \mu) > 1$   $m_{i,j}$  is Given these functional form assumptions we have that the within firm distribution of imports across varieties is Pareto with shape parameter  $\frac{\beta_m}{\beta_m - \delta}$  and scale parameter  $\underline{m}_i$ . The size distribution across importers is truncated Pareto with shape parameter  $\frac{\phi\theta}{\beta_m(\sigma-1)}$  and scale  $\underline{m}$  and upper bound  $m_H$ .

The calibrated values for the various parameters are listed in Table 6. The values of the parameters imply that the shape parameter for importer size distribution is 1.1 consistent with the evidence reported in Section 5.

The effect of a permanent 15% increase in  $P^*$  are reported in Table 7. The increase in  $P^*$  raises the cost of all imported inputs relative to the export price of domestically produced goods. Total imports decline by 19.2%. There is a response both at the intensive and extensive margin. The cut-off productivity of the firm increases by 6.5%. This results in a 17.28% drop in the number of importers. While this is a large drop in the number of importers they account for a decline of 0.69% in imports. This results from the concentration of imports among the few high productivity firms. Among the firms that continue to import following the shock there is a decline in the number of varieties that they import as seen in Figure 8. The solid line depicts  $\underline{b}(a)$  when  $P^* = 1$  and the dashed line depicts  $\underline{b}(a)$  when  $P^* = 1.15$ . For each firm that continues to import the cut-off  $\underline{b}(a)$  is higher following the shock. This results in a Feenstra correction for each firm of 1.05. That is, the measured productivity of the firm declines by 5 percentage points.

$GDP$  and consumption decline by 5%. Demand shifts away from the import sector to the non-traded goods sector. The former sectors output rises by 4.5% while the output of the import sector declines by 39.3%. Real wages decline by 4.5% and gross profits of the import sector (inclusive of labor costs) decline by 27.8%. The terms of trade deterioration is of the magnitude of 9.4% and the relative price of the output of the non-traded sector to

that of the import sector declines by 31.5%.

Table 8 compares the steady state responses for different values of the elasticity of substitution across the imported sector and the non-traded sector input in the final good production function. As in the standard Krugman effect the greater the elasticity of substitution the larger the response.

We next consider the stochastic economy where shocks to  $P^*$  evolve as in equation 14. We set  $\rho_\tau = 0.95$  and  $\sigma(\varepsilon_{\tau au}) = 0.06$ . The impulse response to a one standard deviation shock, in terms of percent deviations from the initial steady state are graphed in figures 17 and 18. The qualitative responses are very similar to the permanent unanticipated shock case with the difference that there are now dynamics that arise because of the exogenously specified dynamics in the shocks process. Here again the intensive margin of trade adjustment does all the work. Most of the responses look consistent with what happens during a crisis except the account deteriorated. This is to be expected in an environment with a temporary decline in output and consumption smoothing.

We also consider the economy where the only shocks are those to the interest rate. Shocks to  $r^*$  evolve as in equation 15. We set  $\rho_{rs} = 0.95$  and  $\sigma(\varepsilon_{rs}) = 0.04$ . The impulse responses are graphed in figures 19 and 20. Most of the responses are qualitatively similar to that of the  $P^*$  shock, with the exception of the current account balance that improves. Again this is to be expected given that a higher interest rate makes savings more attractive causing consumption to decline more than output.

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## 7 Tables

Industry	Share of Inputs that are Imported
Fabricated Metal Products	0.220
Medical, Precision, Optical Instruments	0.223
Chemicals	0.294
Electrical Machinery	0.316
Pharmaceuticals	0.372
Air Transport	0.399
Railroad and Transportation Equipment	0.406
Motor Vehicles, Trailers, Semi-Trailers	0.419
Radio, Television, Communications Equip.	0.601
Office, Accounting, Computing Machinery	0.683

Table 1: Importance of Imported Intermediate Input Use

	2000	2003
# of Importing Firms	25,138	17,657
# of Supplier Countries		
Economy-wide	136	124
Per Firm, median	2	1
Per Firm, maximum	45	35
# of Imported HTS Codes		
Economy-wide	17,333	16,861
Per Firm, median	5	4
Per Firm, maximum	899	1,078
# of Imported Country X HTS Combinations		
Economy-wide	119,067	96,250
Per Firm, median	6	5
Per Firm, maximum	2,159	2,096

Table 2: Import Summary Statistics

	Importer Name	Primary Industry	Primary Sector	Ave. Ann. Imports (\$Millions)	Share of Imports, 2000	Share of Imports, 2002
1	Volkswagen Arg.	Auto Mfg.	Cons. Disc.	544.5	1.6	0.9
2	Ford Arg.			508.2	2.0	2.1
3	General Motors de Arg.			375.7	1.2	2.3
4	Renault Arg.	Auto Mfg.	Cons. Disc.	368.4	2.3	1.0
5	Peugeot Citroen Arg.			308.6	1.5	1.0
6	Daimler Chrysler Arg.			287.3	1.4	0.2
7	Siderar			288.8	0.8	1.9
8	Fiat Auto Arg.	Auto Mfg.	Cons. Disc.	242.1	0.6	0.5
9	YPF	Int. Oil and Gas	Energy	236.1	0.4	0.8
10	C.T.I.			210.1	0.2	0.1
11	Telefonica Comm. Per.			189.0	1.2	0.0
12	Monsanto Arg.			176.5	0.9	2.0
13	Hewlett-Packard Arg.	Tech. Distrib.	IT	172.1	0.9	0.3
14	Toyota Arg.			169.6	0.6	0.7
15	Telecom Personal	Wireless Telecom.	Telecom. Svcs.	165.6	0.8	0.0
16	Petrobras Energia	Int. Oil and Gas	Energy	156.4	0.1	0.5
17	Aluar Aluminio Arg.	Aluminum	Materials	138.4	0.6	1.0
18	Acindar Ind. Arg. de Aceros	Steel	Materials	129.9	0.3	0.9
19	Shell Co. Arg. De Petroleo	Oil and Gas Explo.	Energy	120.6	0.7	1.0
20	Industrias John Deere Arg.			112.1	0.2	0.2
21	Esso Petrolera Arg.	Oil and Gas Explo.	Energy	103.5	1.1	0.5
22	Siderca	Building Products	Industrials	102.3	0.3	0.6
23	Bayer Arg.			97.4	0.4	0.8
24	Honda Motor De Arg.			92.4	0.2	0.1
25	BGH	Household Apps.	Cons. Disc.	92.0	0.4	0.2
26	Siemens Arg.			91.6	0.6	0.2
27	Scania Arg.	Auto Mfg.	Cons. Disc.	91.5	0.4	0.3
28	Productos Roche	Pharmaceuticals	Healthcare	89.5	0.5	0.8
29	Atanor	Comm. Chems.	Materials	88.9	0.2	0.4
30	IBM Arg.			83.7	0.5	0.4
31	Syngenta Agro	Agr. Chems.	Materials	82.7	0.1	0.4
32	Alta Plastica	Distributors	Cons. Disc.	76.8	0.4	0.3
33	Iveco Arg.	Auto Mfg.	Cons. Disc.	75.7	0.2	0.1
34	BASF Arg.			73.9	0.3	0.5
35	Pirelli Neumaticos	Tires and Rubber	Cons. Disc.	73.7	0.2	0.6
36	Minera Alumbrera Limited	Gold	Materials	73.6	0.2	0.8
37	Unilever De Arg.			72.9	0.3	0.6
38	Tetra Pak			70.7	0.4	0.7
39	Novartis Arg.			67.5	0.4	0.4
40	Philips Arg.	Tech. Distrib.	IT	66.7	0.3	0.2
41	Procter & Gamble Arg.			67.6	0.2	0.3
42	Abbott Laboratories Arg.	Pharmaceuticals	Healthcare	65.8	0.4	0.7
43	Voridian Arg.			65.0	0.2	0.8
44	Bridgestone Firestone Arg.			62.0	0.2	0.4
45	Nidera			63.2	0.2	0.3
46	AGCO Arg.			61.8	0.1	0.1
47	Sipar Aceros	Steel	Materials	60.8	0.1	0.2
48	Aerolineas Arg.	Airlines	Industrials	60.3	0.7	0.2
49	Dow Quimica Arg.			59.1	0.2	0.4
10	Gillette Arg.			57.5	0.4	0.3

Table 3: Largest 50 importers

	Total	% Intensive	% Extensive	$\frac{\lambda_t}{\lambda_{t-1}}$	$F(\varepsilon = 6)$
	(From 2001 to 2002)	(From 2001 to 2002)	(From 2001 to 2002)	(From 1999 to 2003)	(From 1999 to 2003)
Firm	-61%	0.93	0.07		
HTS 6	-61%	1.02	-0.02	0.965	1.007
HTS 10	-61%	0.99	0.01	0.895	1.023
HTS 6 X Country	-61%	0.94	0.06	0.935	1.013
HTS 10 X Country	-61%	0.87	0.13	0.873	1.028
Firm X HTS 6	-61%	0.74	0.26	0.805	1.044
Firm X HTS 6 X Country	-61%	0.63	0.37	0.773	1.053
Firm X HTS 10	-61%	0.67	0.33	0.761	1.056
Firm X HTS 10 X Country	-61%	0.56	0.44	0.799	1.046

Table 4: Size of Intensive/Extensive Margins and Aggregate Feenstra Corrections

$\varepsilon = 6$	Aggregate $F$	Weighted Average of $F_i$		
Percentiles Included:	all	all	(5,95)	(20,80)
HTS 6	1.007	1.065	1.029	1.015
HTS 10	1.023	1.095	1.047	1.039
HTS 6 X Country	1.013	1.092	1.041	1.027
HTS 10 X Country	1.028	1.109	1.042	1.043
Simple Average	1.018	1.090	1.040	1.031

Table 5: Size of Firm-Level Feenstra Corrections from 1999-2003



Parameter		Value
Discount factor	$\beta$	0.95
Risk Aversion	$\gamma$	2
Interest rate	$r^*$	$\frac{1}{1-\beta}$
Interest elasticity	$\rho$	0.007
Steady state assets	$B^*$	-0.2
Elasticity of substitution		
–Final good production	$\frac{1}{1-\mu_c}$	2.08
–Importer production	$\frac{1}{1-\mu}$	2.44
Importer demand elasticity	$\sigma$	2
World demand elasticity	$\sigma_E$	4
Import fixed costs		
–Variety	$\lambda$	6.2
–Entry costs	$f$	1.5
Pareto parameters		
–Quality	$\beta_m$	1.1
–Shape	$\beta_m$	1.1
–Scale		1
–Importer Productivity		
–Shape	$\phi$	1.93
–Scale		1
–Max $a$	$a_H$	10
Elasticity of $P^*$ to quality	$\psi$	0.8

Table 6: Parameter values

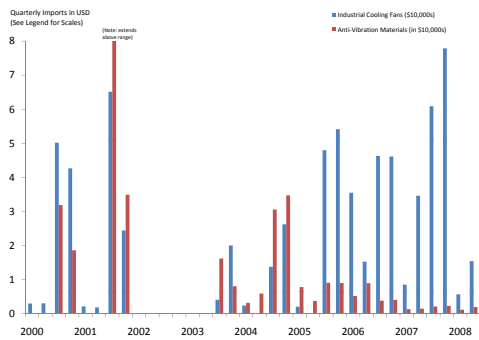
	15% $\uparrow$ in $P^*$
$GDP$	-5.0%
$C$	-5.1%
$Y_N$	4.5%
$Y_M$	-39.3%
$\Gamma/P$	-27.8%
$w/P$	-4.5%
$P_N/P_M$	-16%
$P^*/P_E$	9.4%
Trade	
Imports	-7.85%
Intensive	-7.16%
Extensive	-0.69%
$\bar{a}$	6.5%
Number of importers	-17.28%
Feenstra correction	1.05

Table 7: Response to large shocks

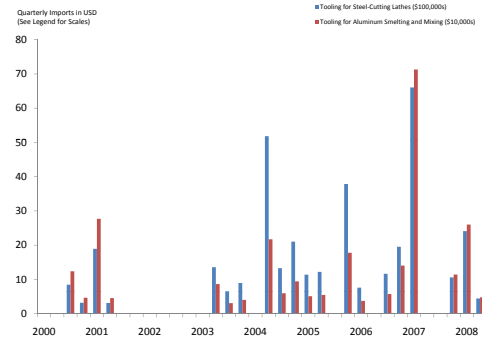
$\mu_c$	Percent change	Feenstra correction
0.0	-12.1%	1.000
0.3	-14.4%	1.01
0.4	-15.6%	1.02
0.5	-18.2%	1.04
0.52	-19.2%	1.05

Table 8: Differential response across  $\mu_c$

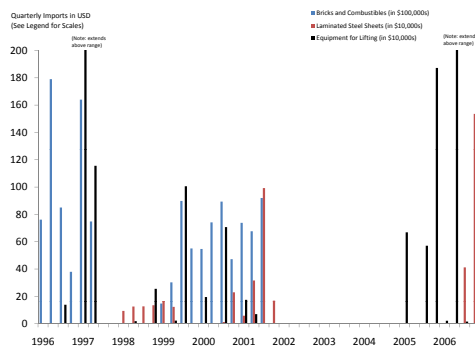
## 8 Figures



(a) BGH S.A.

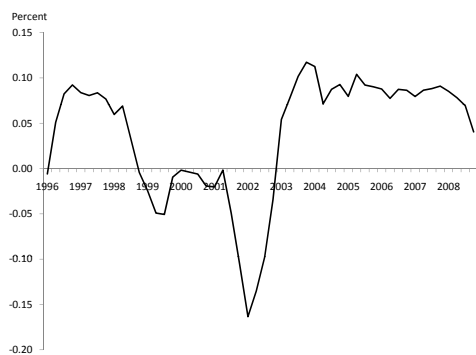


(b) Siderca S.A.I.C.

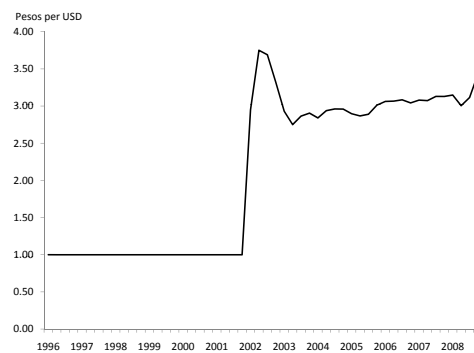


(c) Siderar S.A.I.C.

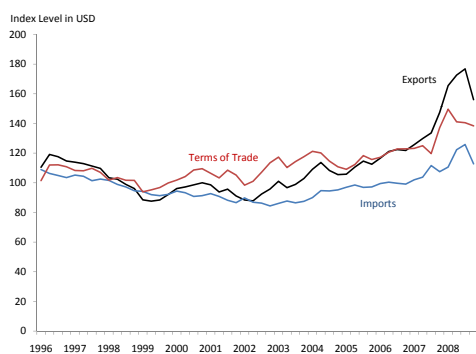
Figure 1: Sample Quarterly Product Imports



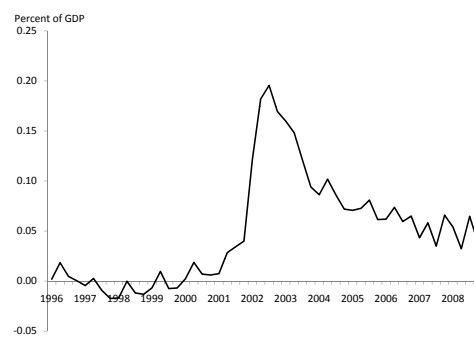
(a) Real 4-Q GDP Growth



(b) Nominal Exchange Rate



(c) Trade Price Indices



(d) Trade Balance

Figure 2: Argentina's Macroeconomic Performance

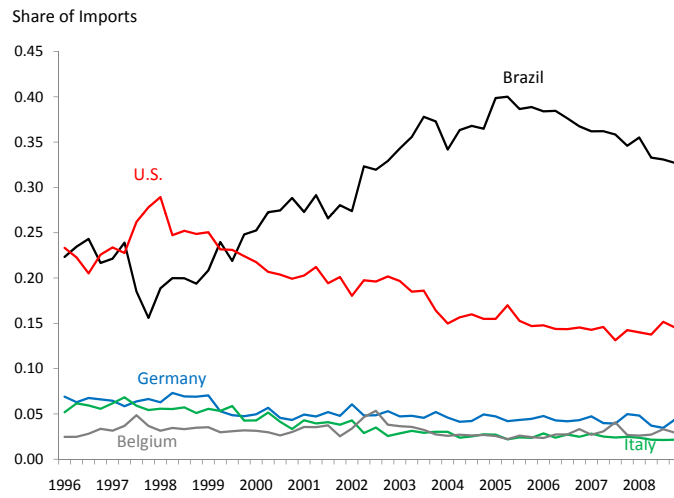
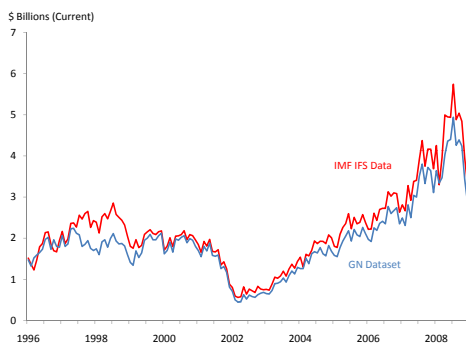
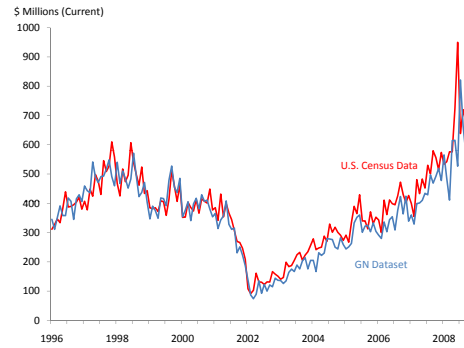


Figure 3: Shares of Largest Exporters to Argentina



(a) Argentina's Total Imports



(b) Argentina's Imports from the United States

Figure 4: Comparison to Other Data Sources

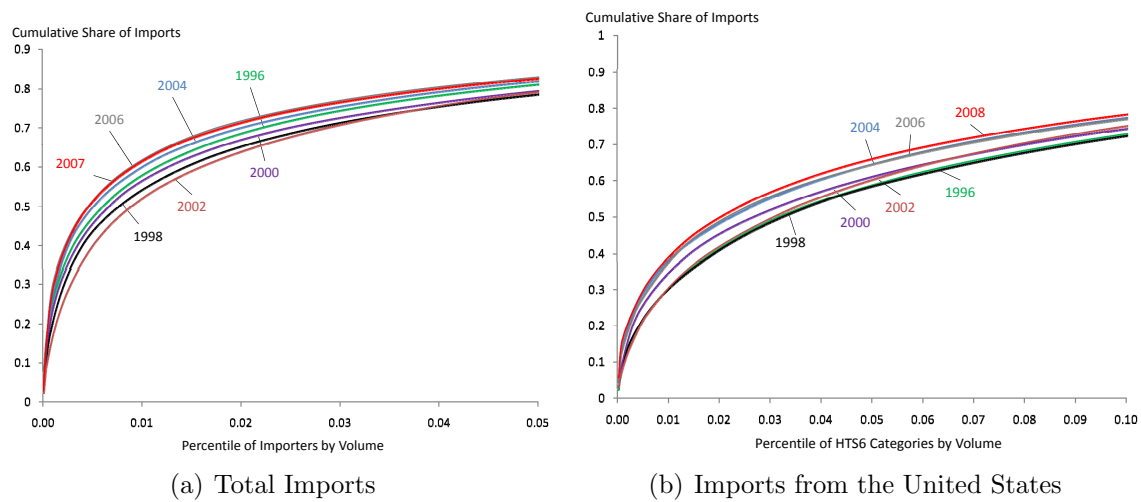


Figure 5: Concentration

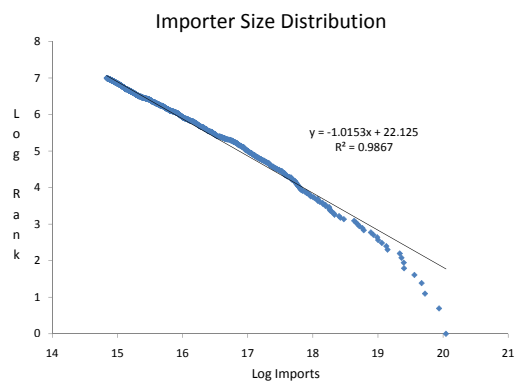
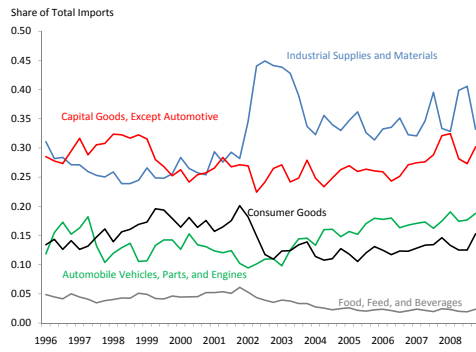
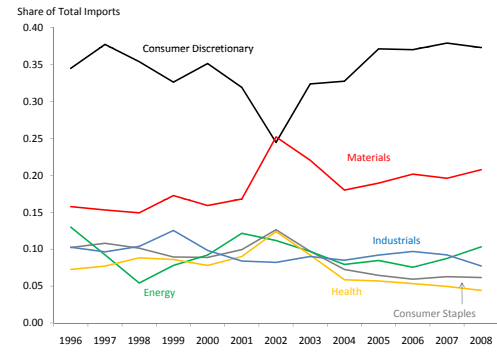


Figure 6: Firm Size Distribution (Top 80 Percent of Imports)



(a) Imports by End-Use Category



(b) Imports by Importer Primary Sector

Figure 7: End-use and Importer Shares

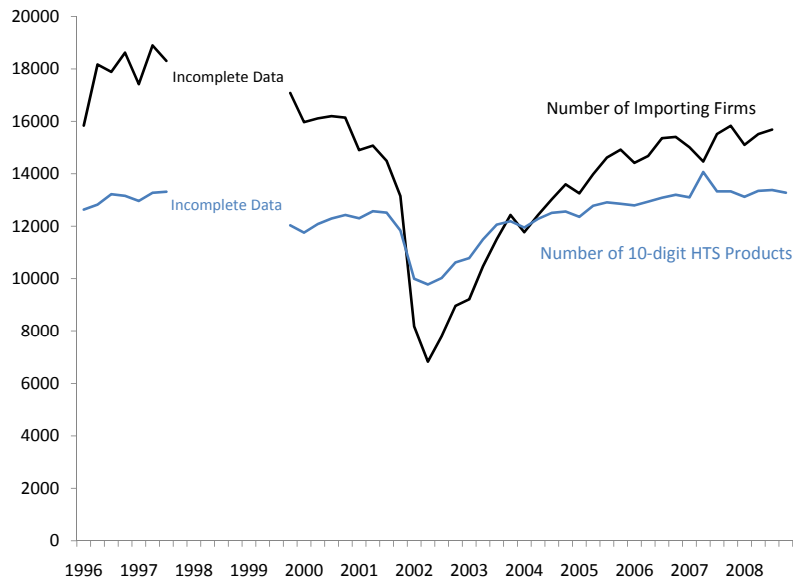
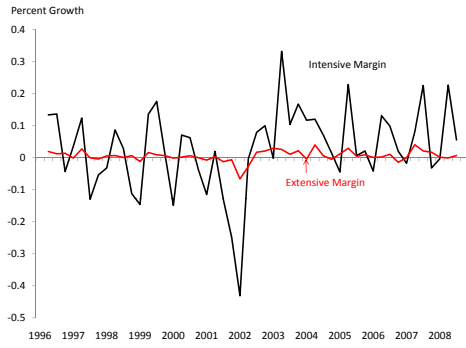
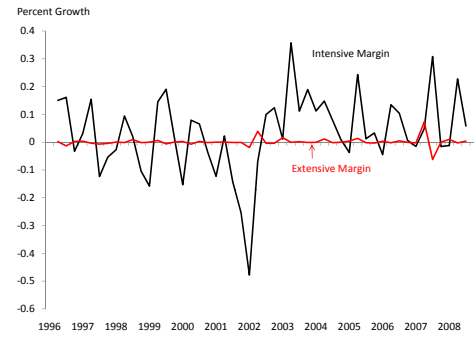


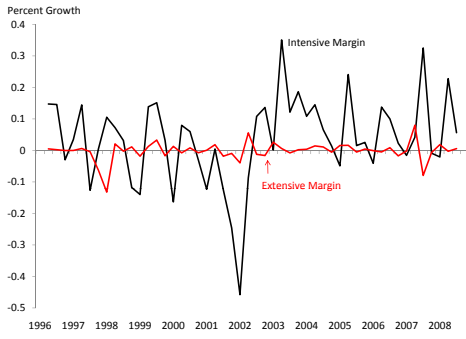
Figure 8: Number of Importing Firms and Products



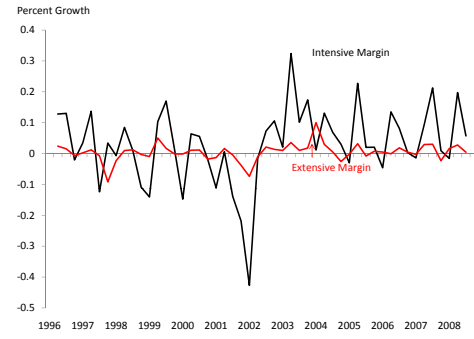
(a) Importing Firm



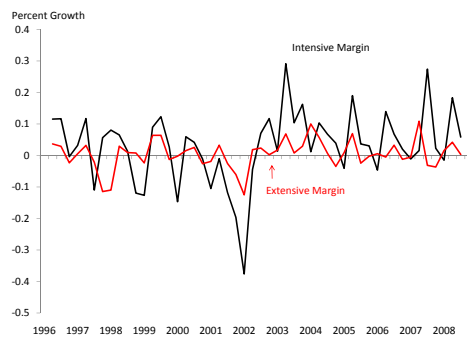
(b) 6-Digit HTS Category



(c) 10-Digit HTS Category



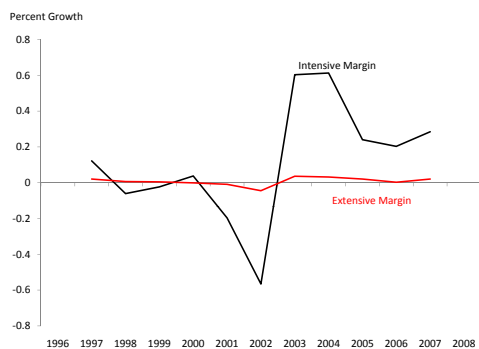
(d) 6-Digit HTS Category X Country



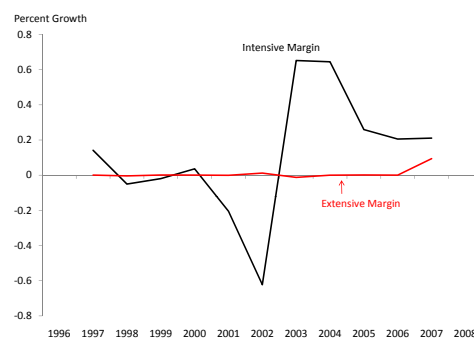
(e) 10-Digit HTS Category X Country

Figure 9: Extensive Margin Under Various Definitions (Quarterly)

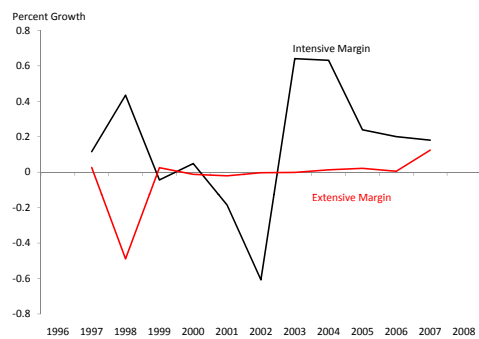




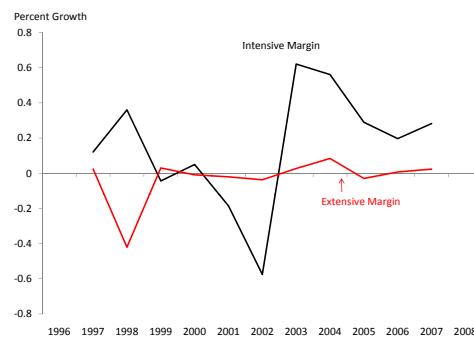
(a) Importing Firm



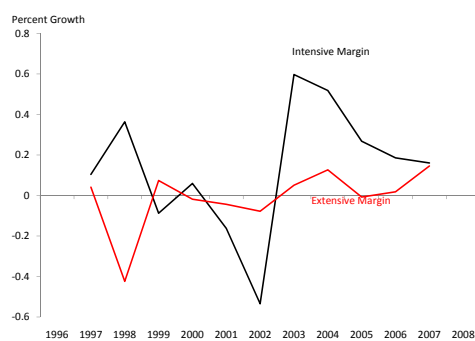
(b) 6-Digit HTS Category



(c) 10-Digit HTS Category

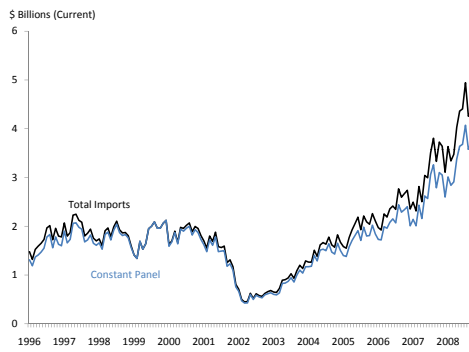


(d) 6-Digit HTS Category X Country

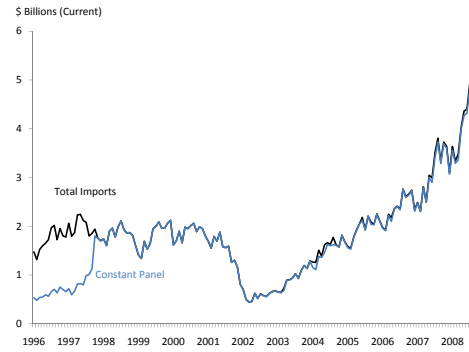


(e) 10-Digit HTS Category X Country

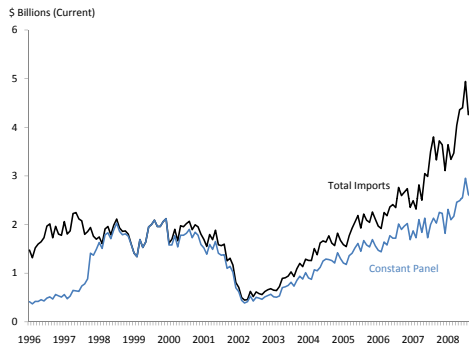
Figure 10: Extensive Margin Under Various Definitions (Annual)



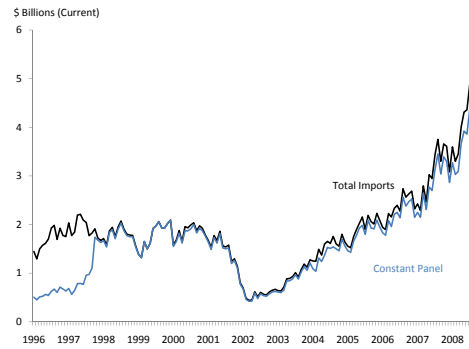
(a) Importers from 1999



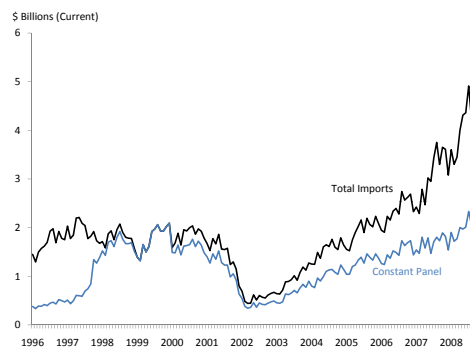
(b) 6-Digit HTS Categories from 1999



(c) 10-digit HTS Categories from 1999

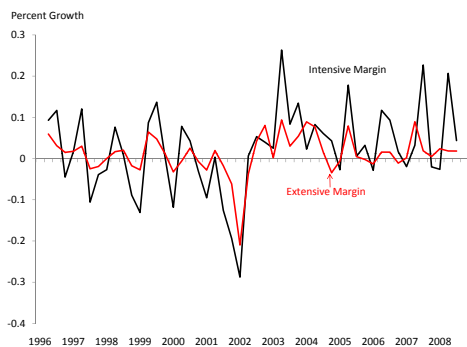


(d) 6-Digit HTS Categories X Country from 1999

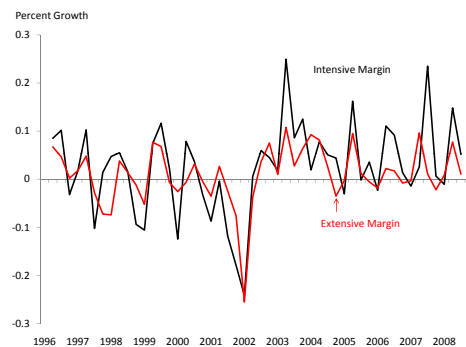


(e) 10-digit HTS Categories X Country from 1999

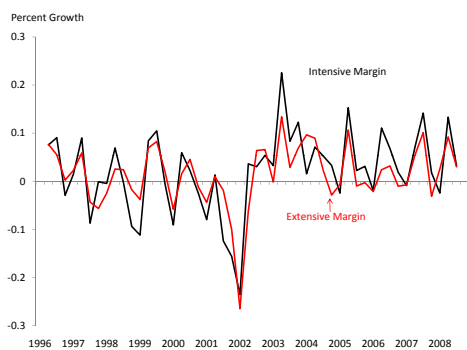
Figure 11: Constant Panel Decomposition



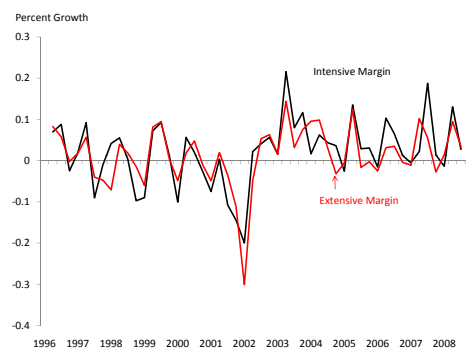
(a) Importing Firm X HTS6



(b) Importing Firm X HTS10

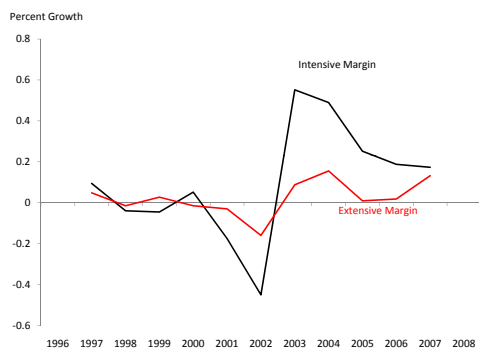


(c) Importing Firm X HTS6 X Country

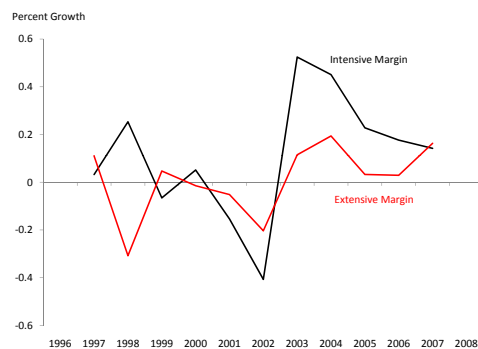


(d) Importing Firm X HTS10 X Country

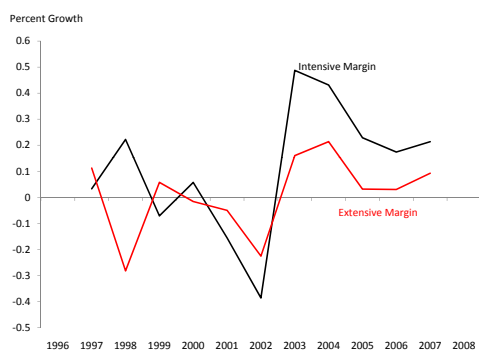
Figure 12: Within-Firm Extensive Margin (Quarterly)



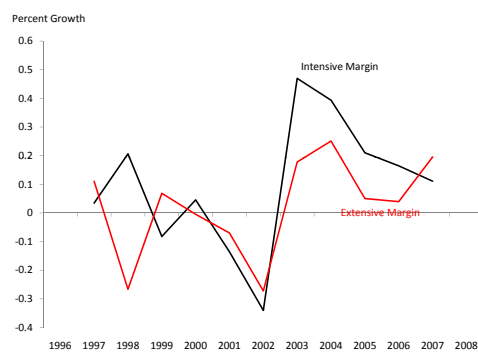
(a) Importing Firm X HTS6



(b) Importing Firm X HTS10

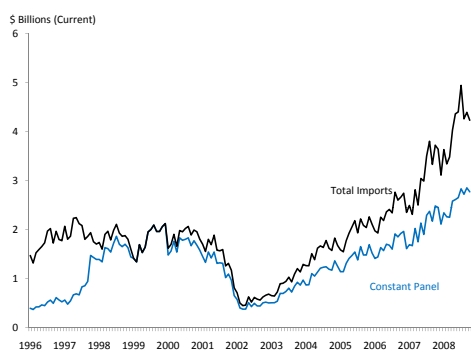


(c) Importing Firm X HTS6 X Country

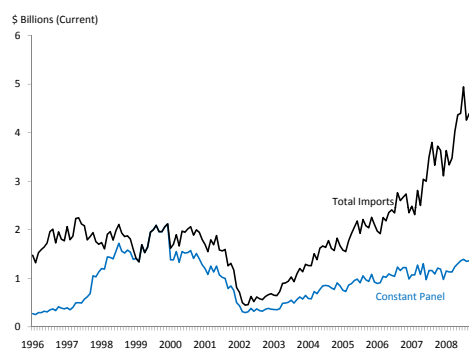


(d) Importing Firm X HTS10 X Country

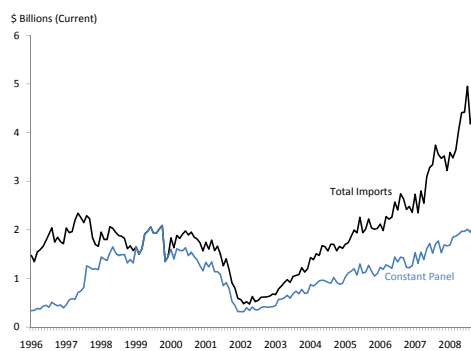
Figure 13: Within-Firm Extensive Margin (Annual)



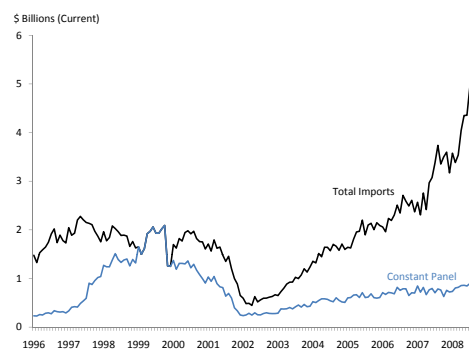
(a) Importing Firm X HTS6



(b) Importing Firm X HTS10

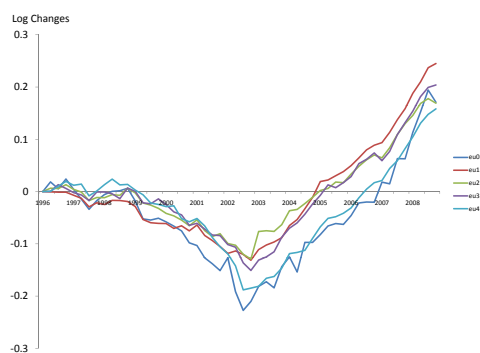


(c) Importing Firm X HTS6 X Country

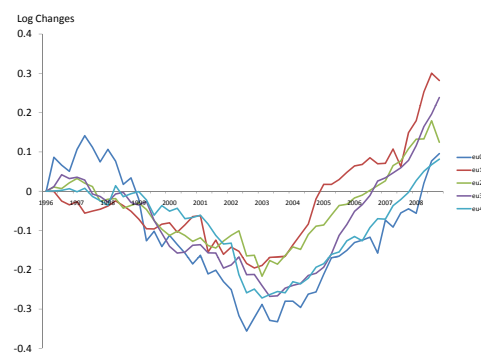


(d) Importing Firm X HTS10 X Country

Figure 14: Within-Firm Constant Panel Decomposition



(a) Time Fixed Effects (Unweighted)



(b) Time Fixed Effects (Weighted)

Figure 15: Trends in Unit Values

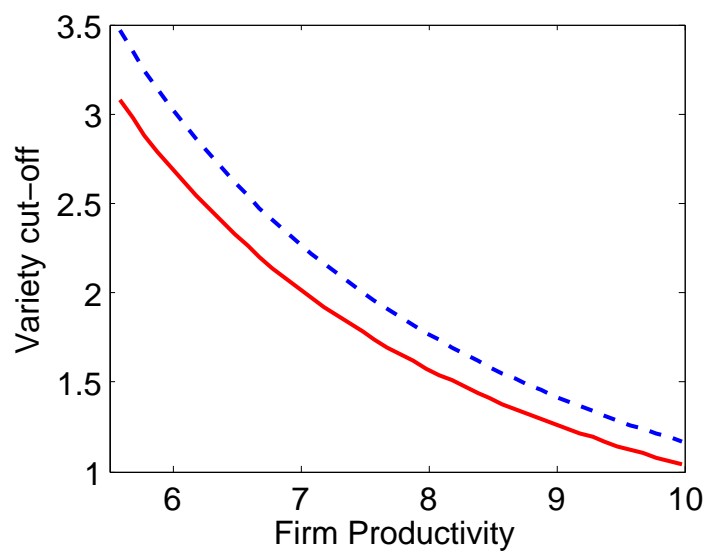


Figure 16: Within-firm cut-off productivity

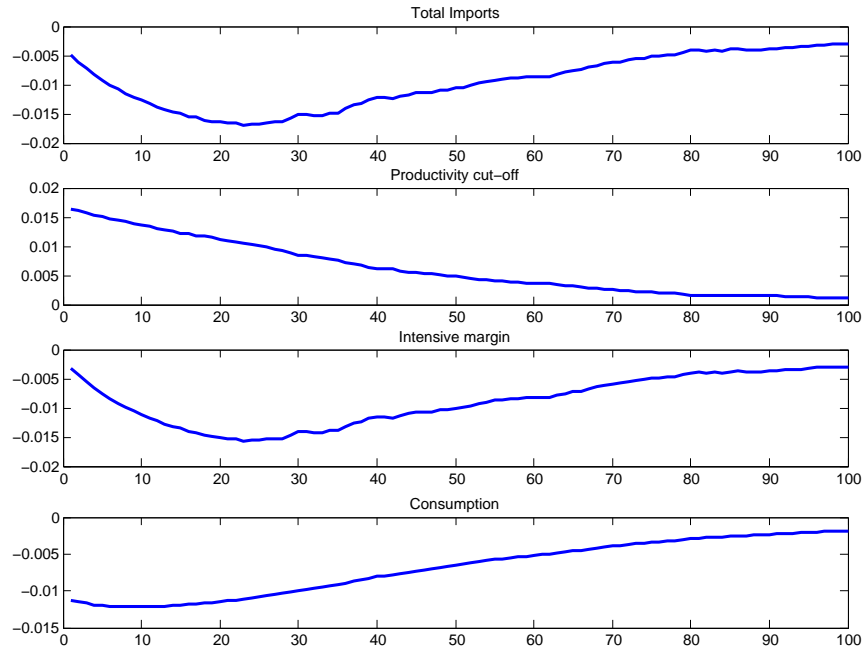


Figure 17: Impulse response,  $P^*$ . % deviations from steady state.

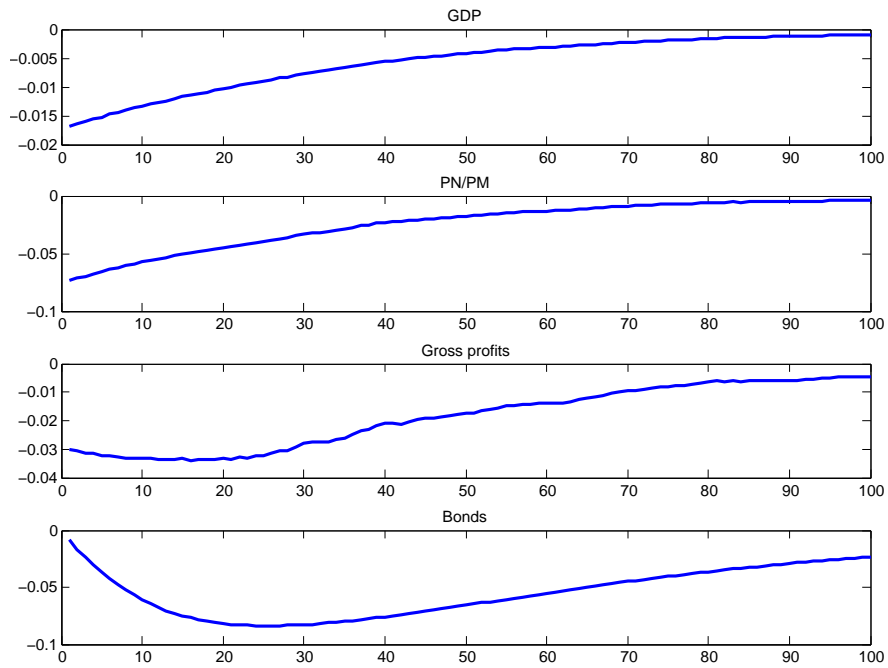


Figure 18: Impulse response,  $P^*$ . % deviations from steady state.

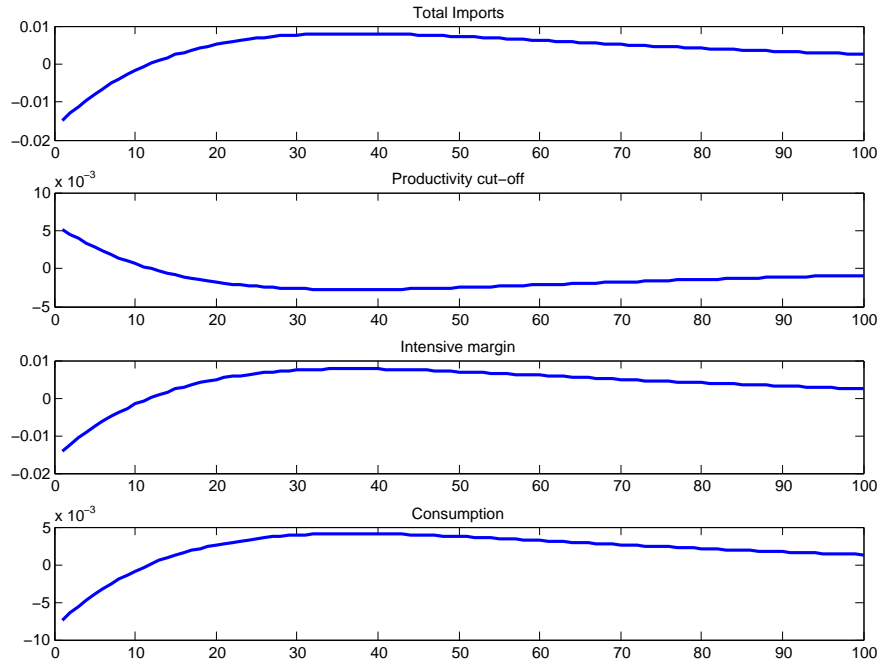


Figure 19: Impulse response,  $r^*$ . % deviations from steady state.

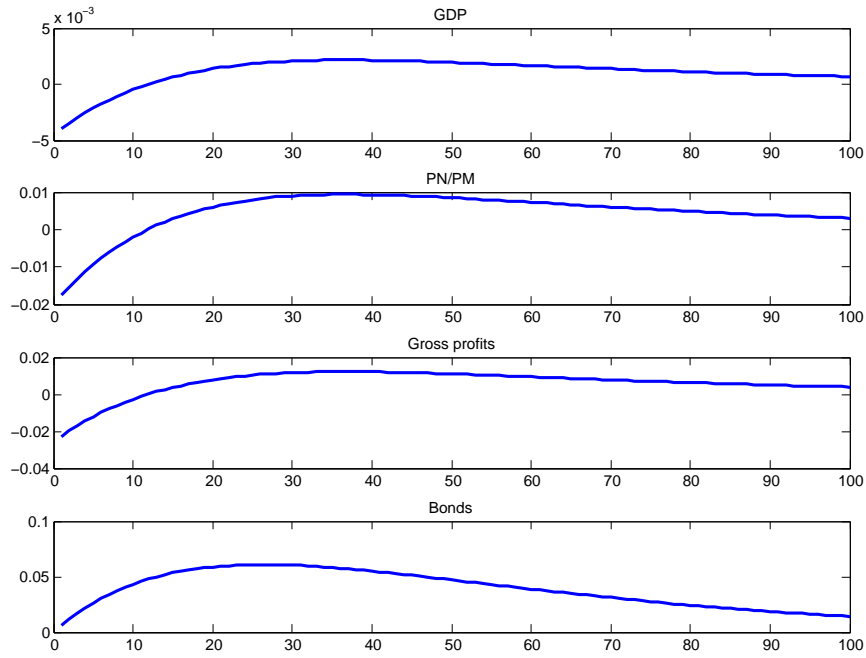


Figure 20: Impulse response,  $r^*$ . % deviations from steady state.



# Appendix A

In this appendix we give a more detailed description of the Customs data for Argentina provided to us by The Datamyne.

1	Importer's name, address, phone, and tax identification number
2	Date the import entered Argentina
3	The country of purchase and the country of the good's origin
4	The freight on board price (in USD), quantity of units purchased, implied unit value, and currency in which the transaction was quoted
6	The total charges for freight, insurance, and taxes
7	The city or port through which the shipment cleared customs
8	The carrier name, the carrier's ID and flag (whether truck, plane, or vessel), and weight of the shipment
9	The Harmonized Tariff Schedule (HTS) code (up to 12digits)
10	A description of the product, often including brand, model, or version information, as well as whether the item is used or new

Table 9: Import Fields

These field values are generally available, though are occasionally missing or internally inconsistent. The information on the importing firm, value of the item, HTS code, and purchase country are almost always filled in. All information is provided by the importing firm (CHECK) so, for example, the country of the good's origin likely reflects the buyer's best estimate and is not precisely defined. Fields requiring a unit of measurement (such as kilograms for "quantity", etc.) are typically accompanied by this information.

1	Exporter's name, address, phone, and tax identification number, but only for the period 1996-1999
2	Date the export left Argentina
3	The destination country
4	The freight on board price (in USD), quantity of units purchased, implied unit value, and currency in which the transaction was quoted
5	The city or port through which the shipment cleared customs
6	The weight of the shipment
7	The Harmonized Tariff Schedule (HTS) code (up to 12digits)
8	A description of the product, often including brand, model, or version information, as well as whether the item is used or new

Table 10: Export Fields

These field values are generally available, though are occasionally missing or internally inconsistent. The information on the value of the item, HTS code, and destination country are almost always filled in.