Global Firms in Large Devaluations*

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Abstract

I investigate the consequences of firms’ joint import and export behavior in the context of large devaluations. I provide evidence that the aggregate imported input share increases after large depreciations, contrary to what standard quantitative trade models of importing predict. Using Mexican micro data, I show that the increase in the overall import intensity is explained by the expansion of exporters, which are intense importers. I develop a model where firms globally decide their import and export strategies and discipline it to match salient features of the Mexican micro data. I study a counterfactual devaluation and show that the calibrated model can generate an increase in the aggregate import share and compositional effects in line with the data. Models of importing-only, or with uncorrelated importing-exporting, cannot generate either and predict increases in consumer prices that are 15-30% larger. JEL Codes: F11, F12, F14, F62, D21, D22

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1 Introduction

Until recently, the majority of the research in international trade studied the behavior of exporters and importers separately. The canonical model of firm-level trade decisions, pioneered by Melitz (2003), deals exclusively with exporting. Recently, a number of contributions have brought firms’ importing decisions to the forefront and studied how input trade affects firm and aggregate productivity - see Gopinath and Neiman (2014) or Halpern et al. (2015). With a few exceptions, notably Amiti et al. (2014), most studies abstract from the fact that intense importers tend to be intense exporters and that these firms, which I refer to as global firms, account for a large fraction of total trade. In this paper, I investigate the implications of firms’ joint import and export behavior for the aggregate effects of large devaluations.

The starting point of the analysis is the empirical finding that large devaluations are associated with an increase in the overall import intensity of the economy. Figure 1 depicts the aggregate imported input share, defined as the ratio of spending in imported inputs to total input spending, in a window of 12 years around a large devaluation for a sample of 9 episodes including Argentina 2002, Brazil 1999 and the East Asian crises of 1997-98. The imported input share increases on impact and remains elevated relative to its pre-devaluation level for 8 years. At the same time, the real exchange rate remains depreciated in the entire post-devaluation period.

![Figure 1: Aggregate Imported Input Share After a Large Devaluation](image)

Notes: The blue line is the rate of growth in the aggregate imported input share between a given year and the year before the devaluation (labeled -1). The year of the devaluation is labeled 0. The red line depicts the rate of growth in the real exchange rate. The lines in the Figure are averages of the experiences of Argentina in 2002, Brazil 1999, Colombia 1999, Indonesia 1998, Korea 1997, Malaysia 1997, Russia 1998, Thailand 1997 and Turkey 2001. The dashed lines give standard errors of the corresponding average (i.e. the standard deviation divided by the square root of the sample size). The data for Brazil, Indonesia, Korea, Russia and Turkey is taken from WIOD, while data for Argentina, Malaysia, Colombia and Thailand is from OECD Sources: OECD, WIOD, IFS.

Figure 1: Aggregate Imported Input Share After a Large Devaluation

This finding is at odds with existing quantitative models of importing that study the gains from input trade - see Halpern et al. (2015), Gopinath and Neiman (2014), Blaum et al. (2018b) or Ramanarayanan (2017). These frameworks predict a decrease in the aggregate import share when foreign inputs become more expensive. Two features are crucial in generating this prediction. First, these frameworks feature an elasticity
of substitution between domestic and foreign inputs in firms’ technology that exceeds unity. Thus, as foreign inputs become more expensive, firms strongly substitute away from imported inputs leading to a fall in import shares for all firms.\(^1\) Second, an increase in the price of foreign inputs disproportionately affects the more intense importers, which tend to lose market share, further reducing the aggregate import share. Both of these features are intimately linked to the aggregate effects of the depreciation. The degree of substitution governs the magnitude of firms’ cost increases, while the pattern of reallocation determines how these are mapped into an aggregate effect.

Exploiting Mexican and Indonesian micro data around the 1994 and 1998 devaluations, I provide evidence that the increase in the aggregate import share is driven by the expansion of exporters. In a decomposition exercise, I start by showing that the growth in the aggregate import share is entirely accounted by compositional effects. Following the devaluation, initially import intensive firms expand their size and the firms that increase their import intensity tend to expand. These “between” and “covariance” effects are inconsistent with the type of reallocation predicted by standard models of importing. In contrast, holding their size constant, firms tend to lower their import shares following the devaluation, consistent with relatively high substitution between domestic and foreign varieties.

In turn, the expansion of intense importers can be linked to their export behavior. Firm with high import shares before the devaluation, which tend to be intense exporters, grow their total sales and export intensity following the devaluation. Across firms, changes in export intensity are highly correlated with changes in import intensity. These patterns suggest that the increase in the aggregate import share of Figure 1 arises from the combination of (i) increased incentives to export after the currency depreciation and (ii) a correlation between exporting and importing. Indeed, I show that the aggregate export share tends to increase after the depreciation in the sample of countries of Figure 1.\(^2\) The fact that large exporters tend to be large importers has been verified in a variety of settings - see Bernard et al. (2007) for the US, Lapham and Kasahara (2013) for Chile, Amiti et al. (2014) for Belgium, and Albornoz and Lembergman (2015) for Argentina, among others.\(^3\)

To rationalize these findings, I propose a model where firms globally decide their import and export strategies that can be taken to the data to study the effects of devaluations. I consider a static small open economy where a mass of local firms can import their material inputs and export their output. As is standard in the literature, importing materials from abroad is a means to lower the unit cost of production, but is subject to frictions in the form of fixed costs. This gives rise to a non-homothetic extensive margin of importing, by which larger firms import more intensively, as in the theories of Gopinath and Neiman (2014) and Halpern et al. (2015). At the same time, firms can sell their products to a continuum of foreign markets which differ in their total demand. Exporting is a means to increase demand but is also subject to fixed costs, generating an association between firm size and export intensity. Importantly, there is a complementarity between importing and exporting that stems from the fact that the profit function is log supermodular in demand and the unit cost. That is, the profits from exporting to a particular destination are increasing in the firm’s import intensity.

\(^{1}\)Indeed, relying on different methods, the quantitative models of importing of the literature find values of the elasticity of substitution between domestic and imported inputs that exceeds unity. For example, Blaum et al. (2018a) estimate this parameter from the sensitivity of firm revenue to (plausibly exogenous) changes in the imported input share holding material spending constant. Applying this approach to firm-level data from the French manufacturing sector results in an elasticity of 2.4. Halpern et al. (2015) estimate a structural model of importing with Hungarian firm-level data and recover a value for this parameter of 4. Antrás et al. (2017) estimate this parameter, which in their framework corresponds to the Frechet parameter governing the dispersion of firm efficiency, from a cross-country regression of sourcing potentials and wages. They obtain a value of 2.8. Gopinath and Neiman (2014) use a value of 4 based on estimates from Broda and Weinstein (2006), Eaton and Kortum (2002) and Bernard et al. (2003).

\(^{2}\)Additionally, Alessandria et al. (2015) provide evidence that export levels tend to increase, albeit slowly, in the sample of countries of Figure 1. The fact in Figure 1 is consistent with the sluggish behavior of exports reported in Alessandria et al. (2015). Initially, the within component is positive, meaning that firms tend to increase their import intensity, due to the J-curve effect. Over time, the within component decreases (to become eventually negative) and the compositional effect becomes stronger.

\(^{3}\)Albornoz and Lembergman (2015) argue that exporting to a new destination leads to subsequent importing from that destination, suggesting that export entry tends to reduced the fixed costs of importing.
This interaction generates an association between the intensities of importing and exporting, which is widely supported by the data.

I discipline the model to match salient features of the Mexican data in 1994. In particular, I target moments from the joint distribution of firm size, import and export intensity. These include the aggregate import and export shares, the dispersion in import and export shares and their correlation, as well as the fraction of firms by import-export status. To be able to match these moments, I allow firms to differ in their efficiency as well as in their fixed costs of importing and exporting.4

Using the calibrated model, I study a counterfactual depreciation of the real exchange rate of the magnitude experienced in Mexico.5 A real depreciation makes imported inputs relatively more expensive and at the same time effectively increases foreign demand for domestic products. In the calibrated model, the depreciation generates an increase in the aggregate import share, consistent with the empirical findings discussed above. The model also predicts an increase in the aggregate export share, the fractions of exporters-only and exporters-importers, as well as a decrease in the fraction of importers-only. These patterns are all consistent with the Mexican experience.6 Additionally, I find that the growth in the aggregate import share generated by the model is mostly explained by compositional effects, namely the expansion of firms that have high import intensity before the shock.7 These findings are consistent with micro evidence from the Mexican and Indonesian devaluations.8

I compare these results to outcomes from two benchmark models: (i) a model of importing-only, which is close to the frameworks in the literature, and (ii) a framework with uncorrelated importing-exporting. In the first case, the fixed costs of exporting are assumed to be prohibitively high and the model is recalibrated to a subset of moments related to importing.9 In the second case, I re-calibrate the model of importing-exporting to the same moments of the Mexican micro-data as above except for the correlation between import and export shares, which is set to zero.10 Both models generate a large decrease in the aggregate import intensity following the real depreciation. This decrease is mostly explained by negative compositional effects, by which firms with high import intensity contract. Finally, both models predict an increase in the consumer price index that is larger than in the benchmark model of importing-exporting. Intuitively, in the models of importing-only or uncorrelated importing-exporting, the devaluation disproportionally affects the initially intense importers, which tend to be efficient firms. Introducing the exporting dimension mitigates this effect, by protecting the most efficient firms from the cost shock and incentivizing them to expand and increase their import intensity.

Related literature. The paper is related to a large literature that incorporates input trade into quantitative models. First and foremost, the paper is closest to recent firm-based frameworks that study the effect of imported inputs on firm and aggregate productivity - see Halpern et al. (2015), Gopinath and Neiman (2014), Blaum et al. (2018b) or Ramanarayanan (2017). While different in their focus, this class of frameworks features an import demand system with an aggregate elasticity of substitution that exceeds unity. As foreign inputs become more expensive, these frameworks predict a decrease in the overall import-intensity of the

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4The firm-specific fixed costs of importing and exporting are allowed to be correlated, which can also generate an association between import and export intensities, beyond the complementarity discussed above.

5The real exchange rate is exogenous because the model is static.

6The increase in the aggregate export share after the devaluation is not only a feature of the Mexican case, but is also present in the experiences of Brazil, Korea, Indonesia and Turkey. Using data from input output tables, I find that, on average across these countries, the aggregate export share is 40% higher five years after the devaluation relative to the year before.

7The effect of changes within the firm tends to decrease the aggregate import share. That is, holding initial firm size constant, firms tend to decrease their import shares.

8The model predicts a positive contribution of net entry, although quantitatively very small.

9I target the aggregate import share, the fraction of importers, as well as the dispersions in value added, import intensity and their correlation.

10The model can generate uncorrelated import and export shares by assigning negatively correlated fixed costs of importing and exporting across firms.
economy and a pattern of reallocation by which initially intense importers contract. Other recent quantitative frameworks that incorporate input trade, which abstract from importer heterogeneity, share this prediction on the aggregate import share - see e.g. Eaton et al. (2011), Caliendo and Parro (2014) or Costinot and Rodríguez-Clare (2014). I provide evidence that these predictions are at odds with data from large devaluations. To be consistent with the data, I show that firms’ export and import behavior need to be studied simultaneously. I also show that doing so matters for the normative implications of devaluations.

Gopinath and Neiman (2014) is particularly related as they focus on a large currency devaluation. Using customs-level data for Argentina, they document how firms stopped importing their products from particular countries in the aftermath of the 2001 devaluation and argue that this constituted a central mechanism to explain the fall in aggregate productivity. I build on their mechanism of how devaluations affect productivity and provide additional evidence on the aggregate degree of substitution between domestic and foreign inputs as well as the pattern of firm reallocation following the crises. I argue that taking into account firms’ export activity, in addition to its import behavior, can significantly affect the aggregate consequences of the devaluation.

This paper is related to a literature that highlights the connection between importing and exporting. Amiti et al. (2014) is particularly related as they focus on movements in the exchange rate and their effect on the pricing decisions of exporters. They show theoretically and empirically that more import-intensive exporters feature a lower exchange rate pass-through into their export prices, because the exchange rate affects their marginal cost. In contrast, I focus on firms’ prices at home and how these are affected by the exchange rate when importing and exporting are complementary activities. I measure changes in domestic prices, both across firms and in the aggregate, through the lens of a counterfactual exercises in a calibrated model. Finally, while Amiti et al. (2014) focus on yearly fluctuations in the exchange rate, I consider large depreciations whose effects on the real exchange rate persist for at least 8 years. Fieler et al. (2018) focus on the large increase in the skill premium observed after trade liberalizations in developing countries. In their model, importing, exporting and the choice of quality are interconnected and jointly help explain the increase in demand for skilled labor. Lapham and Kasahara (2013) study how the complementarity between importing and exporting affects the gains from trade, but do not focus on devaluations.

The paper is also related to a literature that studies sudden stops in emerging market economies, which are characterized by sharp reversals in the current account, deep recessions and large real depreciations - see Korinek and Mendoza (2014) for a survey. In this literature, imported inputs play a key role in explaining the initial output collapse in the crises, which is mainly accounted by a fall in measured aggregate productivity - see Mendoza (2006). These frameworks typically feature an elasticity of substitution between domestic and foreign inputs that is greater than or equal to unity - see Mendoza (2010) or Mendoza and Yue (2012). They also abstract from complementarities between importing and exporting. I argue that this omission can have meaningful implications for the effects of shocks to the price of foreign inputs.

The elasticity of substitution between home and foreign goods has received considerable attention in international economics. International business cycle models require small values of this elasticity to generate high volatility in the terms of trade and the real exchange rate together with low movements in relative quantities. For example, Backus et al. (1994) and Heathcote and Perri (2002) use values around 1. Similarly, a large em-

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11These frameworks feature an import demand system with an aggregate elasticity of substitution between domestic and foreign inputs that exceeds unity. Note that Eaton et al. (2011) feature firm heterogeneity in export behavior, but no heterogeneity in firms’ imported input shares. Caliendo and Parro (2014) and Costinot and Rodríguez-Clare (2014) feature sectoral heterogeneity and a representative importer within sectors. In these frameworks, at their estimated parameters, an increase in trade costs that makes imports effectively more expensive in one country (holding wages constant) leads to a decrease in the aggregate import share of this country.

12As in Gopinath and Neiman (2014), I find that the value of aggregate imports, as well as an index of aggregate import volume, both tend to decrease after the devaluation. The fact that at the same time the aggregate expenditure share on imported inputs increases speaks to the economy-wide degree of substitution between domestic and foreign inputs.
Empirical literature has estimated the price elasticity of import demand focusing on the home-foreign substitution - see Goldstein and Khan (1985) or Marquez (2013) for surveys. This literature also relies on high frequency data, using typically monthly or quarterly data, and tends to find relatively low values of the elasticity of substitution. On the other hand, a vast literature in international trade has estimated this parameter from variation in trade flows and trade costs, yielding estimates larger than 4 - see e.g. Eaton and Kortum (2002) or Simonovska and Waugh (2014).

The paper is also related to the empirical literature that provides evidence on the connection between imported inputs and firm productivity by studying episodes of trade liberalizations - see Amiti and Konings (2007), Pavcnik (2002) and Goldberg et al. (2010). The productivity-enhancing role of foreign inputs is a central piece of my analysis.

The paper is organized as follows. Section 2 documents the behavior of the aggregate import share after large devaluations. Sections 3 and 4 contain the model and quantitative exercise, respectively. Section 5 concludes.

2 Empirical Evidence

2.1 Data Sources

I rely on input output tables from three sources. First, the OECD national input-output tables, which provide information on domestic and imported flows at the sector level for all OECD countries as well as 27 non-member economies between 1995 and 2011. Sectors are defined at the 2 digit according to the ISIC Rev. 3, resulting in 34 sectors. Second, I rely on the World Input Output Database (WIOD) which provides input-output tables for 40 of countries and 35 sectors. Finally, I rely on data from Johnson and Noguera (2016) which provides data going back to 1970 for 42 countries and 4 broad sectors. The empirical results of Section 2.2 below are robust to using any of these sources to compute imported input shares.

I identify currency crises in the period 1970–2011 from Laeven and Valencia (2012). Currency crises are defined as nominal depreciations of the currency relative to the US dollar of at least 30% or more, which is also at least 10 percentage points higher than the rate of depreciation in year before. This dataset also provides information on systemic banking and sovereign debt crises.

I rely on micro data from Mexico and Indonesia. The data for Mexico is taken from the Encuesta Industrial Anual (EIA), administered by the Instituto Nacional de Estadistica, Geografia e Informatica (INEGI). The EIA is a survey of manufacturing establishments which covers roughly 85% of the value of output in each 6-digit industry. This survey does not include the Maquiladora plants. The Indonesian dataset is the Manufacturing Survey of Large and Medium-sized firms (Survei Industri, SI), which is an annual census of all manufacturing firms in Indonesia with at least 20 employees. Both datasets provide information on spending in domestic and foreign materials.

\[13\] For example, Gallaway et al. (2003) finds estimates in the range of 1-5 on average across four-digit industries using monthly US data for 1989-1995.

\[14\] Tables 24, 25 and 27 in the Appendix provide a list of countries in the OECD, WIOD and Johnson and Noguera (2016) databases. See Timmer et al. (2015) for a description of WIOD.

\[15\] Systemic banking crises satisfy the following two conditions (i) significant signs of financial distress in the banking system (as indicated by significant bank runs, losses in the banking system, and/or bank liquidations) and (ii) significant banking policy intervention measures in response to significant losses in the banking system. Examples of significant policy interventions are extensive liquidity support, bank restructuring costs of at least 3 percent of GDP, bank nationalizations or deposit freezes. See Laeven and Valencia (2012) for details.

\[16\] Plants are selected in decreasing order of production value until the selected plants cover at least 85% of the total value of production in each 6-digit industry.

\[17\] Maquiladoras are assembly plants that belong to an export promotion program and sell most of their output to the US. Prior to 2007, INEGI had a separate survey for Maquiladora plants.
I measure tariffs with an average (simple or import-value weighted) of effectively applied tariffs across all products, taken from the UNCTAD’s TRAINS database.

Quarterly data for imports of goods and services, nominal and real GDP, the volume of imports, the real effective exchange rate, and the consumer price index are taken from the IMF’s International Financial Statistics (IFS) database.\textsuperscript{18,19,20} To construct aggregate total factor productivity, I rely on data on capital and labor usage at constant prices from the Penn World Tables. Labor usage is broken down into measures of total number of employees, total hours, and average human capital.

2.2 The Behavior of Imports around Large Devaluations

In this section, I document the behavior of the aggregate imported input share around large devaluations. The aggregate imported input share is defined as the ratio of imported intermediate inputs to total intermediate inputs (domestic and imported). I measure the imported input share with data from input output tables, which provide information on import value of intermediate goods as well as domestic input spending.

Sample Construction. I start from the list of currency crises provided by Laeven and Valencia (2012) for 1970-2011. I identify the episodes for which data from input output tables is available. I rely mainly on Johnson and Noguera (2016) because their input output tables go back to 1970. This results in a sample of 39 currency crises. I further require that the crises features a depreciation of the real exchange rate of at least 10 percent on impact.\textsuperscript{21} The final sample contains 28 devaluations which are listed in Table 1. I also consider a subsample of events for which data from the OECD and WIOD input output tables is available. These sources provide input output tables at the two-digit sector starting in 1995. The resulting sample of 9 recent events is contained in Table 2.\textsuperscript{22}

<table>
<thead>
<tr>
<th>Country</th>
<th>Crisis Year</th>
<th>Country</th>
<th>Crisis Year</th>
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<tr>
<td>Argentina</td>
<td>2002</td>
<td>Malaysia</td>
<td>1997</td>
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<tr>
<td>Brazil</td>
<td>1999</td>
<td>Russia</td>
<td>1998</td>
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<tr>
<td>Colombia</td>
<td>1999</td>
<td>Thailand</td>
<td>1997</td>
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<tr>
<td>Indonesia</td>
<td>1997</td>
<td>Turkey</td>
<td>2001</td>
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<tr>
<td>Korea</td>
<td>1997</td>
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Table 2: Sample of Recent Large Devaluations

\textsuperscript{18}The real effective exchange rate is the nominal effective exchange rate adjusted for relative movements in the price index (or a measure of manufacturing labor costs) in the home and selected foreign countries. The nominal effective exchange rate is an index of the value of a currency against a weighted average of foreign currencies of the main trading partners. I also consider a measure of the bilateral real exchange rate with the US, which I construct by adjusting the nominal exchange rate by the consumer price indexes in the respective country and the US. A decrease of either measure of the real exchange rate represents a depreciation of the local currency.

\textsuperscript{19}The data was seasonally adjusted using the X-12-ARIMA software developed by the US Census Bureau. Alternatively, as a robustness, the series were also adjusted with a seasonal dummy model using data for 1960-2015.

\textsuperscript{20}An index for the volume of imports is not available for Chile, Indonesia, Mexico and Argentina. For these countries, I rely on the import volume index from the World Bank’s World Development Indicators, defined as the ratio of the import value index to the unit value index.

\textsuperscript{21}The events in Laeven and Valencia (2012) feature a nominal exchange rate depreciation of 30 percent on the year of the crisis. In some cases, the real depreciation was much smaller as local prices quickly adjusted. To focus on large devaluations, I remove events with real depreciations smaller than 10 percent. The results of this section are robust to moving this threshold. In fact, they also hold on the sample of 39 events with all the currency crises in Laeven and Valencia (2012) for which imported input share data is available.

\textsuperscript{22}The OECD and WIOD databases provide data for the events of Colombia 1999 and Malaysia 1997 - which were absent in Johnson and Noguera (2016). I require that data is available for at least 2 years before the devaluation - this results in Romania 1996 and Mexico 1995 being dropped. The resulting sample of episodes is close to the one in Alessandria et al. (2015).
Table 1: Sample of Large Devaluations

<table>
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<tr>
<th>Country</th>
<th>Crises Years</th>
<th>Country</th>
<th>Crises Years</th>
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<tbody>
<tr>
<td>Chile</td>
<td>1972, 1982</td>
<td>South Africa</td>
<td>1984</td>
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<tr>
<td>Finland</td>
<td>1993</td>
<td>Spain</td>
<td>1983</td>
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<tr>
<td>Indonesia</td>
<td>1979, 1998</td>
<td>Sweden</td>
<td>1993</td>
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<tr>
<td>Israel</td>
<td>1975</td>
<td>Thailand</td>
<td>1998</td>
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Aggregate Imported Input Share. For the sample of recent large devaluations in Table 2, Figure 1 in the Introduction depicts the evolution of the aggregate imported input share, as well as the real effective exchange rate (RER), in a window of 12 years around the devaluation. The graph shows the average experience over the 9 episodes.\textsuperscript{23} We see that the RER falls by more than 30% on impact and then gradually increases, although it remains 15% below its original level even 8 years after the devaluation. Importantly, following the devaluation, the aggregate imported input share increases by about 30% within the first three years and remains about 20% higher than its pre-devaluation level after 8 years.\textsuperscript{24}

Figure 2 confirms this pattern on the sample of 28 devaluations of Table 1. Figures 14-18 in the Appendix show each of the 28 episodes separately. The pattern of real appreciation before the crisis followed by a collapse in the real exchange and then gradual recovery seen in Figure 2 is consistent with the findings of Korinek and Mendoza (2014) for sudden stops in emerging markets.

An increase in the aggregate import share in a context where foreign inputs are relatively more expensive, as documented in the section, is grossly at odds with recent quantitative models of importing - see Halpern et al. (2015), Gopinath and Neiman (2014) or Blaum et al. (2018b).

Imports, Output and TFP. It is well-known that large devaluations as the ones studied above are characterized by collapses in import values, real output and aggregate total factor productivity (TFP). I confirm these patterns in the sample of 28 large devaluations considered above. I construct TFP as a the Solow residual, defined as output growth net of a share-weighted average of primary input growth, adjusted for non-constant returns to scale and variable labor and capital utilization as in Basu et al. (2006).\textsuperscript{25} I remove a country-specific log linear trend from each series. I compute the percentage change in each variable relative to the year before the devaluation as in Figure 2 above. Figure 3 contains the results for the dollar value of imports and the volume index. The left panel shows that the dollar value of imports falls by about 25-30% and remains substantially depressed relative to trend for several years following the devaluation. The right panel shows that the volume of imports falls by about 20% within two-years and remains 10% depressed relative to trend 8 years after the devaluation.\textsuperscript{26,27}

Real output shows a persistent decline of about 5% relative to trend - see left panel in Figure 4. More than

\textsuperscript{23}Figures 12 and 13 in the Appendix contain the dynamics of the import share for each of these countries separately.
\textsuperscript{24}A similar pattern is found when restricting the analysis to the Manufacturing sector. Figure 23 in the Appendix depicts the evolution of the import share for the Manufacturing sector following large devaluations.
\textsuperscript{25}Unlike Basu et al. (2006), I focus on an aggregate Solow residual and do not employ instrumental variables for input growth. Section 6.2 of the Appendix contains details of the construction of the TFP measure.
\textsuperscript{26}The fall in import value and volume is almost twice as large if we go back two years before the crises. This is related to the fact that imports are pro-cyclical and the recession tends to precede the devaluation.
\textsuperscript{27}Import volume data is available for 19 of the 28 episodes in Table 1. More precisely, import volume data is not available for the episodes of Argentina 1975, Chile 1972, Indonesia 1979, Mexico 1977, Romania 1996, Russia 1998, Turkey 1980 and Vietnam 1972 and 1981.
Notes: The blue line is the rate of growth in the aggregate imported input share between a given year and the year before the devaluation (labeled -1). The year of the devaluation is labeled 0. The red line depicts the rate of growth in the real exchange rate. The lines in the Figure are averages of the experiences of the episodes in Table 1. The dashed lines give standard errors of the corresponding average (i.e. the standard deviation divided by the square root of the sample size). Sources: Johnson and Noguera (2016), IFS.

Figure 2: Imported Input Share After Large Devaluation, Extended Sample

Notes: The left figure depicts the rate of growth in the value of aggregate imports (in current dollars) while the right figure depicts the rate of growth in an index of import volume. All growth rates are computed between a given year and the year before the devaluation (labeled -1). The year of the devaluation is labeled 0. Both figures depict averages of the experiences of the episodes in Table 1. The dashed lines give standard errors of the corresponding average (i.e. the standard deviation divided by the square root of the sample size). Source: IFS.

Figure 3: Imports Value and Volume After Large Devaluation, Extended Sample
Notes: The left figure depicts the rate of growth in real GDP while the right figure depicts the rate of growth in TFP. All growth rates are computed between a given year and the year before the devaluation (labeled -1). The year of the devaluation is labeled 0. Both figures depict averages of the experiences of the episodes in Table 1. The dashed lines give standard errors of the corresponding average (i.e. the standard deviation divided by the square root of the sample size). Section 6.2 of the Appendix contains details on the construction of the TFP measure. Source: Penn World Tables.

Figure 4: Output and TFP After Large Devaluation, Extended Sample

80% of this decline in output is explained by a decline in TFP relative to trend, as seen in the right panel.\textsuperscript{28} Qualitatively, these findings are consistent with those in Meza and Quintin (2007), Korinek and Mendoza (2014) and Gopinath and Neiman (2014).

A Measure with Micro Data. As complementary evidence, I use micro data of Mexican and Indonesian manufacturing establishments around the time of the devaluations. For both episodes, I observe spending on domestic and foreign materials at the establishment level and can therefore compute the manufacturing sector aggregate import share. Figure 5 contains the growth in the aggregate share of imported materials (in total materials) after the Mexican and Indonesian devaluations of 1994 and 1998, respectively. For Mexico, the aggregate import share increases by about 20% in the first three years and remains above 15% after five years. For Indonesia, the import share is about 12% above its pre-devaluation value after 3 years.

\textsuperscript{28}Figure 19 depicts the output and TFP series together for graphical comparison.
Notes: The Figure shows the rate of growth in the ratio of total imported materials to total materials (imported plus domestic) in the Manufacturing sector for Mexico and Indonesia. The growth rate is computed relative to 1994 for Mexico and 1998 for Indonesia. Source: Survey of Manufacturing EIA and SI.

Figure 5: Aggregate Imported Input Share after Mexican and Indonesian Devaluations

In the case of Mexico, the devaluation happened soon after the introduction of NAFTA. Distinguishing the effects of the devaluation from those of the trade agreement is therefore difficult. Nonetheless, there are two reasons why it is unlikely that the pattern in Figure 5 is driven by NAFTA. First, import tariffs were eliminated gradually over a period of 15 years. In fact, between 1995 and 1999, which is the post-devaluation period considered above, a simple average of effectively applied tariffs slightly increased - see Figure 26 in the Appendix. Second, if the reduction in tariffs had offset the real depreciation, making the relative price of foreign inputs effectively lower, we should observe increases in the import shares by all firms. I show below that, holding initial firm size constant, firms’ import shares tended to decrease three years or more after the devaluation. In other words, the increase in the aggregate import share in Mexico was not driven by a within-firm increase in import shares, but rather by between-firm reallocations.

2.3 Robustness

In this section, I assess whether the findings of Figures 1 and 5 are driven by potentially confounding factors. I consider changes in tariffs, long-run time trends, between-sector reallocation, financial crises and recessions, and show that neither of these factors can explain the findings of Section 2.2 above. I also consider a measure of overall import intensity that varies at the quarterly frequency.

Tariffs, time trends and sectoral relocations. I now assess whether the findings of Figures 1 and 5 are driven by potentially confounding factors. One such factor is a reduction in import tariffs, which would tend to lower the relative price of foreign inputs. To the extent that the devaluation episodes considered above took place around times of trade liberalization, tariffs could naturally explain the above findings. Figures 24-26 in the Appendix document the evolution of tariffs in a window of 12 years around the devaluation for the sample

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29In particular, the trade agreement came into effect in January of 1993 and the devaluation happened at the end of 1994.
30We also note that the Maquiladora sector is not included in the the Survey of Manufacturing used to construct Figure 5.
Table 3: Import Share after Large Devaluations

Notes: The dependent variable is the log of the aggregate import share. The sample covers 62 countries in the 1995-2011 period, including the ten episodes listed in Table 2. The import share is computed from the OECD input-output tables. RER is the real effective exchange rate index (with lower values associated with a depreciated currency) and is taken from IFS. The measure of tariffs ($\tau$) is from WDI and corresponds to a weighted average across all products of applied tariff rates, at the yearly frequency. Robust standard errors in parenthesis with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels.

of recent events of Table 2. For the average country, effectively applied tariffs were 11% and 9% (for the simple and weighted average measures, respectively) in the pre-devaluation period and 8.4% and 5.3%, respectively, in the post-devaluation period.

To address this concern, I assess the effect of the devaluation on the imported input share by estimating the following specification:

$$log(m_{jct}) = \alpha_c + \alpha_j + \alpha_t + \beta deva_{ct} + \gamma \tau_{ct} + \varepsilon_{ct},$$

where $m_{jct}$ is the imported input share in sector $j$ of country $c$ in year $t$, $deva_{ct}$ is an indicator variable that equals unity for five years at/after the devaluation and zero otherwise, $\alpha_c$, $\alpha_j$ and $\alpha_t$ are country, sector and year fixed effects, and $\tau_{ct}$ are average effectively applied tariffs. I estimate (1) on the sample constructed from the OECD data which contains 34 sectors, 62 countries (including the 10 country episodes of Table 2) over 1995-2011.

Table 3 contains the results. We see that, after controlling for the effect of tariffs, interest rates and year and sector fixed effects, the aggregate imported input share is 9% higher in the 5 years following the devaluation. When replacing the devaluation indicator with an index of the real exchange rate, we find that a 30 percent depreciation is associated with a 7 percent increase in the import share - see column 3. We conclude that the findings of Figures 1 and 5 are not driven by changes in tariffs, time trends or a pattern of sectoral relocation.

Long run time trends. A potential concern is that the results of Table 3 do not properly control for time trends in the import share as the pre-devaluation period is not long enough: the OECD sample starts in 1995 and several devaluation episodes occur around 1997/1998. To address this concern, I turn to the input output tables of Johnson and Noguera (2016) which go back to 1970. Figure 27 in the Appendix lengthens the pre-devaluation window to 24 years. Indeed, the import share features a positive long-run time trend: a simple linear trend estimated on the pre-devaluation period (displayed in the graph) features a positive slope. When extrapolating this linear trend to the post-devaluation period, we see that the imported input share is

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31The disadvantage of this data, relative to the OECD and WIOD, is its broad level of sectoral aggregation (4 major sectors).
Table 4: Import Share after Large Devaluations

Notes: The dependent variable is the log of the aggregate import share. The data is taken from Johnson and Noguera (2016) and covers 42 countries in the 1970-2010 period, including the episodes listed in Table 2, except Russia, Colombia and Malaysia. RER is the real effective exchange rate index (with lower values associated with a depreciated currency) and is taken from IFS. The measure of tariffs ($\tau$) is from WDI and corresponds to a weighted average across all products of applied tariff rates, at the yearly frequency. Robust standard errors in parenthesis with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels.

Table 5: Imported Input Share in Currency, Banking and Sovereign Debt Crises

above the predicted trend. While this suggests that the pattern of Figures 1 and 5 above is not driven by a time trend, this procedure may be sensitive to the pre-devaluation period where the trend is estimated. For example, in the 10 years before the devaluation, which tend to coincide with 1990s, the imported input share grows at a faster rate. To deal with this issue, I run a version of the specification in (1) at the country-level with year and country fixed effects. Table 4 contains the results. Again we confirm that the devaluation is associated with an increase in the imported input share of about 10%.

Imports-to-GDP Ratio at Quarterly Frequency. A shortcoming of the input output tables is that the data is at the yearly frequency. To increase the frequency of the data, I now proxy the aggregate import share by the ratio of total imports of goods and services to GDP, denoted by $M/Y$. This is an imperfect measure because the numerator includes imports of final goods, instead of intermediate inputs only, and the denominator is total value added, instead of total spending in inputs. This measure, however, allows us to study the behavior of the overall import intensity around the time of the crises at the quarterly frequency.

Figure 28 in the Appendix contains the evolution of $M/Y$ and the real exchange rate in a window of 28 quarters around the devaluation (labeled as period 0), averaged over the 10 episodes in the sample. The Figure shows the growth rate in $M/Y$ and RER between each quarter and the quarter before the devaluation
We see that $M/Y$ jumps in the quarter of the devaluation, grows by about 20% within 3 quarters and remains 10% above its pre-devaluation level after 5 years.\textsuperscript{32,33,34}

I confirm that the devaluations are associated with higher imports-to-GDP ratios by estimating a specification akin to (1) on a sample of 64 countries (including the 10 episodes considered above) between 1960 and 2015. I remove a country-specific log linear trend from the imports-to-GDP ratio and then, pooling all countries, estimate (1) with country and quarter-year fixed effects. Table 26 in the Appendix contains the results. Column 1 shows that the devaluation period (defined as the 20 quarters following the onset of the depreciation) is associated with a 9 percent increase in the imports-to-GDP ratio. The coefficient on the devaluation indicator is barely changed after controlling for tariffs in column 2.\textsuperscript{35} Qualitatively similar results are obtained when including a measure of the real exchange rate instead of the devaluation indicator, as year-to-year depreciations are associated with increases in import intensity - see column 3. Quantitatively, a 30 percent real depreciation implies a 5 increase in the imports-to-GDP ratio.

**Financial Crises and Recessions.** The devaluation episodes considered above were accompanied by severe contractions in output as well as distress in financial markets. I now assess the effect of each type of crises on the economy’s import intensity. Note first that the recessions tend to lower the import-to-GDP ratio, as shown in Table 26 in the Appendix. This is consistent with models of importing with firm heterogeneity, such as Halpern et al. (2015) or Gopinath and Neiman (2014), where a contraction in total domestic spending tends to lower the aggregate import share due to the presence fixed costs to importing.

Regarding financial crises, consider first the 1999 devaluation in Brazil, an example of a recent devaluation which was not accompanied by a banking crises. Figure 29 in the Appendix shows that the aggregate imported input share in Brazil displays a similar pattern around the devaluation as the pattern of the average country in the sample of Figures 1 and 2. Next, I focus on 16 countries which experienced a financial crises in 2008, but did not experience a currency crisis.\textsuperscript{36} Figure 30 shows that the aggregate imported input share tends to decrease after the financial crisis of 2008.

To assess whether these results hold more broadly, I rely on Laeven and Valencia (2012) who provide information on the occurence of systemic banking crises as well as sovereign crises. I combine this information with the input output tables of Johnson and Noguera (2016) to obtain a sample with 39 devaluations, 50 banking crises and 12 sovereign debt crises - see Table 27 in the Appendix for a complete list of episodes. While crises tend to come in waves, with financial crises typically preceeding currency crises, as argued by Reinhart and Rogoff (2011), there is substantial independent variation in the occurrence of crises. For example, out of the 39 currency crises in the sample, 23 were not accompanied by a banking crises - see Table 28 in the Appendix for a list of episodes. I regress the aggregate imported input share on an indicator variables of currency crisis, banking crisis, sovereign default and restructuring, including country and year fixed effects.

\textsuperscript{32}The movements in $M/Y$ documented in Figure 1 may reflect changes in the share of inputs to total value added, or in the share of total imports accounted by inputs, even when the share of imported inputs in total imports is constant.

\textsuperscript{33}Figures 20-21 in the Appendix report the experiences for each of the ten country episodes in the sample. We see that there is some heterogeneity underlying the average pattern of Figure 1. Some countries feature a clear increase in their import intensity throughout the entire post devaluation period (e.g. Argentina, Brazil or Russia), while others feature a more mixed pattern, with a short period of depressed import intensity (e.g. Thailand or Korea). Overall, there is a tendency for the country import intensity to increase, both in the short and medium run.

\textsuperscript{34}Figure 11 in the Appendix shows the behavior of an index of import volume as well as real GDP at the quarterly frequency. For both series a log linear trend was removed. We see that the volume of imports decreases by as much as 40 percent on impact and, while it gradually recovers, it is still 10 percent depressed after 20 quarters. The Figure also shows that real output decreases by about 10 percent during the first year after the devaluation and is still 7 percent below trend after 20 quarters. These patterns are consistent with the findings at the yearly frequency in Section 2.2 above.

\textsuperscript{35}The number of observations in columns 2 and 3 drops because tariff data is not available for all the countries and time periods considered in Figure 1 above. Note also that tariffs are available only at the yearly frequency.

\textsuperscript{36}More specifically, I consider the experiences of Austria, Belgium, Denmark, France Germany, Greece, Hungary, Ireland, Latvia, Luxembourg, Netherlands, Portugal, Russia, Slovenia, Spain, Sweden.
Table 5 contains the results. Column 3 shows that, controlling for the effect of financial and sovereign debt crises, a currency crisis is associated with a 6% increase in the imported input share. Consistent with the results in Figure 30, systemic banking crises are associated with lower import shares, although this relationship is not statistically significant. Sovereign defaults are associated with a large fall in the import share, which is precisely estimated, while debt restructuring has the opposite effect.

Finally, I exploit firm-level measures of financial constraints which are available in the Indonesian data to show that firms that were unconstrained before the devaluation did not exhibit higher growth in the import shares.

2.4 Accounting for the Increase in Aggregate Import Intensity

In this section, I exploit the Mexican and Indonesian micro data to unpack the sources of the increase in the aggregate import intensity documented above. Following Baily et al. (1992), I decompose the change in the aggregate import share into the contribution of continuing importers \((C I)\), new importers \((E)\) and firms that stop importing \((X)\). New importers can be firms that entered the economy after the devaluation or firms that were present before but did not import. Likewise, firms that stop importing can be either firm that exit the sample after the devaluation, or firms that remain in the sample but are no longer importers. In turn, the contribution of the continuing importers is decomposed into a sum of the changes in import shares holding firm size constant (within-firm component), the changes in firm size holding initial import intensity constant (a between-firm component), and term capturing the covariance between changes in import shares and changes in firm size:

\[
\frac{\Delta s_{I,AGG}}{s_{I,AGG}} = \left\{ \sum_{CI} m_{i1} (s_{i2} - s_{i1}) \right\} + \left\{ \sum_{CI} (m_{i2} - m_{i1}) s_{i1} \right\} + \left\{ \sum_{CI} (m_{i2} - m_{i1}) (s_{i2} - s_{i1}) \right\}
\]

\[(2)\]

where \(s_{I,AGG}\) denotes the aggregate import share, \(m_{it}\) denotes the share of firm \(i\) in total manufacturing materials, \(s_{it}\) is the share of imported materials in total materials of firm \(i\), and \(t = 1, 2\) denote the periods before and after the devaluation.

Table 6 contains the results of the decomposition. Three features stand out. First, the within component tends to be negative over sufficiently long horizons. For Mexico, the within is positive over short horizons (i.e. 1994 to 1995 or 1996) and then monotonically decreases becoming negative over longer horizons. This is consistent with an elasticity of substitution that is smaller than unity in the short run, but increases with the time horizon to be larger than unity after 3 years or more. For Indonesia, the within is negative over all horizons. Second, the between and covariance terms are positive and grow in magnitude with the time horizon. Three years after the devaluation, they jointly account for more than 70% of the total increase in the aggregate import share in either country. Third, net entry, defined as the difference between the entry and the exit components, contributes positively to the increase in the aggregate import share, accounting for about one third of the total effect three years after the devaluation.

Taken together, these results suggest that the increase in the aggregate import share following large devaluations documented in Section 2.2 above is not explained by changes within the firm together with a low elasticity of substitution. Rather, it is the consequence of compositional effects by which intense importers expand, as well as by the entry of firms into importing.
Panel A: Mexico

<table>
<thead>
<tr>
<th>Year</th>
<th>Within</th>
<th>Between</th>
<th>Covariance</th>
<th>Net Entry</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>2.91</td>
<td>6.71</td>
<td>0.32</td>
<td>-0.99</td>
<td>8.95</td>
</tr>
<tr>
<td>1996</td>
<td>1.55</td>
<td>5.36</td>
<td>2.87</td>
<td>5.48</td>
<td>15.27</td>
</tr>
<tr>
<td>1997</td>
<td>-0.98</td>
<td>10.89</td>
<td>2.93</td>
<td>6.56</td>
<td>19.41</td>
</tr>
<tr>
<td>1998</td>
<td>-1.91</td>
<td>9.58</td>
<td>4.32</td>
<td>5.93</td>
<td>17.91</td>
</tr>
<tr>
<td>1999</td>
<td>-2.79</td>
<td>9.99</td>
<td>4.27</td>
<td>6.24</td>
<td>17.70</td>
</tr>
</tbody>
</table>

Panel B: Indonesia

<table>
<thead>
<tr>
<th>Year</th>
<th>Within</th>
<th>Between</th>
<th>Covariance</th>
<th>Net Entry</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>-2.09</td>
<td>2.03</td>
<td>2.01</td>
<td>-0.65</td>
<td>1.3</td>
</tr>
<tr>
<td>1999</td>
<td>-2.74</td>
<td>-0.02</td>
<td>1.71</td>
<td>5.37</td>
<td>4.32</td>
</tr>
<tr>
<td>2000</td>
<td>-1.99</td>
<td>8.86</td>
<td>1.26</td>
<td>3.8</td>
<td>11.92</td>
</tr>
</tbody>
</table>

Notes: The Table contains the decomposition of the aggregate import share given in (2) for Mexico. Each row performs the decomposition between 1994 and each of the subsequent five years. The column “All” reports the total increase in the aggregate import share (\(\Delta s_{I, AGG}/s_{I, AGG1}\)). All values are in percentage points. Source: Survey of Manufacturing, EIA.

Table 6: Accounting for the Change in the Aggregate Import Intensity

Sectoral reallocations. How much of the increase in the import share is due to changes within sectors vs changes across sectors? We now decompose the growth in the import share in the Mexican manufacturing sector into a component associated with increases in the sector-level import shares and a component associated with the expansion of import intensive sectors. More precisely, we consider the following decomposition:

\[
\frac{\Delta s_{I, AGG}}{s_{I, AGG1}} = \{ \sum_{j \in J} m_{j1} (s_{I, AGGj2} - s_{I, AGGj1}) \} + \sum_{j \in J} (m_{j2} - m_{j1}) s_{I, AGGj2} \frac{1}{s_{I, AGG1}},
\]

(3)

where \(m_{jt}\) denotes the share of total materials accounted by sector \(j\) in period \(t\), \(s_{I, AGGj}\) denotes the aggregate import intensity of sector \(j\) in period \(t\), and \(J\) is the total number of sectors in Manufacturing. I define sectors at the two digit level and perform the decomposition taking 1994 as initial year, and each of 1995-1999 as final year. Table 29 in the Appendix contains the results. On impact, most of the increase in the import share is accounted by within-sector increases in import intensity. Over time, the between component also helps explain the increase in the overall import intensity - by 1999, it accounts for about half of the increase in the overall import share. Table 30 shows the contribution of the different two digit industries to the within and between components for the 1994-1999 period. The first column shows that, with the exception of Wood, all sectors feature an increase in their import intensity.\(^{37}\) The last two columns show that the large positive contribution of the between component is entirely explained by Metal Products, Machinery and Equipment, which displays a large expansion and is very import intensive in 1999. We conclude that both sectoral reallocations and within sector changes are important to account for the aggregate pattern in the Manufacturing sector.

2.5 The Link to Exporting

What explains the compositional effects documented above? In this section, I argue that these effects are explained by the expansion of exporters, which tend to be intense importers, following the devaluation. The expansion (albeit sluggish) of total exports after large depreciations of the real exchange rate is documented in Alessandria et al. (2015). The fact that intense exporters tend to be intense importers is widely documented

\(^{37}\)Wood and wood products shows a large decline in its import intensity, but accounts for a small share of total Manufacturing materials.
in the international trade literature - see Bernard et al. (2007) for the US, Lapham and Kasahara (2013) for Chile, Amiti et al. (2014) for Belgium, and Albornoz and Lembergman (2015) for Argentina, among others.

Figure 6 shows the evolution of the aggregate export share, defined as the ratio of foreign sales to total (domestic plus foreign) sales, following the Mexican devaluation of 1994. The data is for the Manufacturing sector. We see that the aggregate export share increase sharply after the devaluation, going from about 16 percent in 1994 to 29 percent in 1999, an increase of roughly 80 percent. This pattern is confirmed for the overall economy in the WIOD data for the episodes of Brazil 1998, Korea 1997, Indonesia 1998, Russia 1998 and Turkey 2001 - see Figure 32 in the Appendix.

Notes: The Figure shows the evolution of the aggregate export share (red line, left axis) and the aggregate import share (blue line, right axis) following the currency depreciation of 1994. The data covers the Manufacturing sector. The aggregate export share is the ratio of total foreign sales to total sales (domestic plus foreign). The aggregate import share is the ratio of total imported materials to total materials (domestic plus foreign). Source: Survey of Manufacturing, EIA.

Figure 6: Aggregate Import and Export Shares after the Mexican Devaluation

To see whether the increase in the aggregate import intensity can be attributed to the expansion of exporters, Figure 7 depicts a scatter plot of the changes in the import and export intensities in the Mexican manufacturing establishments between 1994 and 1999. We see that firms that increase their export share tend to also increase their import share.\textsuperscript{38}

\textsuperscript{38}The correlation between the change in the import share and the change in the export share (among firms with non-zero changes) is 0.18.
Notes: The Figure depicts changes in import shares \((s_{i2} - s_{i1})\) and export shares \((s_{Xi2} - s_{Xi1})\) between 1994 and 1999 for Mexican manufacturing firms. Only firms with non-zero changes are included. Source: Encuesta Industrial Anual, Mexico.

Figure 7: Expanding Exporters and Importers After Mexican and Indonesian Devaluations

To further evaluate the link to exporting, I go back to the decomposition in (2) above and investigate whether the positive contribution of the compositional effects can be actually attributed to expanding exporters. More precisely, I measure the fraction of the between, covariance and entry components in (2) that is accounted by expanding exporters:

\[
\sum_{CI} (m_{i2} - m_{i1}) s_{i2} = \sum_{CI} (m_{i2} - m_{i1}) s_{i2} \times I(s_{Xi2} - s_{Xi1} > 0) + \sum_{CI} (m_{i2} - m_{i1}) s_{i2} \times I(s_{Xi2} - s_{Xi1} \leq 0) \quad (4)
\]

\[
\sum_{E} m_{i2}s_{i2} = \sum_{E} m_{i2}s_{i2} \times I(s_{Xi2} - s_{Xi1} > 0) + \sum_{E} m_{i2}s_{i2} \times I(s_{Xi2} - s_{Xi1} \leq 0), \quad (5)
\]

where \(s_{Xi}i\) denotes firm \(i\)'s export share in period \(t\), defined as the ratio of foreign sales to total (domestic plus foreign sales).\(^{39}\) Table 7 contains the results. We see that the positive contribution of the Between and Covariance terms, as well as that of Net Entry, can be (more than fully) accounted by the behavior of firms that increase their export intensity.\(^{40}\)

3 A Theory of Global Firms

This section develops a theory where firms participate in the international economy along two margins: as exporters of their output and as importers of intermediate inputs. Exporting allows firms to increase their revenue by accessing foreign demand. Importing materials is vehicle to reduce their costs of production, via love of variety and quality effects, as in Gopinath and Neiman (2014), Halpern et al. (2015) or Blaum et al. (2018b). A key feature of the theory is a complementarity between importing and exporting that renders firms’ decisions to participate in international markets interdependent.\(^{41}\)

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\(^{39}\) The firms that do not export in either period (before and after the devaluation), or stop exporting are counted as idle or contracting exporters.

\(^{40}\) For 1998-99, expanding exporters account for more than 100% of the sum of the Between and Covariance components, implying that these terms are negative for idle and contracting exporters.

\(^{41}\) This complementarity arises from the fact that profits are log supermodular in increases in demand and reductions in the unit cost. In addition, the fixed costs draws of importing and exporting are allowed to be correlated, giving rise to a second source of complementarity.
### Table 7: The Change in the Aggregate Import Intensity and Expanding Exporters

In Section 4, the theory is parametrized and calibrated to match rich cross-sectional moments of the Mexican pre-devaluation data. There, it is shown that the theory can come to terms with the empirical evidence presented in Section 2 above.

#### 3.1 Environment

Consider a small open economy, called Home, populated by a mass of heterogeneous firms that produce differentiated varieties. Firms can import their inputs and export their output from/to a set of countries $C$. The economy is small in the sense that outcomes in the Home country cannot affect foreign prices or incomes. There is a single primary factor of production, labor. A representative consumer is endowed with $L$ units of labor, which are inelastically supplied in a competitive labor market. As a baseline, we consider the case where the wage is exogenously given.

**Technology.** Local firms produce by combining labor, domestic and foreign materials according to the following production function:

$$y_i = \varphi_i l^{1-\gamma} x^{\gamma}, \quad (6)$$

where $y_i$ is the output of firm $i$, $\varphi_i$ is the firm’s idiosyncratic efficiency, $l$ is labor, $\gamma \in (0, 1)$, and $x$ is a bundle of material inputs given by

$$x = \left( (q_D z_D)^{\frac{1}{\kappa-1}} + x_I^{\frac{1}{\kappa-1}} \right)^{\frac{\kappa-1}{\kappa}}, \quad (7)$$

where $q_D$ and $z_D$ are the quality and quantity of a bundle of domestic inputs, $\varepsilon > 1$, and $x_I$ is a bundle of foreign inputs given by

$$x_I = \left( \int_{\Sigma} (q_c z_c)^{\frac{1}{\kappa-1}} dc \right)^{\frac{\kappa-1}{\kappa}}. \quad (8)$$

Here $q_c$ and $z_c$ are the quality and quantity of the input from country $c$, $\kappa > 1$, and $\Sigma$ denotes the set of countries from which the firm imports its inputs. We refer to this set as the firm’s sourcing strategy. The prices, denoted by $p_c$, and qualities of all foreign inputs are exogenously given. We assume a perfectly elastic supply of foreign inputs at price $p_c$. Without loss of generality, we assume that input prices are constant across countries so that all variation in price-adjusted qualities is driven by country quality. In particular, we assume

---

Notes: The Table contains the breakdown of the Between + Covariance and Entry components in (2) into the part that is accounted by expanding exporters, according to (4)-(5). The data is for the Mexican Manufacturing sector. Each row corresponds to the decomposition between 1994 and each of the subsequent five years. The column “Total” reports the left hand side terms in (4)-(5). All values are in percentage points.

<table>
<thead>
<tr>
<th>Year</th>
<th>Between + Covariance</th>
<th></th>
<th>Net Entry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Expanding Exporters</td>
<td>Total</td>
</tr>
<tr>
<td>1995</td>
<td>7.03</td>
<td>5.43</td>
<td>-0.99</td>
</tr>
<tr>
<td>1996</td>
<td>8.24</td>
<td>7.94</td>
<td>5.48</td>
</tr>
<tr>
<td>1997</td>
<td>13.82</td>
<td>13.50</td>
<td>6.56</td>
</tr>
<tr>
<td>1998</td>
<td>13.89</td>
<td>14.75</td>
<td>5.93</td>
</tr>
</tbody>
</table>

More precisely, we consider the relative price of foreign inputs in terms of domestic labor as determined outside of the model. In Section xx of the Appendix, we consider the case where the labor market clears.

The production side of the economy follows closely the set up in Blaum et al. (2018b).
\[ p_c = e p^* \] for all \( c \) and refer to the constant \( e \) as the real exchange rate and to \( p^* \) as the price of foreign inputs. In Section 4, we study the effect of a devaluation which is modelled as an increase in \( e \).\(^{44}\)

Finally, we assume that country quality \( q_c \) is distributed Pareto with scale parameter \( q_{\text{min}}>0 \) and shape parameter \( \xi \).

**Local Demand.** Local demand for a firm's output stems from domestic consumers as well as other domestic firms. A representative consumer in the Home country consumes the mass of goods produced domestically with preferences given by

\[
U = \left( \int c_i^{\sigma-1} \, di \right)^{\frac{1}{\sigma-1}}, \tag{9}
\]

where \( c_i \) denotes final consumption of good \( i \) and \( \sigma > 1 \). Foreign final goods do not enter into the consumers' utility and hence are not imported.\(^{45}\) Additionally, there is a structure of roundabout production by which firms use the output of all other domestic firms as inputs in production.\(^{46}\) In particular, the domestic variety \( z_D \) is produced with an aggregator given again by (9).\(^{47}\) Total domestic demand for the output of firm \( i \), stemming from consumers and firms, is therefore given by

\[ y_i = p_i^{-\sigma} P^{\sigma-1} S, \tag{10} \]

where \( p_i \) is the price charged by the firm, \( P \equiv \left( \int p_i^{1-\sigma} \, di \right)^{-\frac{1}{1-\sigma}} \) is the price index associated with (9) and \( S \) is total domestic spending, which is the sum of consumer and intermediate spending at Home.

**Foreign Demand.** The demand for the output of firm \( i \) from country \( j \) is given by

\[ y_{ij} = p_{ij}^{-\sigma} e^{\sigma-1} b_j, \]

where \( p_{ij} \) is the price charged by firm \( i \) in market \( j \) and \( e^{\sigma-1} b_j \) is the exogenously given position of the foreign demand function. This position features a component that is common across countries, controlled by \( e \), and a component that is country-specific, given by \( b_j \). The term \( e \) plays the role of a foreign price index; an increase in \( e \) tends to lower the price of the Home firm relative to the foreign firms in market \( j \), thereby increasing demand. We therefore refer to an increase in \( e \) as a real depreciation.

Finally, \( b_j \) is assumed to be distributed Pareto across countries with scale parameter \( b > 0 \) and shape \( \theta > 1 \). We denote this distribution by \( G(b_j) \).

**Trade costs.** Exporting to any destination entails a fixed cost \( f_X \), per destination and a variable cost \( \tau \), which are assumed to be common across destinations for simplicity. Importing from any origin has a fixed

\(^{44}\)Naturally, the distinction between \( e \) and \( p^* \) is inmaterial, and a devaluation can be thought of as an increase in input prices coming from either \( e \) or \( p^* \).

\(^{45}\)This assumption is made for simplicity and to focus on the connection between importing and exporting done by firms. Incorporating imports of final goods into the analysis would be straightforward and would not interact with the main channel studied in the model.

\(^{46}\)Roundabout production is a standard assumption in the literature - see e.g. Gopinath and Neiman (2014); Blaum et al. (2018b); Fieler et al. (2018). It implies that firms’ decisions are interconnected. For example, a shock that induces efficient exporters to export more intensively will increase demand for all other firms, making it more likely that these other firms import their inputs more intensively.

\(^{47}\)The assumption that the domestic variety aggregator features the same functional form as consumer utility in 9 is made for tractability. Under this assumption, the demand functions stemming from consumers and firms are isoelastic functions which differ only in their position (i.e., a multiplicative constant) and hence can be aggregated into a single isoelastic function - see (10) below. It follows that firms use the same pricing rule regardless of whether they sell to consumer or other firms.
costs of $f_i$, assumed to be common across origins for tractability. Variable input costs are included in input prices $p^\ast$. In addition, there are fixed costs associated with the overal international strategy of the firm, given by $F_M$, $F_X$ and $F_{XM}$ to being an importer-only, exporter-only or importer-exporter, respectively.

**Market Structure.** Firms are price takers in input markets: they can buy any quantity $z_c$ of the input from country $c$ at given price $p_c$. In output markets, there is CES monopolistic competition.

**Discussion of Assumptions.** We consider a static model, taking as exogenously given the level of trade deficit, international prices and incomes. The reason is that the theory does not aim to explain the devaluation, nor explore the dynamics of the trade balance. Instead, the goal is to explore how internalizing firms’ joint import and export decisions affects the aggregate quantities traded, conditional on a given evolution of the trade balance and international prices and demand. Furthermore, the model features no sectoral classification as the empirical patterns documented in Section 2 take place within sector.

3.2 Firm Problem

The firm’s problem consists of deciding its domestic output price $p_i$, quantity produced $y_i$, sourcing strategy $\Sigma_i$, quantities of all inputs $z_c$, export status, and the prices and quantities in each destination. In this framework, all of these decisions are interdependent and cannot be studied separately. We start by characterizing the unit cost of production given the extensive margin of imports $\Sigma_i$. We then characterize the optimal prices and quantities at Home and in each foreign market the firm decides to export to. We conclude by expressing the profits associated with each global status in terms of the sourcing strategy.

**Unit Cost given Sourcing Strategy.** Given the sourcing strategy $\Sigma$, the firm chooses the quantities of labor, the domestic bundle and the foreign inputs $\{l, z_D, \{z_c\}\}$ to solve:

$$C(y, \varphi_i, \Sigma) = \arg\min_{l, z_D, \{z_c\}}wl + p_Dz_D + \int_{\Sigma} ep^\ast z_c dc$$

subject to (6)-(8). It can be shown that the optimal expenditure on foreign inputs $m_I$ satisfies:

$$m_I = \int_{\Sigma} ep^\ast z_c dc = \left(\int_{\Sigma} (p^\ast/q_c)^{1-\kappa} dc\right)^{\frac{1}{1-\kappa}} x_I$$

$$\equiv eA(\Sigma)x_I,$$

where $A(\Sigma) \equiv \left(\int_{\Sigma} (p^\ast/q_c)^{1-\kappa} dc\right)^{\frac{1}{1-\kappa}}$ is the price index associated with the foreign bundle $x_I$. Standard calculations imply the following cost function:

$$C(y, \varphi_i, \Sigma) = \varphi_i^{-1} \left(\frac{w}{1-\gamma}\right)^{1-\gamma} \left(\frac{Q(\Sigma)}{\gamma}\right)^\gamma y,$$

(11)

---

48 Allowing for a fixed cost of importing that varies by country would substantially complicate the choice of the optimal sourcing strategy, as discussed in Blaum et al. (2013) and Antras et al. (2017) who provide a solution algorithm to tackle this problem.

49 In particular, Table 3 showed that the sector-level imported input share tends to increase after large devaluations. Table 30 in the Appendix shows that most two-digit sectors within the Mexican manufacturing sector displayed an increase in the imported input share following the 1995 devaluation.

50 Accordingly, in Section 4, the model is estimated with moments pooling firms from all manufacturing sectors.

51 The derivations of the expressions in this section follow closely Blaum et al. (2018b) and are therefore omitted.
where \( w \) is the wage and \( Q \) is the price index associated with the material bundle \( x \), given by

\[
Q(\Sigma; e) = \left( \beta e (p_D/q_D) \right)^{1-\epsilon} + (1 - \beta) e^{1-\epsilon} A(\Sigma)^{1-\epsilon},
\]

(12)

where \( p_D \) denotes the price index of the domestic bundle \( z_D \). An increase in \( e \), which we refer to as a real depreciation, makes foreign inputs more expensive, increasing the price of materials \( Q \) and hence the cost of production.

Because the fixed costs of importing are constant across countries, there is a strict ranking of sourcing countries by their quality \( q_c \). The firm therefore chooses to import from countries with quality higher than a cutoff quality level, which is denoted by \( \bar{q} \). In other words, the choice of the optimal sourcing strategy set reduces to the choice of a scalar, i.e., \( \Sigma = [\bar{q}, \infty) \). This property, together with the assumption that \( q_c \) is Pareto distributed, implies that the price index of the foreign bundle is given by

\[
A(\Sigma) = p^* \left( \frac{\xi q_{\text{min}}^\xi}{(1 + \xi - \kappa) q^{\kappa-\xi-1}} \right)^{1/\gamma} = zn^{-\eta},
\]

(13)

where \( n \) is the mass of countries in the sourcing set and \( z \) and \( \eta \) are auxiliary parameters determined by \( (q_{\text{min}}, \xi, \kappa) \). Combining (11), (12) and (13) shows that the unit cost decreases with the mass of countries sourced, \( n \). Intuitively, sourcing from a larger mass of countries depresses the price index of foreign varieties, \( A \), which in turn reduces the price index of materials \( Q \) and hence the unit cost. In what follows, we represent the firm’s unit cost as a function of its domestic share can be expressed as

\[
u_i = \frac{1}{\sigma - 1} \left( \frac{w}{1 - \gamma} \right)^{1-\gamma} \left( \frac{p_D}{\gamma^\sigma \tau q_D} \right)^{\gamma^{1-\gamma}} s_D^n.
\]

(14)

All input sourcing decisions, including foreign sourcing, are summarized in the unit cost. Without loss of generality, we normalize the wage to unity.

**Domestic Pricing.** We now work out the price and quantity decisions in Home as well as abroad conditional on the input sourcing strategy. Domestic variable profits, excluding any fixed costs from input sourcing, are given by

\[
\pi_{Di} = \max_{p_i} (p_i - u_i) p_i^{-\sigma} P^{\sigma-1} S,
\]

where \( p_i \) denotes the price charged by firm \( i \) in the domestic market. Standard calculations imply the usual constant markup pricing rule

\[
p_i = \frac{\sigma}{\sigma - 1} u_i
\]

(15)

52Because the aggregator for \( z_D \) is given by the same aggregator as consumer utility, it follows that \( p_D = P \).

53In particular, these are given by:

\[
z = \frac{p^*}{q_{\text{min}}} \left( \frac{\xi}{1 + \xi - \kappa} \right)^{1-\kappa} \text{ and } \eta = \frac{1}{\kappa - 1} + \frac{1}{\xi} > 0.
\]

The mass of countries in the sourcing set is given by \( n = Pr(q \geq \bar{q}) = (q_{\text{min}}/\bar{q})^{\xi} \). The expression in (13) requires \( \kappa - \xi - 1 < 0 \).

54The domestic expenditure share is defined as

\[
s_D = \frac{p_{Di}^*}{p_{Di}^* + m_i}.
\]

55We show in Section xx of the Appendix that the relevant prices and general equilibrium objects are \( P/w, S/w \) and \( ep^*/w \).
and the following expression for domestic variable profits:

$$\pi_{Di} = \sigma^{-\sigma} (\sigma - 1)^{\sigma-1} u_i^{1-\sigma} P^{\sigma-1} S. \tag{16}$$

**Foreign pricing and Export Participation.** Consider now the price, quantity and participation decisions in foreign markets.\(^{56}\) The variable profits from exporting to market \(j\) are:

$$\pi^v_{ij} = \max_{p_{ij}} (p_{ij} - (1 + \tau) u_i) p_{ij}^{-\sigma} e^{\sigma^{-1} b_j},$$

where \(p_{ij}\) is the price charged by firm \(i\) in market \(j\). Once again, the optimal price is set at a constant markup over the marginal cost after trade costs:

$$p_{ij} = \frac{\sigma}{\sigma - 1} (1 + \tau) u_i,$$

with associated variable profits:

$$\pi^v_{ij} = \sigma^{-\sigma} (\sigma - 1)^{\sigma-1} (1 + \tau)^{1-\sigma} u_i^{1-\sigma} e^{\sigma^{-1} b_j}.$$

Exporting to market \(j\) is optimal if \(\pi^v_{ij} > f_{X_i}\), which reduces to:

$$b_j > \sigma^{\sigma} (\sigma - 1)^{1-\sigma} \sigma^{-1} e^{\sigma^{-1} f_{X_i}} \equiv b^{*}(u_i) \tag{17}$$

The optimal export strategy is to export to destinations where the demand shifter \(b_j\) exceeds a threshold. This threshold depends negatively on the exporting fixed cost \(f_{X_i}\) and positively on the unit cost \(u_i\). In this way, firms that are efficient exporters (i.e., with low \(f_{X_i}\)), efficient importers (i.e., with low \(f_i\)), or with higher factor neutral efficiency (i.e., high \(\varphi_i\)) are more likely to export to any given destination. Importantly, \(f_{X_i}\) and \(u_i\) enter multiplicatively in (17) giving rise to a complementarity between exporting and importing. Being an importer, or importing from more countries, makes it more likely and more profitable to export to any destination.

Integrating over the countries with sufficiently high demand yields an expression for total profits from exporting, net of the country-level fixed costs of exporting:

$$\pi_{Xi} = \int_{b^{*}(u_i)}^{\infty} (\pi^v_{ij} - f_{X_i}) dG(b_j) = \frac{1}{\theta - 1} b_i^{\theta} e^{\theta \sigma - 1} \sigma^{-\theta \sigma} (\sigma - 1)^{\theta (\sigma - 1)} (1 + \tau)^{-\theta (\sigma - 1)} u_i^{-\theta (\sigma - 1)} f_{X_i}^{1-\theta}. \tag{18}$$

**Global Status and Sourcing Strategy.** We now study the optimal sourcing strategy, summarized by \(s_{Di}\), conditional on the firm’s overall international status. The firm selects the global status (i.e., domestic, importer-only, exporter-only or importer-exporter) with highest profits. Combining the expressions for domestic and foreign profits in (16) and (18), the unit cost in (14), and netting out the importing and global status fixed costs, yields an expression for the total profits associated with being an importer-exporter. After some manipulations,

\(^{56}\) We condition on the unit cost and the overall export status, i.e., we assume that the firm has paid the fixed cost to its overall sourcing strategy that allows it to export, i.e., either \(F_X\) or \(F_{XM}\). We consider the overall international status decision at the end.
these are
\[
\tilde{\Pi}_{XM} = \beta \frac{\tilde{\epsilon}}{\tilde{\sigma} - 1} \tilde{\varphi}_i^{\sigma - 1} \tilde{s}_{Di}^{\gamma - 1} (\tilde{\varphi}_i^{\sigma - 1} + \tilde{\gamma} \tilde{\varphi}_i^{\sigma - 1} + \tilde{\gamma} \tilde{s}_{Di}^{\gamma - 1}) - \tilde{f}_i \tilde{\gamma}^{\sigma - 1} (\tilde{\beta} \tilde{s}_{Di}^{\gamma - 1} - 1) - \tilde{F}_{XM},
\]
where the variables with tilde have been re-scaled by general equilibrium variables (i.e., \(S\) and \(P\)) and parameters.\(^{57}\) Recall that \(\tilde{f}_i\) denotes the per-country fixed costs of importing. The firm chooses its sourcing strategy, \(s_{Di}\), to maximize the expression in (19). Importing from more countries (i.e., a lower \(s_D\)) increases domestic and foreign profits (the first two terms) at the expense of increasing the bill of importing fixed costs (third term). The optimal sourcing strategy balances these two forces.

The remaining global strategies can be studied as special cases of (19). The profits of being an importer-only, \(\tilde{\Pi}_M\), are given by (19) when \(f_{X_i} \to \infty\) and \(\tilde{F}_M\) is replaced by \(\tilde{F}_M\). The profits of an exporter-only, \(\tilde{\Pi}_X\), are given by (19) with \(s_D = 1\) and \(\tilde{F}_X\) instead of \(\tilde{F}_{XM}\). Finally, the profits of being purely domestic, \(\tilde{\Pi}_D\), are given by (19) with \(s_D = 1\) and omitting \(\tilde{F}_{XM}\). The firm selects the status that yields the highest profits:
\[
\pi = \max \{\tilde{\Pi}_D, \tilde{\Pi}_X, \tilde{\Pi}_M, \tilde{\Pi}_{XM}\}.
\]

### 3.3 Equilibrium

The equilibrium is defined as follows. Given foreign input prices \([e p^*]\), the levels of foreign demands \([e^{\sigma - 1} b_j]\), and transfers \(T\), an equilibrium is a set of local and export prices for all export destinations \([p_i, p_{ij}]\), differentiated product quantities for home and all export destinations \([c_i, x_{ij}]\), labor demands for production and fixed costs \(l_i, l_{ij}^{F}\), domestic and international input demands by local firms \([z_{ci}]\) and sourcing strategies \(s_{Di}\) such that:

1. Firms maximize profits,
2. Consumers maximize utility given in (9) subject to:
\[
\int p_i c_i \, di = L + \int \pi_i \, di + T,
\]
where \(\pi_i\) is given by (20).
3. Goods markets clear:
\[
y_i = c_i + x_i + h_i,
\]
where \(x_i\) and \(h_i\) are the amounts exported and sold to other domestic firms, respectively, by firm \(i\).

The economy need not attain balanced trade for two reasons. First, there are exogenous transfers \(T\) that, if positive, result in a trade deficit. Second, because the equilibrium does not impose labor market clearing, the manufacturing sector can be a net supplier of labor to the rest of the economy and thus attain a trade deficit.

\(^{57}\) For example, the re-scaled fixed cost of importing are given by:
\[
\tilde{f}_i = \frac{\gamma - 1}{\gamma} (1 - \gamma)^{-1/(\gamma - 1)} p_{Di}^{\sigma - 1} \left( \frac{\sigma}{\sigma - 1} \right)^{\sigma - 1} \left( \frac{\sigma}{\sigma - 1} \right)^{\gamma - 1} e^{\frac{\sigma}{\sigma - 1}} P^{1-\sigma} f_i.
\]
The corresponding expressions for \(\tilde{f}_X, \tilde{F}_{XM}, \tilde{F}_M, \tilde{F}_X, \tilde{\Pi}_{XM}, \tilde{\Pi}_M, \tilde{\Pi}_{XM}, \tilde{\Pi}_{XM}\), as well as a derivation of (19), are contained in Section 6.3 in the Appendix.
Unlike the transfers, the size of the gap in the labor market is endogenous. In Section 6.6 of the Appendix, an equilibrium with labor market clearing is defined and characterized.

As seen in Section 3.2, all equilibrium objects and outcomes depend on the level of domestic spending $S$ and price index $P$. The following result characterizes these two equilibrium objects as functions of the data on firms’ domestic expenditure and export shares. The solution and calibration strategy employed in Section (4) below heavily rely on this result.

**Proposition 1.** Given firms’ domestic expenditure and export shares $(s_{Di}, s_{Xi})$, the domestic price index associated with preferences in (9) is given by

$$P = \left( \frac{\sigma}{\sigma - 1} \right)^{-\frac{1}{\sigma - 1}} (1 - \gamma)^{-1} \left( \gamma \beta \frac{s_{Di}}{s_{Di}} \right)^{-\frac{1}{\sigma - 1}} \left( \int_i \varphi_i^{\gamma - 1} s_{Di}^{\gamma - 1} (1 - \sigma) \, di \right)^{-\frac{1}{\sigma - 1}},$$

and aggregate domestic spending $S$ is given by

$$\frac{S}{w} = \frac{L + T}{1 + \left( \frac{P}{w} \right)^{\sigma - 1} (1 - \gamma)} \Psi - \frac{1}{\sigma} - \frac{\kappa_1 \Gamma}{\sigma - 1} \left( \int_i \omega_{Di} s_{Di} \, di \right) - \frac{\gamma - 1}{\sigma} \frac{\kappa_1 \Gamma}{\sigma - 1} \left( \int_i \omega_{Di} s_{Di} \, di \right),$$

where $\Gamma$, $\Upsilon$, and $\Psi$ are functions of firms’ import and export shares

$$\Upsilon = \int_i \varphi_i^{\gamma - 1} s_{Di}^{\gamma - 1} \left( \int_i \phi_i^{\gamma - 1} s_{Di}^{\gamma - 1} \, di \right),$$

$$\Gamma = \int_i \varphi_i^{\gamma - 1} s_{Di}^{\gamma - 1} \left( \int_i \phi_i^{\gamma - 1} s_{Di}^{\gamma - 1} \, di \right),$$

$$\Psi \equiv \int_i \left( \kappa_2 \left( s_{Di}^{-1} - 1 \right) \right)^{\frac{1}{\sigma - 1}} \int_i \kappa_3 \left( \frac{k}{1 - \theta} - 1 \right) \varphi_i^{\gamma - 1} s_{Di}^{\gamma - 1} \left( \int_i \phi_i^{\gamma - 1} s_{Di}^{\gamma - 1} \, di \right),$$

and $\kappa_1$, $\kappa_2$, and $\kappa_3$ are constants determined by model parameters defined in (37), (44) and (45) in Section (6.5) of the Appendix.

**Proof.** See Section (6.5) of the Appendix.

Section 6.4 in the Appendix contains a description of the algorithm used to solve for the equilibrium model.

### 4 Quantitative Exercise

In this Section, the model is calibrated to salient features of the Mexican micro data pre-devaluation. Key moments from the joint distribution of firm size, import and export intensities are used to discipline the model parameters. The calibrated model is then used to simulate a counterfactual devaluation,

$$TB \equiv X - M = -T - (L - L_d),$$

where $L_d$ is the total labor demand.
4.1 Calibration

4.1.1 Parametrization and Moments

To generate rich distributions in the model, three dimensions of firm heterogeneity are allowed: efficiency $\varphi_i$ and the per country fixed costs of importing $f_i$ and exporting $f_{Xi}$. These three firm-specific variables are assumed to be jointly log-normally distributed with means $\mu_\varphi, \mu_f$ and $\mu_{fX}$, variances $\sigma_\varphi^2, \sigma_f^2$ and $\sigma_{fX}^2$, and correlations $\rho_{\varphi f}, \rho_{\varphi fX}$ and $\rho_{f fX}$. These parameters, as well as the global status parameters $F_M, \tilde{F}_M$ and $F_{XM}$, are chosen to match the following moments of the Mexican data in 1994 (i.e., pre-devaluation): (i) the aggregate import and export shares, (ii) the dispersions of firm sales, import and export shares, (iii) all pairwise correlations between sales, import and export shares, and (iv) the fractions of importers-only, exporters-only and importer-exporters. Sales are normalized by total manufacturing sales to eliminate the effect of economic growth. The value of $\theta$, which governs the dispersion in foreign demand levels $b_j$ across countries, is chosen to match the growth in total exports between 1994 and the average of the 1995–1999 period seen in the Mexican manufacturing sector. In the model, the devaluation is generated via a 20% increase in $e$, which controls foreign input prices as well the level of foreign demands. Finally, the values for $\sigma, \gamma, \varepsilon$, and $\eta$ are taken from Blaum et al. (2018b).

4.1.2 Solution Algorithm

The model is solved and calibrated with the following approach. Consider first the choice of the parameters that govern the distribution of efficiency and fixed costs, given a value of $\theta$. These parameters can be calibrated to match the above-mentioned moments of the joint distribution of import and export shares without solving for the price index $P$ and aggregate domestic spending $S$. The reason is that the firms’ domestic and export shares $(s_{Di},s_{Xi})$ can be obtained purely from the distribution of firm efficiency and re-scaled fixed costs $(\varphi_i,f_i,\tilde{f}_{Xi})$, $\tilde{F}_{XM}, \tilde{F}_M$ and $\tilde{F}_X$ - see Section 3.2 above. In other words, conditional on $\theta$, the model can calibrated purely in terms of re-scaled fixed costs, thus bypassing the need to compute $S$ and $P$ inside of the first loop of the calibration. After the moments have been matched, $S$ and $P$ can be computed from Proposition 1 above and the model-implied data on import and export shares. Next, $\theta$ is chosen to match the growth rate in total exports following a counterfactual 20% real devaluation (i.e., increase in $e$). In this step, after $e$ is increased, the equilibrium values of $S$ and $P$ need to be computed. The details of the solution algorithm are contained in Section 6.4 of the Appendix.

4.1.3 Calibration Results and Model Fit

Table 8 below contains the results of the calibration. The model is able to perfectly match all targeted moments. To generate the positive correlation between import and export shares observed in the data, the model requires a positive correlation between the fixed costs of importing and exporting. In addition, matching the positive

59 These parameters refer to moments of the log of the corresponding variables. For example, $\mu_f \equiv \mathbb{E} [\log (f)], \sigma_f^2 \equiv \mathbb{V} [\log (f)]$ and $\rho_{\varphi f} \equiv \text{corr} (\log (f), \log (\varphi))$. Mean efficiency is normalized to unity so that $\mu_\varphi = -\sigma_\varphi^2/2$.

60 An expression for firm sales is given by (32) in Section 6.4 of the Appendix.

61 The demand elasticity $\sigma$ is measured from profit margins (i.e., sales to costs ratios) and yields a value of 3.8, while the output elasticity of materials $\gamma$ is measured from the material cost shares and yields a value of 0.61. This values are standard in the literature. Broda and Weinstein (2006), e.g., finds an average elasticity of 4. The elasticity of substitution between domestic and foreign inputs, $\varepsilon$, is measured via a production function estimation exercise. More precisely, it is shown that when materials in terms of spending rather than quantities, $\varepsilon$ controls the sensitivity of output to the domestic expenditure share. Exploiting shocks to the world supply of the firms’ inputs as an exogenous shifter of the domestic share, Blaum et al. (2018b) estimate a value of $\varepsilon = 2.38$. The sensitivity of the price index of foreign varieties to the mass of countries sourced, $\eta$, is estimated from the cross-sectional relationship between the domestic expenditure share and the number of countries sourced. This yields a value of $\eta = 0.38$.

62 I normalize $\beta = 1$ and $\beta = 0.5$. 
but imperfect correlation between firm sales and import (export) shares requires a positive relation between firm efficiency and the fixed costs of importing (exporting).

The average fixed cost paid for importing is about $2,580,000 and for exporting is $229,000.

Tables 9 and 10 present non-targeted moments of the joint distributions of sales, import shares and export shares. The model is able to replicate well the marginal distributions of size, import and export intensity, as well as the positive association between these variables seen in the data.

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Description</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average importing fixed cost ($\mu_{fM}$)</td>
<td>-0.44</td>
<td>Aggregate Import Share</td>
<td>0.36</td>
<td>0.36</td>
</tr>
<tr>
<td>Average exporting fixed cost ($\mu_{fX}$)</td>
<td>104.93</td>
<td>Aggregate Export Share</td>
<td>0.16</td>
<td>0.16</td>
</tr>
<tr>
<td>Fixed cost import status ($\tilde{F}_M$)</td>
<td>0.01</td>
<td>Fraction Importers-Only</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Fixed cost export status ($\tilde{F}_X$)</td>
<td>0.019</td>
<td>Fraction Exporters-Only</td>
<td>0.07</td>
<td>0.07</td>
</tr>
<tr>
<td>Fixed cost import-export ($\tilde{F}_{XM}$)</td>
<td>0.02</td>
<td>Fraction Importer-Exporters</td>
<td>0.17</td>
<td>0.17</td>
</tr>
<tr>
<td>Dispersion in efficiency ($\sigma_x$)</td>
<td>0.61</td>
<td>Dispersion in sales</td>
<td>1.71</td>
<td>1.71</td>
</tr>
<tr>
<td>Dispersion in importing fixed costs ($\sigma_{\tilde{f}}$)</td>
<td>3.15</td>
<td>Dispersion in imp. shares</td>
<td>0.27</td>
<td>0.27</td>
</tr>
<tr>
<td>Dispersion in exporting fixed costs ($\sigma_{fX}$)</td>
<td>71.63</td>
<td>Dispersion in exp. shares</td>
<td>0.18</td>
<td>0.18</td>
</tr>
<tr>
<td>Corr. efficiency - importing fixed cost ($\rho_{\varphi\tilde{f}}$)</td>
<td>0.86</td>
<td>Corr. sales-imp. shares</td>
<td>0.27</td>
<td>0.27</td>
</tr>
<tr>
<td>Corr. efficiency - exporting fixed cost ($\rho_{\varphi fX}$)</td>
<td>0.48</td>
<td>Corr. sales - exp. shares</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>Corr. importing - exporting fixed costs ($\rho_{f\tilde{f}X}$)</td>
<td>0.19</td>
<td>Corr. imp. - exp. shares</td>
<td>0.18</td>
<td>0.18</td>
</tr>
<tr>
<td>Dispersion in Foreign Demand ($\theta$)</td>
<td>1.03</td>
<td>Growth in Exports</td>
<td>81%</td>
<td>84%</td>
</tr>
</tbody>
</table>

Notes: Firm sales are computed in logs. The import shares correspond to $1 - s_D$ in the text. The moments in the data are computed for the Mexican manufacturing sector in 1994.

Table 8: Calibrated Parameters and Targeted Moments

<table>
<thead>
<tr>
<th>Description</th>
<th>Percentiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normalized log domestic sales</td>
<td>10th</td>
</tr>
<tr>
<td>Data</td>
<td>-12.05</td>
</tr>
<tr>
<td>Import Shares, Importers</td>
<td>3.37</td>
</tr>
<tr>
<td>Data</td>
<td>3.93</td>
</tr>
<tr>
<td>Export Shares, Exporters</td>
<td>0.54</td>
</tr>
<tr>
<td>Data</td>
<td>2.32</td>
</tr>
</tbody>
</table>

Notes: Sales are normalized by total industry sales. The percentiles of the import (export) share distribution are computed over the sample of importers (exporters). All data moments are calculated for the Mexican manufacturing sector in 1994.

Table 9: Unconditional Distributions of Sales, Import and Export Shares: Model vs Data

63 To see this, consider the case where the fixed costs of importing are common across firms and hence uncorrelated with firm efficiency. In this case, the model generates a one-to-one increasing relation between firm size and import shares. By assigning higher fixed costs to more efficient firms, the model generates a lower correlation between firm size and import shares. A similar pattern is found in Blau et al. (2018b).

64 This number is obtained by computing the ratio of average sales to average fixed costs of importing, for the population of importers. Then, relying on the average dollar sales of importers in the Mexican data in 1994, we back out the average fixed costs paid.
Table 10: Conditional Distributions: Model vs Data

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4 (largest)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Import Share</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td>7.92</td>
<td>15.21</td>
<td>19.89</td>
<td>27.91</td>
</tr>
<tr>
<td>Model</td>
<td>1.96</td>
<td>18.28</td>
<td>20.13</td>
<td>21.42</td>
</tr>
<tr>
<td>Export Share</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td>3.49</td>
<td>5.26</td>
<td>7.3</td>
<td>9.98</td>
</tr>
<tr>
<td>Model</td>
<td>0.72</td>
<td>9.12</td>
<td>9.63</td>
<td>8.13</td>
</tr>
<tr>
<td>Export Share, Exporters</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td>19.63</td>
<td>18.59</td>
<td>21.69</td>
<td>27.29</td>
</tr>
<tr>
<td>Model</td>
<td>21.85</td>
<td>31.15</td>
<td>37.86</td>
<td>33.27</td>
</tr>
</tbody>
</table>

Notes: In the first two panels, firms are grouped into quartiles of total sales (including domestic and export revenue). For each quartile, the table depicts the average import share (first panel) and the average export share (second panel). The last panel focuses on importer-exporters and groups firms into quartiles of import shares. For each quartile, the table depicts the average export share. All data moments are calculated for the Mexican manufacturing sector in 1994.

4.2 A Counterfactual Devaluation

This section studies the effect of the real exchange rate on firms’ international behavior and the aggregate pattern of substitution between domestic and foreign inputs. A real depreciation is engineered as an across-the-board increase in the prices of foreign goods relative to domestic labor.\(^{65}\) This includes the prices of foreign inputs as well as of foreign goods that compete with the Home-produced goods in export markets. Higher foreign input prices make importing less attractive, inducing firms to substitute towards domestic inputs. At the same time, higher prices by foreign competitors in export markets translates into increased foreign demand for the goods of Home firms, inducing firms to increase their export intensity.

4.2.1 Baseline

I consider a decline in the real exchange rate of 20 percent which is the observed value in the Mexican devaluation of 1995.\(^{66}\) The exogenous transfers \(T\) are changed so as to match the observed reduction in the trade deficit as a share of absorption in Mexico. The trade deficit is reduced by about 9-10 percentage points of domestic absorption in the model and data - see Table 31 in the Appendix.

Tables 11-13 contain the effects of the devaluation for the model counterfactual and the Mexican experience. The data figures correspond to changes between 1994 and the average of the 1995-99 period. The calibrated model generates an increase in the aggregate import share of about 7 percent.\(^{67}\) As shown below, models that do not incorporate firms’ joint importing and exporting behavior are not able to generate increases in the aggregate import share. Quantitatively, while short of what was seen in Mexico, the increase in the aggregate import share generated by the model is closer to the within-sector increase of about 10 percent observed in the

\(^{65}\)Formally, this this achieved via an increase in \(e/w\), which is an exogenous parameter of the model that controls both types of foreign prices.

\(^{66}\)More precisely, the average real exchange rate in 1995-1999 was 20% lower than the average in 1991-1994 in Mexico. Relatedly, Mendoza (2006) documents that the price of imported inputs increased by 15% in 1995 and remained high for about 6 years in Mexico.

\(^{67}\)In levels, the aggregate imported input share increases from 0.36 to about 0.39. In the data, the increase was from 0.36 to 0.42.
data for the 1995-99 period. As the aggregate import shared increases, the marginal distribution of import shares tends to shift to the left both in the data and in the model, as seen in Table 12. This widespread reduction in firm-level import shares is consistent with the increase in the aggregate share because, as shown in Table 13, firm size and import shares become more correlated after the devaluation. The model reproduces well this feature of the data.

As for exporting, the model predicts an increase in the aggregate export intensity of about 64% which is more than three-quarters of the increase seen in the data. This increase arises from the combination of a shift to the right in the marginal distribution of export shares (except at the very top) and a stronger correlation between firm size and export intensity, both in the model and data. Finally, the model matches well the changes in firms’ international status: there are fewer pure importers, more pure exporters, and more importer-exporters. The model accurately predicts that the share of firms doing any importing increases. In terms of normative implications, the model predicts an increase in the ideal consumer price index of about 4.9 percent.

<table>
<thead>
<tr>
<th>Rate of growth in ...</th>
<th>Model, 20% depreciation</th>
<th>Mexico 94-99</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate Import Share</td>
<td>7.07</td>
<td>15.85</td>
</tr>
<tr>
<td>Aggregate Export Share</td>
<td>63.52</td>
<td>78.32</td>
</tr>
<tr>
<td>Price Index</td>
<td>4.91</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 11: Effects of a Counterfactual Devaluation (Baseline Model)

Notes: The Table contains the rate of growth in the aggregate import share, the aggregate export share and the consumer price index resulting from a counterfactual devaluation in the model and for the Mexican manufacturing sector. The figures for Mexico correspond to changes between 1994 and the average of 1995-1999. The model corresponds to the baseline calibration of Section 4.2.1. The consumer price index is computed according to (23). All entries are in percentage points.

<table>
<thead>
<tr>
<th>Percentiles</th>
<th>10th</th>
<th>25th</th>
<th>50th</th>
<th>75th</th>
<th>90th</th>
<th>95th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Import Shares, Importers, final - initial</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td>0.40</td>
<td>0.38</td>
<td>0.42</td>
<td>0.47</td>
<td>1.62</td>
<td>1.02</td>
</tr>
<tr>
<td>Model</td>
<td>-1.61</td>
<td>-2.00</td>
<td>-5.09</td>
<td>-7.05</td>
<td>-3.14</td>
<td>-1.33</td>
</tr>
<tr>
<td>Export Shares, Exporters, final - initial</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td>0.42</td>
<td>1.26</td>
<td>3.73</td>
<td>4.78</td>
<td>2.42</td>
<td>-0.91</td>
</tr>
<tr>
<td>Model</td>
<td>0.14</td>
<td>0.47</td>
<td>1.22</td>
<td>2.02</td>
<td>2.06</td>
<td>1.78</td>
</tr>
</tbody>
</table>

Notes: The data rows depict changes in the percentiles of the distribution of import shares (first panel) and export shares (second panel) between 1994 and the average of 1995-99 in the Mexican manufacturing sector. For the data, the figures are constructed as the difference between the average percentile in the 1995-99 period and the percentile in 1994. The model rows depict changes in the model generated data resulting from a 20% depreciation of the real exchange rate. All entries are in percentage points. Source: EIA.

Table 12: Changes in Distribution of Import and Export Shares

To further understand the mechanics of the model, the increase in the aggregate import share is decomposed using the methodology of Section 2.4 above. Table 14 contains the results of applying the decomposition of equation (2) to both the model-generated data and the Mexican data between 1994 and 1999. The model generates a within component that is negative and of about half the magnitude as in the data. Importantly, Section 2.4 documented that about half of the increase in the aggregate imported input share in the Mexican manufacturing sector was due to within-sector changes. See equation (3) for the decomposition used and Table 29 in the Appendix for the results. For this exercise, the select 1999 as the post devaluation period. In constrast, Tables 11, 12 and 13 take an average of 1995-1999 as the post devaluation period in the data. For the decomposition in Table 14, a single year is selected as post devaluation period to ensure that all the terms of the decomposition add up to the total. Table 6 of Section 2.4 shows the decompositions when any of the years in 1995-1998 are used as post devaluation period.

This suggests that the estimate of the elasticity of substitution between domestic and foreign inputs, \( \varepsilon \), taken from Blaum et al. (2018b), may be appropriate for the Mexican manufacturing sector.
<table>
<thead>
<tr>
<th>Change in...</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fraction Importers-Only</td>
<td>-2.97</td>
<td>-7.05</td>
</tr>
<tr>
<td>Fraction Exporters-Only</td>
<td>2.57</td>
<td>3.70</td>
</tr>
<tr>
<td>Fraction Importer-Exporters</td>
<td>8.25</td>
<td>9.74</td>
</tr>
<tr>
<td>Corr. sales-imp. shares</td>
<td>0.03</td>
<td>0.06</td>
</tr>
<tr>
<td>Corr. sales-exp. shares</td>
<td>0.07</td>
<td>0.08</td>
</tr>
<tr>
<td>Corr. imp.-exp. shares</td>
<td>0.05</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Notes: The data rows depict changes in the percentiles of the distribution of import (export) shares between 1994 and the average of 1995-1999 in the Mexican manufacturing sector. The model rows depict changes in the model generated data resulting from a 20% depreciation in the real exchange rate. The correlation between firm sales and import shares is computed on the sample of importers. The correlation between firm sales and export share is computed on the sample of exporters. The correlation between import shares and export shares is computed on the sample of importers or exporters (i.e., the sample that excludes purely domestic firms). All entries are in percentage points. Source: EIA.

Table 13: Changes in Other Non-Targeted Moments

<table>
<thead>
<tr>
<th></th>
<th>Within</th>
<th>Between</th>
<th>Covariance</th>
<th>Net Entry</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model, 20% depreciation</td>
<td>-1.66</td>
<td>8.06</td>
<td>0.42</td>
<td>0.26</td>
<td>7.07</td>
</tr>
<tr>
<td>Mexico 94-99</td>
<td>-2.79</td>
<td>9.99</td>
<td>4.27</td>
<td>6.24</td>
<td>17.70</td>
</tr>
</tbody>
</table>

Notes: The Table contains the Baily et al. (1992) decomposition in (2) performed on model-generated data resulting from a 20% counterfactual real depreciation as well as on data from the Mexican manufacturing sector between 1994 and 1999. All entries are in percentage points.

Table 14: Decomposition of Import Share Growth: Model vs Data

the model generates compositional effects that are in line with the data: the between and covariance terms are both positive and jointly contribute to an increase in the aggregate import share of about 8.5 percentage points. The between component is positive whenever the firms with high import intensity initially tend to expand. The covariance term is positive whenever the firms which become more import intensive tend to be the ones that expand. Both of these effects are present in the model generated data, and have empirical support in the Mexican micro data. Finally, the contribution of net entry in the model is positive but very small. In the data, however, this is an important margin.71

Figure 8 below depicts a scatter plot of the changes in the import and export intensities associated with the 20 percent real devaluation in the model. We see that the firms that increase their export intensity tend to increase their import intensity as well, consistent with the pattern seen for Mexican manufacturing firms, reproduced in the right panel. Quantitatively, the model predicts a tighter relationship between changes in import and export shares than observed in the Mexican episode.

[GE forces] Finally, I assess the role played by general equilibrium and roundabout forces. So far, the price index of domestically produced goods and the overall level of domestic demand were allowed to adjust to satisfy the consumer budget constraint and the price index fixed-point condition in (23)-(24). In the previous quantitative exercise, both of these general equilibrium objects increased as a result of the devaluation.72 If instead they are forced to remain constant, Table

In terms of prices, this means that the same increase in the price of foreign inputs (in terms of domestic labor) results in a la

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71Recall that entry and exit are defined relative to the importing status. In the data, I cannot measure entry (exit) into (out of) the economy, as survey of Mexican manufacturing excludes small firms.

72The level of spending by domestic consumers and firms, denoted by $S$, goes up by about 16% in the exercise considered in this section.
Figure 8: Expanding Importers and Exporters in Counterfactual Devaluation: Model vs Data

### 4.2.2 Uncorrelated Importing and Exporting

This section considers a special parametrization of the model where importing and exporting are uncorrelated. The model is re-calibrated to the same moments as above except that the target correlation between import and export shares is set to zero. In this way, this section explores the effects of a devaluation when the importing and exporting activities are carried out by different firms. Table 15 contains the results of the calibration. To attain a zero correlation between importing and exporting, the model requires that the fixed costs of importing and exporting be negatively correlated ($\rho_{\tilde{f}\tilde{f}} < 0$). By assigning comparative advantage in exporting and in importing in a negatively correlated way, the model generates an effective separation of the importing and exporting activities across firms. This calibration is referred to as the uncorrelated model.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
<th>Targeted Moment</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average importing fixed cost ($\mu_{\tilde{f}M}$)</td>
<td>-0.30</td>
<td>Aggregate Import Share</td>
<td>0.36</td>
<td>0.36</td>
<td></td>
</tr>
<tr>
<td>Average exporting fixed cost ($\mu_{\tilde{f}X}$)</td>
<td>155.21</td>
<td>Aggregate Export Share</td>
<td>0.16</td>
<td>0.16</td>
<td></td>
</tr>
<tr>
<td>Fixed cost import status ($\tilde{F}_M$)</td>
<td>0.0102</td>
<td>Fraction Importers-Only</td>
<td>0.25</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>Fixed cost export status ($\tilde{F}_X$)</td>
<td>0.0113</td>
<td>Fraction Exporters-Only</td>
<td>0.07</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>Fixed cost import-export ($\tilde{F}_{XM}$)</td>
<td>0.0116</td>
<td>Fraction Importer-Exporters</td>
<td>0.17</td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td>Dispersion in efficiency ($\sigma_{\varphi}$)</td>
<td>0.59</td>
<td>Dispersion in sales</td>
<td>1.71</td>
<td>1.71</td>
<td></td>
</tr>
<tr>
<td>Dispersion in importing fixed costs ($\sigma_{\tilde{f}M}$)</td>
<td>3.20</td>
<td>Dispersion in imp. shares</td>
<td>0.27</td>
<td>0.27</td>
<td></td>
</tr>
<tr>
<td>Corr. efficiency - importing fixed cost ($\rho_{\varphi\tilde{f}M}$)</td>
<td>99.05</td>
<td>Dispersion in exp. shares</td>
<td>0.18</td>
<td>0.18</td>
<td></td>
</tr>
<tr>
<td>Corr. efficiency - exporting fixed cost ($\rho_{\varphi\tilde{f}X}$)</td>
<td>0.84</td>
<td>Corr. sales-imp. shares</td>
<td>0.27</td>
<td>0.27</td>
<td></td>
</tr>
<tr>
<td>Corr. importing - exporting fixed costs ($\rho_{\tilde{f}\tilde{f}X}$)</td>
<td>0.28</td>
<td>Corr. sales - exp. shares</td>
<td>0.15</td>
<td>0.15</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Firm sales are computed in logs. The import shares correspond to $1 - s_D$ in the text. The moments in the data, except for the correlation between import and export shares, correspond to the Mexican manufacturing sector in 1994. The correlation between import shares and export shares is counterfactually set to zero.

Table 15: Calibration of Model with Uncorrelated Importing and Exporting

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73The re-calibration entails the parameters governing firm heterogeneity, i.e., the joint distribution of efficiency and fixed costs, as well as the global status fixed costs. The value of $\theta$ is kept constant at the value of the baseline calibration of Section 4.1.3.

74Absent any correlation between the importing and exporting fixed costs, the model delivers positively correlated import and export shares. The reason is that importing and exporting are complements, as unit cost reductions and increases in revenue enter multiplicatively in the profit function.
Table 16: Effects of a Counterfactual Devaluation (Uncorrelated Model)

Notes: The Table contains the rate of growth in the aggregate import share, the aggregate export share and the consumer price index resulting from a counterfactual devaluation in the uncorrelated model and for the Mexican manufacturing sector. The figures for Mexico correspond to changes between 1994 and the average of 1995-1999. The model corresponds to the calibration of Table 15. The consumer price index is computed according to (23). All entries are in percentage points.

Tables 16-19 contain the effects of a 20% real depreciation on various model outcomes. The key finding is that the aggregate import share tends to fall by about 11%. This result follows from a widespread reduction in firm-level import shares together with a reduction in the correlation between firm size and import shares. These findings are in stark contrast to what was observed in the Mexican manufacturing sector and the predictions of the baseline model, by which the aggregate import share increases as a result of an increased correlation between firm size and import intensity. This can also be seen in Table 19 which decomposes the increase in the aggregate import share according to the methodology in Bailey et al. (1992) -see equation (2). The decrease in the aggregate import share predicted by the uncorrelated model is mostly explained by a large, negative between component. In turn, this arises whenever the firms that are ex-ante import intensive tend to grow following the devaluation.

<table>
<thead>
<tr>
<th>Rate of growth in</th>
<th>Model, 20% depreciation</th>
<th>Mexico</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate Import Share</td>
<td>-11.12</td>
<td>-12.33</td>
</tr>
<tr>
<td>Aggregate Export Share</td>
<td>42.01</td>
<td>44.19</td>
</tr>
<tr>
<td>Price Index</td>
<td>4.98</td>
<td>5.61</td>
</tr>
</tbody>
</table>

Table 17: Changes in Distribution of Import and Export Shares (Uncorrelated Model)

Notes: The data rows depict changes in the percentiles of the distribution of import shares (first panel) and export shares (second panel) between 1994 and the average of 1995-99 in the Mexican manufacturing sector. For the data, the figures are constructed as the difference between the average percentile in the 1995-99 period and the percentile in 1994. The model rows depict changes in the model generated data resulting from a 20% depreciation of the real exchange rate. All entries are in percentage points. Source: EIA.
## Change in... Model, Constant $T$ Model, Adjusted $T$ Data

<table>
<thead>
<tr>
<th>Change in...</th>
<th>Model, Constant $T$</th>
<th>Model, Adjusted $T$</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fraction Importers-Only</td>
<td>-0.75</td>
<td>-1.04</td>
<td>-7.05</td>
</tr>
<tr>
<td>Fraction Exporters-Only</td>
<td>1.62</td>
<td>1.62</td>
<td>3.70</td>
</tr>
<tr>
<td>Fraction Importer-Exporters</td>
<td>7.00</td>
<td>6.66</td>
<td>9.74</td>
</tr>
<tr>
<td>Corr. sales-imp. shares</td>
<td>-0.01</td>
<td>-0.01</td>
<td>0.06</td>
</tr>
<tr>
<td>Corr. sales-exp. shares</td>
<td>0.06</td>
<td>0.06</td>
<td>0.08</td>
</tr>
<tr>
<td>Corr. imp.-exp. shares</td>
<td>0.04</td>
<td>0.04</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Notes: The data rows depict changes in the percentiles of the distribution of import (export) shares between 1994 and the average of 1995-1999 in the Mexican manufacturing sector. The model rows depict changes in the model generated data resulting from a 20% depreciation in the real exchange rate. The correlation between firm sales and import shares is computed on the sample of importers. The correlation between firm sales and export share is computed on the sample of exporters. The correlation between import shares and export shares is computed on the sample of importers or exporters (i.e., the sample that excludes purely domestic firms). All entries are in percentage points. Source: EIA.

### Table 18: Changes in Other Non-Targeted Moments (Uncorrelated Model)

<table>
<thead>
<tr>
<th>Model, 20% depreciation, Uncorrelated</th>
<th>Within</th>
<th>Between</th>
<th>Covariance</th>
<th>Net Entry</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mexico 94-99</td>
<td>-0.92</td>
<td>-10.65</td>
<td>0.14</td>
<td>0.26</td>
<td>-11.18</td>
</tr>
<tr>
<td></td>
<td>-2.79</td>
<td>9.99</td>
<td>4.27</td>
<td>6.24</td>
<td>17.70</td>
</tr>
</tbody>
</table>

Notes: The Table contains the Baily et al. (1992) decomposition in (2) performed on model-generated data of counterfactual devaluations. All entries are in percentage points.

### Table 19: Uncorrelated Model: Decomposition of Increase in Import Share
Notes: The Figures depict the effects of a 20% increase in foreign prices for models that are calibrated to the moments in Section 4.1.1 except that the (pre-devaluation) correlation between import and export shares is set to one of the following values: 0.05, 0.10, 0.15, 0.18 and 0.20. The upper left panel shows the growth in the aggregate import share (in percentage points). The upper right panel shows the between component (measured in percentage points) resulting from the decomposition of the aggregate import share growth given in (2). The bottom left panel shows the difference in the coefficient of correlation between import and export shares resulting from the devaluation, i.e., the correlation post-devaluation minus the correlation pre-devaluation. In every period, this correlation is computed on the sample of importers or exporters (i.e., the sample that excludes purely domestic firms). The bottom right panel depicts the rate of growth in the consumer price index (in percentage points) computed using (23).

Figure 9: Targeting Different Pre-Devaluation Correlations of Import and Export Shares

4.2.3 A Model of Importing

In this section, I compare the baseline model to the standard model of importing considered in the literature. In particular, I consider the special case of the baseline framework in Section 3 where the costs of exporting are prohibitively large, i.e., $F_X \to +\infty$, $F_{XM} \to +\infty$, $f_{Xi} \to +\infty$ for all firms, so that no firm chooses to export.\textsuperscript{75} In this case, the model reduces to a framework of firm-level importing akin to the ones considered in the literature - e.g. Gopinath and Neiman (2014); Halpern et al. (2015); Ramanarayanan (2014); Blaum et al. (2018b).\textsuperscript{76}

The model of importing is recalibrated to a subset of the moments targeted in the baseline case above. These are moments of the joint distribution of firm sales and import shares, namely: (i) the aggregate import share, (ii) the dispersions of firm sales and import intensities, (iii) their correlation, and the fractions of

\textsuperscript{75}In practice, by setting the global status fixed costs $F_X$ and $F_{XM}$ to sufficiently large values, the values of the per-country exporting fixed costs $f_X$ are irrelevant. Thus, $\sigma_{f_X}$, $\rho_{f_X}$ and $\rho_{f}$ are unspecified in the model of importing-only.

\textsuperscript{76}In the models of Gopinath and Neiman (2014) and Ramanarayanan (2014), firms differ only in their efficiency $\varphi_i$. This corresponds to a further special case of the model considered in this section where the fixed costs of importing are common across firms, i.e., $\sigma_{f_M} = \rho_{f_M} = 0$. If, in addition, all fixed costs are assumed to be zero, i.e., $F_M = f_i = 0$, the model reduces to a model without firm heterogeneity such as Costinot and Rodríguez-Clare (2014).
### Table 20: Model with Importing: Calibration to Mexican Data

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Targeted Moment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average importing fixed cost ((\mu_f))</td>
<td>1.659</td>
<td>Aggregate Import Share</td>
</tr>
<tr>
<td>Fixed cost import status ((\bar{F}_M))</td>
<td>0.112</td>
<td>Fraction Importers</td>
</tr>
<tr>
<td>Dispersion in efficiency ((\sigma_{\varphi}))</td>
<td>0.636</td>
<td>Dispersion sales</td>
</tr>
<tr>
<td>Dispersion in importing fixed costs ((\sigma_f))</td>
<td>3.678</td>
<td>Dispersion imp. shares</td>
</tr>
<tr>
<td>Corr. efficiency - importing fixed cost ((\rho_{\varphi f}))</td>
<td>0.896</td>
<td>Corr. sales-imp. shares</td>
</tr>
</tbody>
</table>

Notes: The dispersion in value added is the standard deviation of the log of value added. The dispersion in import shares is the standard deviation of import shares. The correlation of value added and import shares is the coefficient of correlation between log value added and import shares (in levels). To compute the fraction of importers, all firms engaged in importing are considered, regardless of their export status.

Table 20 contains the results. The model is able to perfectly match all moments.

The moments are matched by choosing the parameters governing the joint distribution of firm efficiency and fixed costs of importing \((\mu_f, \sigma_{\varphi}^2, \sigma_f^2, \rho_{\varphi f})\) and the fixed cost to being an importer \(\bar{F}_M\). Table 20 contains the results. The model is able to perfectly match all moments.

Table 21 contains the effect of a 20% counterfactual real depreciation on the aggregate import share and the price index. I consider two exercises. In the first (reported in the first column), the transfers are kept unchanged and hence the deficit is allowed to change with the devaluation. In the second (reported in the second column), the level of transfers is adjusted to generate a change in the trade deficit equal to the one generated by the baseline model. Across all scenarios, the aggregate import share falls sharply: by about 15% when transfers are kept constant and by 37% when they are adjusted. The price index of domestically produced goods increases by 7.89% and about 17%, respectively. Recall that the price index increase was 4.9% in the baseline model with importing-exporting. It follows that the model of importing-only predict a large aggregate elasticity of substitution and tends to over-predict the increase in the price index relative to the baseline model.

<table>
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<tr>
<th>Rate of growth in ...</th>
<th>Model (20% depreciation)</th>
<th>Mexico</th>
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<tbody>
<tr>
<td>Aggregate Import Share</td>
<td>-14.97</td>
<td>-36.88</td>
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<tr>
<td>Price Index</td>
<td>7.89</td>
<td>19.53</td>
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</table>

Notes: The table depicts changes in the aggregate imported input share and the price index of domestically produced goods resulting from the devaluation. The data rows contains changes between 1994 and the average of 1995-1999 in the Mexican manufacturing sector. The model rows depict changes in the model generated data resulting from a 20% depreciation in the real exchange rate. All entries are growth rates expressed in percentage points. Source: EIA.

### Table 21: Effects of a Counterfactual Devaluation: Model of Importing

77 This calibration approach follows closely Blaum et al. (2018b).

78 Recall that changes in the trade deficit reflect changes in the gap between labor supply and demand in the manufacturing sector.

79 In the first exercise, transfers are set to zero in both periods. The trade deficit as a share of absorption is reduced by 6 percentage points. In the second exercise, the post-devaluation level of transfers is reduced to induce a reduction in the trade balance as a share of absorption of 9.08 percentage points, which is exactly the change generated by the baseline model of Section 4.2.1. See Tables xx and 31 in the Appendix.

80 In levels, the aggregate import share falls from 0.36 to 0.23 when transfers are adjusted.
Table 22: Model of Importing: Other Non-Targeted Moments

Table 4.2.3 shows that the model of importing performs poorly in two additional moments. It predicts that the fraction of importers, and the correlation between firm size and import shares, should both fall after the devaluation. These results are intuitive, as in model with only importing an increase in the cost of foreign inputs discourages importing. In contrast, the Mexican devaluation resulted in an increase in both moments.

<table>
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<td>Fraction Importers</td>
<td>-0.38</td>
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<tr>
<td>Corr. sales-imp. shares</td>
<td>-0.03</td>
<td>-0.03</td>
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Notes: The table depicts changes in the fraction of importers and the correlation between firm size and import shares resulting from the devaluation. The data rows contains changes between 1994 and the average of 1995-1999 in the Mexican manufacturing sector. The model rows depict changes in the model generated data resulting from a 20% depreciation in the real exchange rate. The set of importers includes all firms engaging in importing activity regardless of their export status. The entries for the fraction of importers are in percentage points. The entries for the correlation between firm sales and import shares are differences in the coefficient of correlation before and after the devaluation. Source: EIA.

Table 23: Models of Importing-Only: Decomposition of Increase in Import Share

To uncover the mechanics of the importing-only model, I decompose the change in the aggregate import share following the methodology in (2). Table 23 contains the results. We see that the model with importing-only is consistent with the within-firm decrease in import intensity observed in the data - see the negative within component. However, the model predicts reallocations that are inconsistent with the data. In particular, it predicts that firms that are initially import intensive tend to contract, as evidenced by the negative between component, a feature that is at odds with the Mexican data. Because initially import intensive firms are on average more productive, this pattern of reallocation explains why the model predicts a large impact of the devaluation on the consumer price index.\(^81\)

The pattern of reallocation of the model can also be seen graphically. To illustrate the importance of the between effect, Figure 10 depicts the changes in firm size by quartile of initial import intensity. More precisely, for each quartile of initial import intensity, the figure depicts the 25th, 50th and 75th percentiles of the distribution of growth in the material share \(m_i\). In the model with importing-only, depicted in the upper left panel, there is a stark pattern of reallocation: firms with initially high import intensity lose market share, while those with low initial import intensity expand. Intuitively, the initial import intensity measures the degree of exposure of the firm to the cost shock induced by the devaluation.

In contrast, the pattern of reallocation in the model with importing-exporting is more nuanced, as seen in the upper right panel of Figure 10. While there is a tendency for the median and 25th percentile growth rate to decrease with initial import intensity, there is much more heterogeneity, with some firms growing and some contracting within each quartile of initial import intensity.\(^82\) Finally, the bottom panel of Figure 10 depicts the pattern of reallocation in the Mexican data for the 1994-1999 period. The data displays a much

\(^81\) Finally, we note that, like the model with importing-exporting, the model of importing-only predicts a role of net entry that is much smaller that in the data.

\(^82\) In fact, note that, within the highest quartile of initial import intensity, the 75th percentile of firm growth is positive.
Notes: Each panel depicts the growth rate in firm size, measured as $(m_{i,t} - m_{i,1})/m_{i,1} \times 100$ where $m_{i,t}$ is the share of firm $i$ in total industry materials in period $t$, by quartile of initial import intensity $s_{i1}$. The vertical edges of the each box correspond to the 25th and 75th percentile of firm growth. The red line inside the box represents the median. The points outside the box represent outliers, defined as any observation greater than the 75th percentile or smaller than the 25th. The upper panels depict data generated by a 20 percent counterfactual devaluation in the model with importing-only (left panel) and importing-exporting (right panel). The bottom panel corresponds to the Mexican data between 1994-1999.

Figure 10: Pattern of reallocation: Models vs Data

A stronger degree of heterogeneity, with a positive 75th percentile and a negative 25th percentile growth rate in all quartiles. We conclude the pattern of reallocation in the model with importing-exporting is closer to the pattern seen in the data than the one generated by the importing only model.

5 Conclusions

International input sourcing decisions have significant effects on firm and aggregate productivity. When the real exchange rate changes, firms’ importing responses are therefore important to understand how aggregate productivity is affected. At the same time, the real exchange rate is an important determinant of firms’ decisions to sell abroad vs. domestically. In this paper, I have argued that these two phenomena cannot be studied separately. Firms’ international sourcing and exporting strategies are intimately linked, as the benefits from importing are larger when the firm exports and vice versa. Focusing on the case of large devaluations, I have argued that incorporating this complementarity into the analysis significantly affects our understanding of the effect of large crises on aggregate productivity.

The starting point of the analysis is the realization that the aggregate import intensity tends to increase after large real depreciations. I have documented this fact in a sample of ten recent events of large devaluations in emerging market economies. This fact cannot be reconciled with standard theories of importing, which typically feature large estimates of the elasticity of substitution between domestic and foreign inputs. Using micro data for the cases of Mexico and Indonesia, I have shown that the increase in the aggregate import intensity is accounted by the expansion and entry of import-intensive firms, which tend to be expanding.
exporters.

I have proposed a theory of joint importing-exporting where foreign inputs are a vehicle to reduce unit costs and exporting is a means to expand demand. A complementarity between both international activities arises naturally as profits are multiplicative in unit costs and the size of demand. I allow for multiple sources of firm heterogeneity (efficiency, fixed costs of importing and exporting) and calibrate the model to salient moments of the joint distribution of import and export intensities in the Mexican pre-devaluation economy. I also consider a version of the model where firms do not have an exporting decision, as in the literature. In the model without exporting, the devaluation generates an increase in the consumer price index that is larger than the one predicted by the model with importing-exporting. This suggests that accounting for firms’ joint importing-exporting behavior is important to understand the aggregate consequences of changes in the real exchange rate.

References


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Table 24: Countries in OECD Input Output Tables

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6 Appendix

6.1 Additional Figures and Tables

Notes: The Figure depicts the rate of growth of an index of import volume (left axis) and of real GDP (right axis) between a given quarter and the quarter before the devaluation (labeled -1). The quarter of the devaluation is labeled 0. Data for the volume of imports is available only for Argentina, Brazil, Korea, Thailand and Turkey. The import volume index is the ratio of the import value index to the unit value index. A log-linear trend was removed from the real output series, as well as the import volume series. The trend was calculated for each country using the full sample starting in 1960. Source: IFS and UNCTAD.

Figure 11: Import Volume and Real GDP after a Large Devaluation
Notes: The Figure depicts the rate of growth in the ratio of imported inputs to total (imported plus domestic) inputs between a given year and the year before the devaluation (labeled -1). The year of the devaluation is labeled 0. Source: WIOD.

Figure 12: Aggregate Import Share After Devaluations, By Country, Recent Events

Notes: The Figure depicts the rate of growth in the ratio of imported inputs to total (imported plus domestic) inputs between a given year and the year before the devaluation (labeled -1). The year of the devaluation is labeled 0. Source: OECD.

Figure 13: Aggregate Import Share After Devaluations, By Country (ctd), Recent Events
Figure 14: Aggregate Imported Input Share, By Country, Large Sample

Figure 20: Imports to GDP Ratio After Large Devaluations, By Country
Figure 15: Aggregate Imported Input Share, By Country, Large Sample

Figure 16: Aggregate Imported Input Share, By Country, Large Sample
Figure 17: Aggregate Imported Input Share, By Country, Large Sample

Figure 18: Aggregate Imported Input Share, By Country, Large Sample
Notes: The blue line is the rate of growth in the aggregate imported input share between a given year and the year before the devaluation (labeled -1). The year of the devaluation is labeled 0. The red line depicts the rate of growth in the real exchange rate. The lines in the Figure are averages of the experiences of the episodes in Table 1. The dashed lines give standard errors of the corresponding average (i.e. the standard deviation divided by the square root of the sample size). Sources: Johnson and Noguera (2016), IFS.

Figure 19: Output and TFP After Large Devaluation, Extended Sample
Figure 22: Imports to GDP Ratio, Uruguay

Figure 23: The Aggregate Import Share After a Large Devaluation: Manufacturing Sector

Notes: The Figure depicts the rate of growth in the ratio of imported inputs to total (imported plus domestic) inputs in the Manufacturing sector between a given year and the year before the devaluation (labeled -1). The year of the devaluation is labeled 0. The lines in the Figure are an average of the experiences of Brazil 1998, Indonesia 1998, Korea 1997, Russia 1998 and Turkey 2001. Source: WIOD.
Notes: The Figure depicts the average ad valorem tariff rate (in percentage points) in the sample of countries of Table 2. The tariff rate is the effectively applied rate (i.e. the lowest available tariff) for non-agricultural products. “Simple Avg. Tariff” denotes that products are averaged with a simple average for each country. “Wght. Avg. Tariff” denotes an import-value weighted average across products for each country. The year of the devaluation is labeled 0. Source: WITS-TRAITS.

Figure 24: Tariffs After Devaluations

Notes: The Figure depicts the average ad valorem tariff rate (in percentage points) in the sample of countries of Table 2. The tariff rate is the effectively applied rate (i.e. the lowest available tariff) for non-agricultural products. “Simple Avg. Tariff” denotes that products are averaged with a simple average for each country. “Wght. Avg. Tariff” denotes an import-value weighted average across products for each country. The year of the devaluation is labeled 0. Source: World Development Indicators.

Figure 25: Tariffs After Devaluations, By Country
Notes: The Figure depicts the average ad valorem tariff rate (in percentage points) in the sample of countries of Table 2. The tariff rate is the effectively applied rate (i.e., the lowest available tariff) for non-agricultural products. “Simple Avg. Tariff” denotes that products are averaged with a simple average for each country. “Wght. Avg. Tariff” denotes an import-value weighted average across products for each country. The year of the devaluation is labeled 0. Source: World Development Indicators.

Figure 26: Tariffs After Devaluations, By Country (ctd)
Notes: The Figure depicts the average ad valorem tariff rate (in percentage points) in the sample of countries of Table 2. For each country, the tariff rates is a simple average of the effectively applied rates for all products. The year of the devaluation is labeled 0. Source: World Development Indicators.

Figure 27: Aggregate Imported Input Share: Long Pre-Devaluation Period
Notes: The blue line is the rate of growth in the ratio of total imports to GDP between a given quarter and the quarter before the devaluation (labeled -1). The quarter of the devaluation is labeled 0. The red line depicts the rate of growth in the real exchange rate. The lines in the Figure are averages of the experiences of Argentina in 2001, Brazil 1998, Colombia 1998, Indonesia 1998, Korea 1997, Malaysia 1997, Mexico 1994, Russia 1998, Thailand 1997 and Turkey 2001. Source: IFS.

Figure 28: Imports-to-GDP ratio After a Large Devaluation

Notes: The blue line is the rate of growth in the aggregate imported input share between a given year and the year before the devaluation (labeled -1). The year of the devaluation was 1999 and is labeled 0. The red line depicts the rate of growth in the real exchange rate. Sources: Johnson and Noguera (2016), IFS.

Figure 29: Aggregate Imported Input Share After Brazilian Devaluation
Notes: The blue line is the rate of growth in the aggregate imported input share between a given year and the year before the financial crisis (i.e., 2007, labeled -1). The year of the financial crisis was 2008 and is labeled 0. The graph depicts the average experience of Austria, Belgium, Denmark, France, Germany, Greece, Hungary, Ireland, Latvia, Luxembourg, Netherlands, Portugal, Russia, Slovenia, Spain, Sweden. Source: WIOD.

Figure 30: Aggregate Imported Input Share After Financial Crisis of 2008

Notes: The Figure shows the rate of growth in the ratio of total imported materials to total materials (imported plus domestic) between a given year and 1997 (labeled -1) for the Manufacturing sector in Indonesia. Source: Survey of Manufacturing, SI.

Figure 31: The Aggregate Import Share in Manufacturing after the Indonesian Devaluation
Table 26: Imports-to-GDP ratio after Large Devaluations

Notes: The dependent variable is the log of the imports-to-GDP ratio. The sample contains the ten country episodes listed in Table 2 and data for eight quarters before and twenty quarters after the devaluation. Data for imports of goods and services, nominal GDP and the real exchange rate (RER) is from IFS. RER is the real effective exchange rate index (with lower values associated with a depreciated currency). The measure of tariffs (τ) is from WDI and corresponds to a weighted average across all products of applied tariff rates, at the yearly frequency. Robust standard errors in parenthesis with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels.

6.2 Construction of aggregate TFP

In this section, I provide details on the construction of the aggregate total factor productivity measure used in Figure xx. I will use the subscript i to refer to countries and t to time throughout. Let $x_{it} \in \{L_t, K_t\}$ be the primary factors of production and $y_{it}$ denote real GDP in country $i$. Let $\kappa_{x, it}$ be the share of input $x$ in country $i$ total factor use - for example, $\kappa_{L, it}$ refers to total labor compensation in country $i$ divided by the sum of total labor and capital compensations. I measure the growth in TFP, denoted by $z_{it}$, by estimating:

Consider the following equation:
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Table 27: Episodes of Banking, Currency and Sovereign Debt Crises

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Table 28: Episodes of Currency Crises Without Banking Crises
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Table 29: Change in Import Share: Sector Level Decomposition

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<td>5.60</td>
<td>0.00</td>
<td>-0.19</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Table 30: Sector Level Decomposition, Within and Between Component

Notes: The first two columns display the within component in, while the last two columns display the between component. Source: Mexican Survey of Manufacturing.

<table>
<thead>
<tr>
<th>Increase in RER of 20%</th>
<th>Importing-Exporting</th>
<th>Importing-Only</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exports / Absorption</td>
<td>16.01</td>
<td>28.78</td>
<td>-</td>
</tr>
<tr>
<td>Imports / Absorption</td>
<td>16.15</td>
<td>19.01</td>
<td>22.19</td>
</tr>
<tr>
<td>Trade Balance / Absorption</td>
<td>-0.14</td>
<td>9.77</td>
<td>-22.19</td>
</tr>
<tr>
<td>Difference</td>
<td>9.91</td>
<td>6.32</td>
<td></td>
</tr>
</tbody>
</table>

Notes: The Table depicts the changes in exports, imports and the trade deficit as a percentage of domestic absorption resulting from the devaluation. Absorption is computed as total manufacturing sales minus total exports plus total imports. The first two columns correspond to a 20% real depreciation in the calibrated model with importing-exporting. The third and fourth columns correspond to a similar depreciation in the model with importing-only. The last two columns correspond to the Mexican data. All values are in percentage points.

Table 31: Trade Deficit: Baseline Model and Data

<table>
<thead>
<tr>
<th>Increase in RER of 20%</th>
<th>Importing-Exporting</th>
<th>Un correlated Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td>Exports / Absorption</td>
<td>16.01</td>
<td>28.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imports / Absorption</td>
<td>16.15</td>
<td>19.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trade Balance / Absorption</td>
<td>-0.14</td>
<td>9.77</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>9.91</td>
<td>9.25</td>
</tr>
</tbody>
</table>

Notes: The Table depicts the changes in exports, imports and the trade deficit as a percentage of domestic absorption resulting from a 20% real devaluation for different models. Absorption is computed as total manufacturing sales minus total exports plus total imports. The first two columns correspond to the baseline calibrated model of Section 4.2.1. The rest of the columns consider the calibrated model of importing-only of Section 4.2.3. The third and fourth columns correspond to the case where transfers are set to zero in both periods. Columns 5-6 correspond to the case where the post-devaluation tariffs are adjusted to attain a change in the ratio of trade balance over absorption as in the baseline model. All values are in percentage points.

Table 32: Trade Deficit: Uncorrelated Model
<table>
<thead>
<tr>
<th>Increase in RER of 20%</th>
<th>Importing-Exporting</th>
<th>Importing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td>Exports / Absorption</td>
<td>16.01</td>
<td>28.78</td>
</tr>
<tr>
<td>Imports / Absorption</td>
<td>16.15</td>
<td>19.01</td>
</tr>
<tr>
<td>Trade Balance / Absorption</td>
<td>-0.14</td>
<td>9.77</td>
</tr>
</tbody>
</table>

Table 33: Trade Deficit: Model of Importing

\[
\log \left[ \frac{y_{i,t}}{y_{i,t-1}} \right] = \gamma_i + \beta \sum_{x \in \{K,L\}} \frac{1}{2} \left( \kappa_{i,t}^x + \kappa_{i,t-1}^x \right) \left( \log \frac{x_{i,t}}{x_{i,t-1}} \right) + \log \left( \frac{z_{i,t}}{z_{i,t-1}} \right)
\]

at the country-level. Here \( \gamma_i \) captures a trend in TFP growth and \( \beta \) captures departures from constant returns to scale. I employ data for all variables from Penn World Tables. For capital \( K \), I use the value of the capital stock at constant national prices. I construct labor \( L \) by multiplying the total number of employees by the average number of hours and by the human capital index. Including the number of hours into the measure of labor helps address the concern of labor hoarding - see e.g. Meza and Quintin (2007). I use the labor share provided in Penn World Tables, and compute the capital share as the residual. For each country, I normalize TFP to unity in the initial period and compute

\[
TFP_{i,t+1} = \left[ 1 + \log \left( \frac{z_{i,t}}{z_{i,t-1}} \right) \right] TFP_{i,t}.
\]

6.3 Derivations for Firm’s Problem

**Domestic share - mass of countries relationship.** Standard calculations with CES production functions imply that the expenditure share on domestic materials is

\[
s_D = \frac{p_D z_D}{p_D z_D + m_I} = \frac{\beta \psi (p_D/q_D)^{1-\varepsilon}}{\beta \psi (p_D/q_D)^{1-\varepsilon} + (1-\beta)^{\psi} e^{1-\varepsilon} A(\Sigma)^{1-\varepsilon} \varepsilon} = Q(\Sigma; e)^{\psi-1} \beta \psi (p_D/q_D)^{1-\varepsilon},
\]

where \( Q(\cdot) \) is the price index of materials defined in (12) above. Equation (26) implies a relationship between \( Q(\cdot) \) and \( s_D \) which, when plugged into (11), delivers the expression for the unit cost given by (14) above. In addition, using the expression for \( A(\cdot) \) as a function of \( n \) given by (13), equation (26) implies the following relationship between \( s_D \) and \( n \):

\[
s_D = \left( 1 + \left( \frac{1-\beta}{\beta} \right)^{\varepsilon} e^{1-\varepsilon} (p_D/q_D)^{\varepsilon-1} z^{1-\varepsilon} n^{\psi(\varepsilon-1)} \right)^{-1}.
\]
Firm profits. This section derives the expression in (19). Consider the strategy of importing-exporting. Combining the expressions in (16) and (18), firm profits can be expressed as:

$$\Pi_{XM} = \pi_D + \pi_X - fn - F_{XM}$$

$$= \sigma^{-\sigma} (\sigma - 1)^{-\sigma - 1} u_i^{-1} \sigma \theta^{-\sigma} (\sigma - 1)^{\theta(\sigma - 1)} \left(1 + \tau\right)^{-\theta(\sigma - 1)} u_i^{-\theta(\sigma - 1)} f_X^{1-\theta} - fn - F_{XM}$$

Since the unit cost and the mass of imported countries \(n\) are both linked to the domestic share via (14) and (27), this expression becomes

$$\Pi_{XM} = \sigma^{-\sigma} (\sigma - 1)^{-\sigma - 1} \left(\frac{1}{1 - \gamma}\right)^{(1-\gamma)(\sigma - 1)} \left(\frac{p_D}{\gamma \beta D q_D}\right)^{\gamma(\sigma - 1)} \varphi^{-1} \sigma^{-1} \pi^{s} \theta^{-\sigma} f_D^{-1} P^{\sigma - 1} S_D$$

$$+ \frac{1}{\theta - 1} \frac{\beta}{\beta - 1} \theta^{-\sigma} (\sigma - 1)^{\theta(\sigma - 1)} \left(\frac{1}{1 - \gamma}\right)^{-\theta(\sigma - 1)(1-\gamma)} \left(\frac{p_D}{\gamma \beta D q_D}\right)^{-\theta(\sigma - 1)\gamma} \left(1 + \tau\right)^{-\theta(\sigma - 1)} \varphi^{\theta(\sigma - 1)} s_{Di}^{-\theta(\sigma - 1)} f_X^{1-\theta}$$

$$- f \left(\frac{\beta}{1 - \beta}\right)^{\sigma / (\sigma - 1)} \left(\frac{q_D}{p_D}\right)^{\gamma} \frac{1}{\theta} \frac{1}{\gamma} \left(s_D^{-1} - 1\right)^{\frac{1}{\sigma - 1}} - F_{XM}.$$

This expression can be written as

$$\tilde{\Pi}_{XM} \equiv \frac{\Pi_{XM}}{\sigma^{-\sigma} (\sigma - 1)^{-\sigma - 1} \left(\frac{1}{1 - \gamma}\right)^{(1-\gamma)(\sigma - 1)} \left(\frac{p_D}{\gamma \beta D q_D}\right)^{\gamma(\sigma - 1)} \varphi^{-1} \sigma^{-1} \pi^{s} \theta^{-\sigma} f_D^{-1} P^{\sigma - 1} S_D} = \beta^{-\sigma} \gamma^{\sigma} (\sigma - 1) \varphi^{-1} \sigma^{-1} s_{Di}^{-\sigma} f_{Di}^{1-\sigma} (\sigma - 1)$$

$$+ f^{1-\theta} f_X^{1-\theta} \left(\frac{\beta}{1 - \beta}\right)^{\sigma / (\sigma - 1)} \left(\frac{q_D}{p_D}\right)^{\gamma} \frac{1}{\theta} \frac{1}{\gamma} \left(s_D^{-1} - 1\right)^{\frac{1}{\sigma - 1}} - F_{XM},$$

where \(\bar{f}, \bar{f}_X\) and \(\bar{F}_{XM}\) are given by

$$\bar{f} \equiv \frac{1}{\gamma \eta} \left(\frac{1}{1 - \gamma}\right)^{(1-\gamma)(\sigma - 1)} \left(\frac{p_D}{\gamma q_D}\right)^{\gamma(\sigma - 1)} \left(\frac{p_D}{\gamma D q_D}\right)^{\gamma(\sigma - 1)} \left(\frac{q_D}{p_D}\right)^{\gamma} \frac{1}{\theta} \frac{1}{\gamma} f_{Di}^{1-\sigma} P^{1-\sigma} S^{-1}$$

$$\bar{f}_X^{1-\theta} \equiv P^{(1-\sigma)} S^{-1} \left(\frac{\theta - 1}{\theta - 1}\right) \frac{\beta}{\beta - 1} \theta^{-\sigma} (\sigma - 1)^{\theta(\sigma - 1)(1-\gamma)} \left(\frac{1}{1 - \gamma}\right)^{(\sigma - 1)(1-\gamma)(1-\gamma)} \left(\frac{p_D}{\gamma D q_D}\right)^{(\sigma - 1)(1-\gamma)} \left(\frac{p_D}{\gamma q_D}\right)^{(\sigma - 1)(1-\gamma)} \left(1 + \tau\right)^{-\delta(\sigma - 1)} f_X^{1-\theta}$$

$$\bar{F}_{XM} \equiv \sigma^{\sigma} (\sigma - 1)^{-\sigma} \left(\frac{1}{1 - \gamma}\right)^{\gamma(\sigma - 1)} \left(\frac{p_D}{\gamma D q_D}\right)^{\gamma(\sigma - 1)} P^{1-\sigma} S^{-1} F_{XM}.$$
6.4 Calibration Strategy

I follow Blaum et al. (2018b) and adopt a strategy to bypass the computation of the general equilibrium variables within the calibration. This strategy allows for a fast calibration of the model. The approach consists of two steps.

**Step 1. Choose efficiency and re-scaled fixed costs to match moments.**

**Step 1a. Solve the firms’ problem given re-scaled fixed costs.** Note first that, given firm efficiency $\varphi_i$ and the re-scaled fixed costs $\tilde{f}_i, \tilde{F}_{X, \text{M}}, \tilde{F}_X$ defined in (29)-(31), the firms’ problem can be solved without knowledge of the general equilibrium variables, $S$ and $P$. This follows from expressions (19) and (20). Thus, the distribution of domestic and export shares $(s_{Di}, s_{Xi})$ can be obtained.

**Step 1b. All targeted moments can be obtained from $(s_{Di}, s_{Xi})$**. Note next that, after solving the firms’ problem, all of the targeted moments listed in Section 4.1.1 can be computed. Consider the aggregate import share, which is given by

$${s}_{I, \text{AGG}} \equiv \int_{i} \frac{\text{mat}_i}{\text{mat}_i} \times (1 - s_{Di}) \, di = \frac{\int_{i} \omega_i \times (1 - s_{Di}) \, di}{\int_{i} \omega_i \times (1 - s_{Di}) \, di} ,$$

where $\text{mat}_i$ are materials of firm $i$ and $\omega_i$ is the firm’s share in total materials. We can use revenue to compute $\omega_i$ as materials are proportional to revenue. Domestic and foreign revenue is given by

$$R_{Di} = \kappa_1 \varphi_i^{-1} s_{Di}^{-(\sigma-1)\frac{\gamma}{\sigma}} p^{(\sigma-1)(1-\gamma)} s \quad \text{and} \quad R_{Xi} = \kappa_1 \varphi_i^{-1} s_{Di}^{-(\sigma-1)\frac{\gamma}{\sigma}} p^{(\sigma-1)(1-\gamma)} s$$

where $\kappa_1$ is a composite of parameters defined in (37) below. Total firm revenue is therefore

$$R_i = \kappa_1 \varphi_i^{-1} s_{Di}^{-(\sigma-1)\frac{\gamma}{\sigma}} \left( \frac{1}{1 - s_{Xi}} \right) p^{(\sigma-1)(1-\gamma)} s . \quad (32)$$

Note that revenue can be obtained, up to a general equilibrium constant, from $(s_{Di}, s_{Xi})$. Hence the material shares can be computed as

$$\omega_i = \frac{R_i}{\int R_i \, di} = \frac{\varphi_i^{-1} s_{Di}^{-(\sigma-1)\frac{\gamma}{\sigma}} \left( \frac{1}{1 - s_{Xi}} \right)}{\int \varphi_i^{-1} s_{Di}^{-(\sigma-1)\frac{\gamma}{\sigma}} \left( \frac{1}{1 - s_{Xi}} \right) \, di} .$$

It follows that the distribution of material shares $[\omega_i]$, and hence the aggregate import share, can be computed from the distribution of firm efficiency and domestic and export shares $[\varphi_i, s_{Di}, s_{Xi}]$. Similarly, the aggregate export share can be computed from the same data.

---

83More precisely,

$$\text{mat}_i = \gamma u_i y_i = \gamma \frac{1}{\sigma} R_i .$$

84In particular, the aggregate export shares is given by

$${s}_{X, \text{AGG}} \equiv \frac{\int R_{Xi} \, di}{\int R_i \, di} = \frac{\int \varphi_i^{-1} s_{Di}^{-(\sigma-1)\frac{\gamma}{\sigma}} \left( \frac{1}{1 - s_{Xi}} \right) \, di}{\int \varphi_i^{-1} s_{Di}^{-(\sigma-1)\frac{\gamma}{\sigma}} \left( \frac{1}{1 - s_{Xi}} \right) \, di} .$$
from \((s_{Di}, s_{Xi})\). Finally, note that while the level of sales \(R_i\) depends on \(S, P\) - as seen in (32) - the dispersion of log sales, \(\log(R_i)\), as well as its correlation with import and export shares, does not. To sum up, the targeted moments listed in Section 4.1.1 depend on the general equilibrium variables \(S, P\) only via \((s_{Di}, s_{Xi})\), and not directly.

**Step 1c. Calibrate the model.** It follows from the previous two steps that the model can be calibrated to the moments listed in Section 4.1.1 by choosing the distribution of firm efficiency and re-scaled fixed costs \((\tilde{\varphi}, \tilde{f}, \tilde{f}_{Xi}, \tilde{F}_{XM}, \tilde{F}_M, \tilde{F}_X)\). The computation of \(S, P\) is not required.

**Step 2. Compute \(S\) and \(P\).** The second step consists of computing \(S\) and \(P\) after the model was calibrated. \(P\) is computed with the distribution of \(\varphi;\) and \(s_{Di}\) using (23). Aggregate spending \(S\) is computed with the distribution of \(\varphi, s_{Di}, s_{Xi}\) as well as all re-scaled fixed costs from (??) in Section 6.5 below, which contains all derivations.

### 6.5 Equilibrium Characterization

In this Section, we provide a characterization of the equilibrium of the model and in doing so provide a proof of Proposition 1 in the main text.\(^{55}\) Solving for the general equilibrium boils down to finding \(P/w\) and \(S/w\) - recall that \(e/w\) is exogenously given. I consider a two-step approach to characterize the equilibrium. First, given data on domestic and export shares \((s_{Di}, s_{Xi})\), I provide conditions that characterize \(P/w\) and \(S/w\). Then, the equilibrium \(S/w\) and \(P/w\) need to be such that they generate the firm-level data on \((s_{Di}, s_{Xi})\) via the firms’ problem in Section 3.2.\(^{86}\)

This two-step characterization is particularly convenient given the calibration strategy outlined in Section 6.4. There, we showed that we can calibrate the model to moments of the distribution of \((s_{Di}, s_{Xi})\) without knowledge of \((S, P)\). Now, in Step 1 below, we find the levels of \((S, P)\) that are consistent with equilibrium in goods markets given the \((s_{Di}, s_{Xi})\) data. We can therefore use these expressions for \(S, P\) after calibrating the model to find the general equilibrium of the model. Step 2 of the characterization is ensured by the calibration approach.

**Step 1. Find \(S\) and \(P\) given \((s_{Di}, s_{Xi})\).** Assume that \(s_{Di}, s_{Xi}\) are given for all firms. Combining the expression for the unit cost in (14), the pricing rule in (15), and the definition of the price index \(P^{1-\sigma} = \tilde{f}_i p_i^{1-\sigma} di\), yields:

\(^{55}\)We consider the case where \(b/w\) is exogenously given and the domestic labor market clearing need not hold. That is, there are other sectors in the economy which can demand (supply) the deficit (excess) of labor.

\(^{86}\)In this step, we rely on the fact that the data \((s_{Di}, s_{Xi})\) together with \(\varphi_i\) imply values of normalized fixed costs \((\tilde{f}_i, \tilde{f}_{Xi}, \tilde{F}_X, \tilde{F}_M, \tilde{F}_X)\). For an importer-exporter, the FOC and the export share equations pin down the norm fixed costs as well as all re-scaled fixed costs from (??) in Section 6.5 below, which contains all derivations.

\[f_{Xi}^s - 1 = -\varphi^{(s-1)(\theta-1)} s_{Di}^s (\sigma-1)(\theta-1) \beta^{\gamma} s_{Xi}^s (\sigma-1)(\theta-1) \tilde{f}_{Xi}^{\theta-1}\]

For a non-exporter, \(\tilde{f}_i\) is pinned down by the FOC and \(f_{Xi}\) is undetermined. And for a purely domestic firm neither \(\tilde{f}_i\) nor \(\tilde{f}_{Xi}\) is identified (bounds can be obtained). Note that the un-identified normalized fixed costs will not matter because as will be clear below \(f_{Xi}\) is only required when \(s_{Xi} > 0\) and \(f_i\) is required only when \(s_{Di} < 1\). Finally, we choose \(\tilde{F}_X, \tilde{F}_M, \tilde{F}_X\) so that the numbers of importers, exporters and importer-exporters match the ones implied by the data \((s_{Di}, s_{Xi})\).
\[
\left(\frac{P}{w}\right)^{1-\sigma} = \left(\frac{\sigma}{\sigma - 1}\right)^{1-\sigma} \int u_i^{1-\sigma} \, di = \left(\frac{\sigma}{\sigma - 1}\right)^{1-\sigma} \left(\frac{1}{1-\gamma}\right)^{-(\sigma-1)(1-\gamma)} \left(\frac{p_D/w}{\beta \gamma + \zeta qD}\right)^{-(\sigma-1)\gamma} \int \varphi_i^{\sigma-1} s_{Di}^{-(\sigma-1)} \, di
\]

Solving this equation delivers the expression for \(P\) in (23) in the Proposition. We next turn to finding aggregate domestic spending \(S\), which is defined as

\[
S = I + S_X,
\]

where \(S_X\) denotes spending by local producers and \(I\) is consumer income. In turn, consumer income is given by the RHS of the consumer budget (21):

\[
I = wL + wT + \int \pi_i \, di.
\]

Firm profits are given by

\[
\pi_i = \frac{R_i}{\sigma} - w_{F_i},
\]

where \(R_i\) is total revenue and \(l_{F_i}\) is the total fixed cost bill arising from international activity. In turn, total revenue is composed of domestic and export revenue, so that \(R_i = R_{Di} + R_{Xi}\). Total domestic revenue equals

\[
\int R_{Di} \, di = \int p_i y_i \, di = \int \left(\frac{p_i}{P}\right)^{1-\sigma} S \, di = S.
\]

Letting \(R_X \equiv \int R_{Xi} \, di\) be total export revenue, the definition of consumer income (34) together with (33) imply:

\[
\frac{S}{w} = L - L_F + T + \frac{S}{w} \, 1 - \frac{R_X}{w} \, 1\sigma + \frac{S_X}{w}.
\]

We now work out expressions for \(S_X/w\), \(R_X/w\) and \(L_F\) and argue that each is a function of \(P/w\) and \(S/w\).

**Export Revenue.** It can be shown that firm-level exports are given by:

\[
\frac{R_{Xi}}{w} = \kappa_1 \varphi_i^{\sigma-1} \frac{s_{Xi}}{1 - s_{Xi}} \, s_{Di}^{\gamma (1-\gamma)} \left(\frac{P}{w}\right)^{(1-\gamma)(\sigma-1)} \frac{S}{w}
\]

where

\[
\kappa_1 = \left(\frac{\sigma}{\sigma - 1}\right)^{1-\sigma} (1-\gamma)^{(1-\gamma)(\sigma-1)} \left(\gamma \beta + \zeta qD\right)^\gamma (\sigma-1).
\]

Aggregate exports are therefore

\[
\frac{R_X}{w} = \kappa_1 \left(\int \varphi_i^{\sigma-1} \frac{s_{Xi}}{1 - s_{Xi}} \, s_{Di}^{\gamma (1-\gamma)} \, di\right) \left(\frac{P}{w}\right)^{(1-\gamma)(\sigma-1)} \frac{S}{w} \equiv \kappa_1 \Upsilon \left(\frac{P}{w}\right)^{(1-\gamma)(\sigma-1)} \frac{S}{w},
\]

where

\[
\Upsilon = \int \varphi_i^{\sigma-1} \frac{s_{Xi}}{1 - s_{Xi}} \, s_{Di}^{\gamma (1-\gamma)} \, di.
\]
Domestic material spending. Letting $m_i$ be total material spending by firm $i$, we have that

$$S_X = \int s_{Di} m_i di = \int s_{Di} \frac{\sigma-1}{\sigma} R_idi$$

$$= \gamma \frac{\sigma-1}{\sigma} S \int s_{Di} \left( \frac{p_i}{P} \right)^{1-\sigma} di + \gamma \frac{\sigma-1}{\sigma} \int s_{Di} R_{Xi} di,$$

where we used that firms spend a fraction $\gamma$ of their total input spending, which is given by a fraction $(\sigma-1)/\sigma$ of total revenue $R_i$. Note that

$$\left( \frac{p_i}{P} \right)^{1-\sigma} = \frac{\varphi_i^{-1}s_{Di}^{\frac{\gamma}{\sigma}}(1-\sigma)}{\int \varphi_i^{-1}s_{Di}^{\frac{\gamma}{\sigma}}(1-\sigma) di} \equiv \omega_{Di},$$

where $\omega_{Di}$ is the share of domestic sales accounted by firm $i$. It follows that

$$\frac{S_X}{w} = \gamma \frac{\sigma-1}{\sigma} S \int \omega_{Di} s_{Di} di + \gamma \frac{\sigma-1}{\sigma} \int s_{Di} R_{Xi} di.$$  

(40)

Note that

$$\int s_{Di} R_{Xi} di = \kappa_1 \Gamma \left( \frac{P}{w} \right)^{(1-\gamma)(\sigma-1)} \frac{S}{w}$$

(41)

where

$$\Gamma \equiv \int \varphi_i^{-1}s_{Di}^{1+1} \sigma^{-\gamma} \frac{1}{1-s_{Di}^{\gamma}} di$$

Plugging (41) into (40), we obtain

$$\frac{S_X}{w} = \gamma \frac{\sigma-1}{\sigma} \left( \int \omega_{Di} s_{Di} di \right) \frac{S}{w} + \gamma \frac{\sigma-1}{\sigma} \kappa_1 \Gamma \left( \frac{P}{w} \right)^{(1-\gamma)(\sigma-1)} \frac{S}{w}.$$  

(42)

Labor used for fixed costs. The total labor used for fixed costs is given by

$$L_F = \int (f_i n_i + f_{Xi} n_{Xi} + f_{Mi} F_M + f_{Xi} F_X + f_{XM} F_{XM}) di,$$

(43)

where $n_i$ is the mass of countries sourced, $n_{Xi}$ is the mass of countries to which the firm exports to, and $f_{Mi}, f_{Xi}$ and $f_{XM}$ are indicators of whether the firm is an importer-only, exporter-only or importer-exporter, respectively.\footnote{Note that these status indicators are functions of $(s_{Di}, s_{Xi})$. More precisely, $I_{Mi} = I(s_{Di} < 1) \times I(s_{Xi} = 0)$, $I_{Xi} = 1(s_{Di} = 1) \times I(s_{Xi} > 0)$ and $I_{XM} = I(s_{Di} < 1) \times I(s_{Xi} > 0)$.}

Note that

$$n_{Xi} f_{Xi} = \frac{\theta - 1}{\theta - \sigma} (\sigma - 1)^{-\gamma - 1} \left( \frac{1}{1-\gamma} \right)^{-\gamma - (1-\gamma)} \left( \frac{1}{\gamma \beta s_{Di}^{\sigma-1} q_D} \right)^{-\gamma} \varphi_i^{-1} s_{Di}^{\gamma} n_{Xi} (s_{Di} - 1)^{\gamma} \left( \frac{P}{w} \right)^{(\sigma-1)(1-\gamma)} \frac{S}{w}.$$  

We now express each of these terms as functions of the micro data $(s_{Di}, s_{Xi})$ and the re-scaled fixed costs. First, using (29), the importing fixed cost bill can be written as

$$n_i f_i = \kappa_2 \left( \frac{P}{w} \right)^{(\sigma-1)(1-\gamma)} \left( \frac{S}{w} \right) (s_{Di} - 1)^{\gamma} \tilde{f}_i.$$  

\footnote{Note that these status indicators are functions of $(s_{Di}, s_{Xi})$. More precisely, $I_{Mi} = I(s_{Di} < 1) \times I(s_{Xi} = 0)$, $I_{Xi} = 1(s_{Di} = 1) \times I(s_{Xi} > 0)$ and $I_{XM} = I(s_{Di} < 1) \times I(s_{Xi} > 0)$.}
In addition, the definition of the export share, together with expressions for the optimal fixed costs to the overall global status are given by:

\[ n_{Xi} f_{Xi} = \left( \frac{\theta - 1}{\theta} \right) \kappa_3 \left( \frac{P}{w} \right)^{(\sigma-1)(1-\gamma)} \left( \frac{S}{w} \right) \left( s_{X_i}^{-1} - 1 \right)^{-\frac{\theta}{1-\theta}} f_{Xi}. \]

Similarly, relying on (30), the exporting fixed cost bill can be written as

\[ F_s = \tilde{f}_s \kappa_3 \left( \frac{P}{w} \right)^{(\sigma-1)(1-\gamma)} \left( \frac{S}{w} \right), \]

where \( s \in \{ M, X, XM \} \). Combining the above expressions, the total fixed-cost labor is therefore

\[ L_F = \left( \frac{P}{w} \right)^{(\sigma-1)(1-\gamma)} \left( \frac{S}{w} \right) \Psi \]

where

\[ \Psi = \int \left( \kappa_2 \left( s_{Di}^{-1} - 1 \right)^{\frac{1}{\sigma-1}} \tilde{f}_i + \kappa_3 \left( \frac{\theta - 1}{\theta} \right) \left( \frac{s_{X_i}}{1 - s_{X_i}} \right)^{\frac{\theta}{1-\theta}} \tilde{f}_{Xi} + \kappa_3 \left( \tilde{I}_M \tilde{F}_M + \tilde{I}_X \tilde{F}_X + \tilde{I}_{XM} \tilde{F}_{XM} \right) \right) di. \]

Equation (46) gives an expression for the total labor used for fixed costs as a function of the data \((s_{Di}, s_{X_i})\) and the re-scaled fixed costs. We next show that, in turn, these re-scaled fixed costs can be obtained from \((s_{Di}, s_{X_i})\).

**Re-scaled fixed costs from \((s_{Di}, s_{X_i})\).** We now show that there is a one-to-one mapping between the firm behavior data \((s_{Di}, s_{X_i})\) and the re-scaled fixed costs \((\tilde{f}_i, \tilde{f}_{Xi}, \tilde{F}_s)\) where \( s \in \{ M, X, XM \} \). This mapping follows from the optimality conditions of the firm’s problem. Consider the first order condition characterizing the optimal \( s_{Di} \) associated with the profit function in (19):

\[
\begin{align*}
(1 - \beta) \frac{1}{s_{Di}} & \beta ^{\frac{1}{\gamma} - 1} (\eta \gamma (\sigma - 1) - \gamma \varphi_i s_{Di}^{-1} \frac{1}{\gamma} (1 - \eta \gamma (\sigma - 1)) - (1 - s_{Di})^{1 - \frac{1}{\gamma} (\sigma - 1)}} (1 - s_{Di})^{1 - \frac{1}{\gamma} (\sigma - 1)} \\
+ & (1 - \beta) \frac{1}{s_{Di}} \beta ^{\frac{1}{\gamma} - 1} (\theta \eta \gamma (\sigma - 1) - \varphi_i \theta (\sigma - 1) s_{Di}^{-1} \frac{1}{\gamma} (1 - \theta \eta \gamma (\sigma - 1)) - (1 - s_{Di})^{1 - \frac{1}{\gamma} (\sigma - 1)} \\
= & \tilde{f}_{Mi}.
\end{align*}
\]

In addition, the definition of the export share, together with expressions for \( R_{Di} \) and \( R_{Xi} \), and the definition of \( f_{Xi} \), yields:

\[ \frac{1}{s_{X_i}} - 1 = \beta ^{\frac{1}{\gamma} - 1} \frac{(\sigma - 1) \gamma (1 - \theta)}{s_{Di}} (\sigma - 1) s_{Di}^{-1} \frac{1}{\gamma} \tilde{f}_{Xi}^{\theta - 1}. \]

Equations (47)-(48) imply a mapping from \((s_{Di}, s_{X_i})\) to \((\tilde{f}_i, \tilde{f}_{Xi})\). Finally, to obtain the re-scaled fixed costs to the global strategy, \( \tilde{F}_s \), note that the firm behavior data \((s_{Di}, s_{X_i})\) imply the following fractions of firms in each status:

\[ frac_M = \int \tilde{I}_M di, \quad frac_X = \int \tilde{I}_X di \quad \text{and} \quad frac_{XM} = \int \tilde{I}_{XM} di, \]

62
Putting it all together. Plugging (38), (42) and (46) into the fixed point condition (35) delivers

$$S = L + T - \left(\frac{P}{w}\right)^{(\sigma-1)(1-\gamma)} \left(\frac{S}{w}\right) \Psi + \frac{S}{w} \frac{1}{\sigma} + \kappa_1 \gamma \left(\frac{P}{w}\right)^{(1-\gamma)(\sigma-1)} \frac{S}{w} \frac{1}{\sigma}$$

(49)

Solving for $S$, this condition delivers (24) in Proposition (1). Welfare is given by $I/P$ where

$$I = \frac{S}{w} \left[ 1 - \frac{1}{\sigma} \gamma \int l_{Di} \omega_{Di} s_{Di} di - \frac{1}{\sigma} \kappa_1 \gamma \left(\frac{P}{w}\right)^{(1-\gamma)(\sigma-1)} \frac{S}{w} \right].$$

Step 2. $(s_{Di}, s_{Xi})$ are induced by $S$ and $P$. In the previous step, we found the levels of $S$ and $P$ that are consistent with equilibrium in goods markets given data on firm behavior $(s_{Di}, s_{Xi})$. The second step consists of ensuring that $(s_{Di}, s_{Xi})$ solve the firms’ problem given the levels of $S$ and $P$ in (23) and (49).

6.6 Baseline Model with Labor Market Clearing

This Section considers a version of the model of Section 3 where the labor market clears. The labor market clearing condition is

$$L = \int (l_{pi} + f_i n_i + f_{Xi} n_{Xi} + \mathbb{I}_{M_i} F_M + \mathbb{I}_{X_i} F_X + \mathbb{I}_{XM_i} F_{XM}) di,$$

(50)

where $L$ is the (perfectly inelastic) labor supply, $l_{pi}$ is firm $i$’s demand for variable labor and $n_i, n_{Xi}, \mathbb{I}_{M_i}, \mathbb{I}_{X_i}$ and $\mathbb{I}_{XM_i}$ are defined below equation (43) in Section 6.5. Recall that imposing clearing in the labor market is equivalent to imposing the trade balance condition, i.e., the requirement that the trade balance equals the exogenously given transfers $T$ - see footnote 58 in the text. To ensure that this additional equation is satisfied, one additional variable needs to be endogenous. This section considers a version of the model where the average level of foreign demand, $\bar{b}$, is endogenous. In this case, all equilibrium outcomes depend on three endogenous, general equilibrium variables: $S, P$ and $\bar{b}$. While the price of foreign inputs is still exogenously given (controlled by $e$), the average level of foreign demand, $e^{\sigma-1} \bar{b}$, now endogenously adjusts to attain a given level of transfers $T$.

Equilibrium Characterization. Start by noting that the firm problem can be fully solved as a function of the triple $(S, P, \bar{b})$. It follows that the distribution of domestic and export shares $(s_{Di}, s_{Xi})$ is a function of such triple. The two equilibrium conditions in the partial equilibrium case, i.e., equations (23) and (24) of Proposition 1, still apply in the current setting. These are derived from the definition of the price index and the consumer budget constraint - see Section 6.5. We now provide a third equilibrium condition, derived from the labor market clearing condition in (50), which together with equations (23)-(24) fully characterizes the equilibrium triplet $(S, P, \bar{b})$. 

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The total labor used for variable production, denoted by $L_p$, is given by

$$L_p = \frac{\sigma - 1}{\sigma} (1 - \gamma) \int \left( \frac{R_{Di}}{w} + \frac{R_{Xi}}{w} \right) di = \frac{\sigma - 1}{\sigma} (1 - \gamma) \left( \kappa_1 \Psi \left( \frac{P}{w} \right)^{(1-\gamma)(\sigma-1)} + 1 \right) \frac{S}{w},$$

where the second line follows from (38). The total labor demand, denoted by $L_d$, is given by

$$L_d = L_p + L_F = \frac{\sigma - 1}{\sigma} (1 - \gamma) \left( \kappa_1 \Psi \left( \frac{P}{w} \right)^{(1-\gamma)(\sigma-1)} + 1 \right) \frac{S}{w} + \left( \frac{P}{w} \right)^{(\sigma-1)(1-\gamma)} \left( \frac{S}{w} \right) \Psi,$$

where $L_F$ is the total amount of labor used for fixed costs given by (46). The labor market clearing condition reads $L_d = L_p + L_F = L$. Because $P/w$ has already been determined, the labor market clearing condition pins down $S/w$:

$$\frac{S}{w} = \frac{\sigma - 1}{\sigma} (1 - \gamma) \left( \kappa_1 \Psi \left( \frac{P}{w} \right)^{(1-\gamma)(\sigma-1)} + 1 \right) + \left( \frac{P}{w} \right)^{(\sigma-1)(1-\gamma)} \Psi. \quad (51)$$

Equations (23), (24) and (51) jointly characterize the equilibrium triplet $(S, P, \bar{b})$.

**Calibration And Solution Strategy.** The calibration strategy adopted for the partial equilibrium case, described in Section 6.4, cannot be applied to the model with equilibrium in the labor market. The reason is that targeting the distribution of domestic and export shares $(s_{Di}, s_{Xi})$ implicitly determines the level of the trade deficit which need not equal the exogenously given transfers $T$. To see this, note that the trade balance is given by

$$TB = R_X - M = \left( s_{X,AGG} - s_{I,AGG} \frac{\sigma - 1}{\sigma} \right) R,$$

where $s_{X,AGG}$ and $s_{I,AGG}$ are the aggregate export and import shares, $R_X$ is aggregate exports and $R$ is aggregate revenue. Thus, the aggregate import and export shares imply a given level of trade balance as a fraction of total revenue. Next, note that after calibrating to $(s_{Di}, s_{Xi})$ and obtaining the corresponding normalized fixed costs $(\tilde{f}_i, \tilde{f}_{Xi}, \tilde{F}_X, \tilde{F}_M, \tilde{F}_{XM})$, as outlined in Section 6.4, we can compute $\Psi, \Upsilon$ and $\Gamma$ and hence obtain $S$ and $P$ from the labor market clearing and price index equations, (23) and (51), respectively. Importantly, nothing guarantees that the trade balance condition (24) is satisfied, i.e., that the trade deficit equals the exogenously given transfers $T$.

To deal with this issue, the following calibration strategy is adopted. First, the parameters governing firm heterogeneity are calibrated following Step 1 outlined in Section 6.4. The targets are the moments of the

88 The following relationships were used

$$s_{X,AGG} = \frac{R_X}{R} \quad \text{and} \quad s_{I,AGG} = \frac{M}{TotMat}$$

and total materials $TotMat = \gamma \left( \frac{\sigma - 1}{\sigma} \right) R$.

89 Another way to see this is that

$$\frac{R_X}{w} = \kappa_1 \Psi \left( \frac{P}{w} \right)^{(1-\gamma)(\sigma-1)} \frac{S}{w}$$

and

$$\frac{M}{w} = \gamma \frac{\sigma - 1}{\sigma} \left( \frac{S}{w} + \frac{R_X}{w} \right) - \frac{S_X}{w}$$

so that exports and imports in levels are determined from $(s_{Di}, s_{Xi}), (\tilde{f}_i, \tilde{f}_{Xi}, \tilde{F}_X, \tilde{F}_M, \tilde{F}_{XM})$ and the $S, P$ obtained via the GE conditions (23) and (51) above. Their difference need not be equal to exogenous $T$. 

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distribution of domestic and export shares \((s_{Di}, s_{Xi})\) in the pre-devaluation period listed in Section 4.1.1. As before, this procedure yields a distribution of efficiency and re-scaled fixed costs \((\varphi_i, \tilde{f}_i, \tilde{f}_{Xi}, \tilde{F}_{XM}, \tilde{F}_M, \tilde{F}_X)\). In contrast to the previous approach, the level of transfers \(T\) is now treated as an additional parameter and chosen to make equation (24) hold. Intuitively, because the trade deficit is determined by the targeted data on domestic and export shares, I require that the exogenous transfers \(T\) rationalizes the observed level of deficit. Finally, the values of the re-scaled fixed costs, together with the equations that defined them given in (29)-(31), can be used to back out the actual fixed costs \(\left(\tilde{f}_i, \frac{b^\sigma f_{Xi}}{\tilde{F}_M, \tilde{F}_{XM}}\right)\). More precisely, the following conditions are used

\[
\tilde{f}_i = \frac{1}{\gamma \eta} \left(\frac{1}{1 - \gamma}\right)^{(\sigma - 1)(1 - \gamma)} \left(\frac{1}{\gamma \eta D}\right)^{(\sigma - 1)\gamma} \frac{\sigma}{(\sigma - 1)} \eta^{-\frac{1}{\sigma}} \left(\frac{P}{w}\right)^{-\gamma} \left(\frac{S}{w}\right)^{-\frac{1}{\sigma}} \tilde{f}_i
\]

\[
\tilde{f}_{Xi} = \left(\frac{P}{w}\right)^{1 - \sigma + (1 - \theta)(\sigma - 1)} \left(\frac{S}{w}\right)^{-1} \frac{\theta}{\theta - 1} \left(\frac{e}{w}\right)^{\sigma_\theta} \sigma^{-\sigma/(\theta - 1)} \left(\frac{S}{w}\right)^{\sigma - \sigma/(\theta - 1)} \left(\frac{S}{w}\right)^{\theta/(\theta - 1)} \left(\frac{S}{w}\right)^{(\theta - 1)(\sigma - 1)} \times \left(\frac{1}{1 - \gamma}\right)^{(\sigma - 1)(1 - \gamma)(1 - \theta)} \left(\frac{1}{\gamma \eta D}\right)^{(1 - \theta)(\sigma - 1)} \left(1 + \tau\right)^{-\theta(\sigma - 1)} \left(\frac{P}{w}\right)^{\frac{1}{\sigma}} \frac{b^\sigma f_{Xi}}{\tilde{F}_M, \tilde{F}_{XM}}
\]

Note that \(b\) and \(f_{Xi}\) cannot be identified separately in this step, but only the combo \(b^\sigma f_{Xi}\) is obtained. The pre-devaluation level of \(b\) is not required to compute any of the relevant model outcomes. Finally, the value of \(\theta\) is kept at the level calibrated in Section 4.1.1.\(^{90}\)

Consider next the computation of the post-devaluation equilibrium with a higher level of \(e\). The following algorithm is adopted. Guess a triple \((x, P', S')\) where

\[
x = \left(\frac{b'}{b}\right)^{\frac{\sigma}{\gamma}}
\]

is the factor by which \(b^\sigma f_{Xi}\) grows. Given this guess, compute the corresponding re-scaled fixed costs using equations (52)-(53), where the right hand side of (53) is multiplied by the factor \(x\). With the updated re-scaled fixed costs, the firms’ problem can be solved to get the implied domestic and export shares \((s'_{Di}, s'_{Xi})\). Then, use (23) to compute \(P'\), (51) to compute \(S'\) and (24) to compute \(T'\). Compute the mean squared error as \((P' - P)^2 + (S' - S)^2 + (T' - T_d)^2\), where \(T_d\) is the exogenously given level of transfers post devaluation (which is allowed to differ from the pre-devaluation one, \(T\)). Repeat this process until the mean square error is sufficiently small.

**Results of Counterfactual Devaluation.** Given the approach outlined above, the calibrated parameters governing firm heterogeneity are identical to the ones obtained in Section 4.1.1 of the main text.\(^{91}\) The reason is that the calibration strategy adopted does not depend on general equilibrium considerations. In what follows, the level of transfers post devaluation is chosen to generate an increase in the level of exports of about 80%, as observed in Mexico between 1994 and the average of 1995-99.

Tables 34-36 contain the results for both the baseline calibration as well as the one that targets a counterfactual zero correlation between import and export shares considered in Section 4.2.2. The data figures correspond to changes between 1994 and the average of the 1995-99 period. The results confirm the main

---

\(^{90}\)In addition, the values of \(\sigma, \gamma, e\) and \(\eta\) are kept at the same values used in Section 4.1.1, i.e., values taken from Blaum et al. (2018b).

\(^{91}\)The difference lies in the fact that the pre-devaluation transfers \(T\) are calibrated to rationalize the observed level of trade deficit as share of absorption. Recall also that the equilibrium level of \(S\) is now computed according to (51).
findings of Section 4.2.1. In the baseline model, a real devaluation implies that: (i) the aggregate import share increases, (ii) there is a widespread reduction in firm-level import shares, and (iii) import shares and firm size become more correlated. These findings are consistent with what was observed in Mexico following the devaluation of 1995. In contrast, in the model with uncorrelated (pre-devaluation) import and export intensities, the aggregate import share decreases as firm-level import shares tend to both fall and become less correlated with firm size.

Table 36: Changes in Other Non-Targeted Moments (GE)

<table>
<thead>
<tr>
<th>Change in...</th>
<th>Model (Uncorrelated)</th>
<th>Model (Baseline)</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fraction Importers-Only</td>
<td>-4.59</td>
<td>-9.25</td>
<td>-7.05</td>
</tr>
<tr>
<td>Fraction Exporters-Only</td>
<td>1.85</td>
<td>3.97</td>
<td>3.70</td>
</tr>
<tr>
<td>Fraction Importer-Exporters</td>
<td>4.60</td>
<td>6.37</td>
<td>9.74</td>
</tr>
<tr>
<td>Corr. sales-imp. shares</td>
<td>-0.02</td>
<td>0.04</td>
<td>0.06</td>
</tr>
<tr>
<td>Corr. sales-exp. shares</td>
<td>0.08</td>
<td>0.12</td>
<td>0.08</td>
</tr>
<tr>
<td>Corr. imp.-exp. shares</td>
<td>0.02</td>
<td>0.07</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Notes: The data rows depict changes in the percentiles of the distribution of import (export) shares between 1994 and the average of 1995-1999 in the Mexican manufacturing sector. The model rows depict changes in the model generated data resulting from a 20% depreciation in the real exchange rate. The correlation between firm sales and import shares is computed on the sample of importers. The correlation between firm sales and export share is computed on the sample of exporters. The correlation between import shares and export shares is computed on the sample of importers or exporters (i.e., the sample that excludes purely domestic firms). All entries are in percentage points. Source: EIA.

Table 34: Effects of a Counterfactual Devaluation (GE)

<table>
<thead>
<tr>
<th>Rate of growth in...</th>
<th>Model, 20% depreciation</th>
<th>Mexico 94-99</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Uncorrelated</td>
<td>Baseline</td>
</tr>
<tr>
<td>Aggregate Import Share</td>
<td>-23.97</td>
<td>10.34</td>
</tr>
<tr>
<td>Aggregate Export Share</td>
<td>81.98</td>
<td>120.21</td>
</tr>
<tr>
<td>Price Index</td>
<td>11.75</td>
<td>11.20</td>
</tr>
</tbody>
</table>

Notes: The Table contains the rate of growth in the aggregate import share, the aggregate export share and the consumer price index resulting from a counterfactual devaluation in the model (first two columns) and for the Mexican manufacturing sector (third column). The figures for Mexico correspond to changes between 1994 and the average of 1995-1999. The first column considers the calibration of Section 4.2.2 which targets a zero correlation of import and export shares pre-devaluation. Column 2 considers the baseline calibration of Section 4.2.1 which targets the positive correlation between import and export shares observed in the Mexican manufacturing sector in 1994. All other moments targeted by the two models coincide. All entries are in percentage points.

Table 35: Changes in Distribution of Import and Export Shares (GE)

<table>
<thead>
<tr>
<th>Percentiles</th>
<th>Import Shares, Importers, final - initial</th>
<th>Export Shares, Exporters, final - initial</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10th</td>
<td>25th</td>
</tr>
<tr>
<td>Data</td>
<td>-0.40</td>
<td>-0.46</td>
</tr>
<tr>
<td>Model (Baseline)</td>
<td>-1.62</td>
<td>-2.04</td>
</tr>
<tr>
<td>Model (Uncorrelated)</td>
<td>-0.01</td>
<td>-0.45</td>
</tr>
<tr>
<td>Data</td>
<td>0.42</td>
<td>1.26</td>
</tr>
<tr>
<td>Model (Baseline)</td>
<td>1.45</td>
<td>4.07</td>
</tr>
<tr>
<td>Model (Uncorrelated)</td>
<td>0.21</td>
<td>0.88</td>
</tr>
</tbody>
</table>

Notes: The data rows depict changes in the percentiles of the distribution of import shares (first panel) and export shares (second panel) between 1994 and the average of 1995-99 in the Mexican manufacturing sector. For the data, the figures are constructed as the difference between the average percentile in the 1995-99 period and the percentile in 1994. The model rows depict changes in the model generated data resulting from a 20% depreciation of the real exchange rate. All entries are in percentage points. Source: EIA.
Within & Between Covariance Net Entry Total
Model, 20% depreciation, Uncorrelated -2.30 -21.93 0.48 -0.22 -23.97
Model, 20% depreciation, Baseline -3.90 13.18 1.70 -0.64 10.34
Mexico 94-99 -2.79 9.99 4.27 6.24 17.70

Notes: The Table contains the Baily et al. (1992) decomposition in (2) performed on model-generated data resulting from a 20% counterfactual real depreciation as well as on data from the Mexican manufacturing sector between 1994 and 1999. All entries are in percentage points.

Table 37: Decomposition of Import Share Growth: Model (GE) vs Data

As for exporting, both the baseline and the uncorrelated models predict (i) an increase in the aggregate export shares, (ii) a widespread increase in firm-level export shares and (iii) an increase in the correlation between firm size and export intensity. These patterns are all consistent with what was observed in the Mexican experience. Quantitatively, the baseline model tends to predict stronger effects than observed in the data. As for firms’ international status, both models predict fewer pure importers, more pure exporters and more importer-exporters.

These findings are corroborated when performing a decomposition of the growth in the aggregate import share following Bailey et al. (1992). Table (37) applies the decomposition in equation (2) to the model-generated data and the Mexican data between 1994 and 1999. Both in the Mexican and in the baseline model, the increase in the import share is mostly accounted by a positive between component. The between term is positive whenever firms that are import intensity before the devaluation tend to expand in size following the devaluation. In contrast, in the uncorrelated model, the between component is negative and large, accounting for most of the decrease in the aggregate import share.

Overall, the results in this Section confirm the findings obtained with the model with partial equilibrium in the labor market in the main text.

6.7 Model of Importing with Labor Market Clearing

This section considers a version of the model of Section 3 that shuts down the heterogeneity in export behavior. In particular, it is assumed that \( F_X = f_{X,i} = 0 \forall i \) and \( F_M = F_{XM} > 0 \). That is, there are no fixed costs to exporting whatsoever and the fixed costs to importing are kept as before. It follows that all firms will export to all countries. Importantly, export intensities will be equalized across firms.\(^\text{92}\) In this way, this version of the model focuses entirely on the heterogeneity in import behavior. In addition, it is assumed that trade is balanced.\(^\text{93}\) To do so, it is assumed that the level of foreign demand \( \hat{b} \) is endogenously determined.

This version of the model is calibrated to the same moments of the joint distribution of firm sales and import intensity used in Section 4.2.3. Table 38 contains the results. As before, the model is able to perfectly match all moments. Tables 39 and 40 consider a 20% real depreciation. We see that the aggregate import share falls by about 15% - from about 0.36 to 0.30. The fraction of importers falls by about 1 percentage point. Firm size and import intensity becomes less correlated following the depreciation. In contrast, the aggregate

---

\(^\text{92}\) Formally, the exporting strategy is to export to all countries, i.e., \( \hat{b}(u_i) = \hat{b} \) for all firms. It follows that the ratio of domestic to foreign revenue is given by

\[
\frac{R_{Di}}{R_{Xi}} = p^{\sigma - 1} s^{1 - \sigma} (1 + \tau)^{\sigma - 1} \frac{\theta - 1}{\theta} \frac{1}{\hat{b}},
\]

which is constant across firms.

\(^\text{93}\) This is the same as imposing labor market clearing, as the consumer budget constraint in (21) and the goods market clearing conditions in (22), together imply that

\[
TB = X - M = -T - (L - L_d),
\]

where \( L_d \) is the total labor demand. In this section, transfers are assumed to be zero, i.e., \( T = 0 \). It follows that trade balanced is achieved whenever the labor market clears.
imported input share, the fraction of importers and the correlation between size and import intensity all increased following the Mexican devaluation of 1995. The increase in the price index of domestically produced goods is about 8.40%, which is higher than what the baseline predicts.

<table>
<thead>
<tr>
<th>Description</th>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
<th>Value</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average importing fixed cost ($\mu_f$)</td>
<td></td>
<td>1.42</td>
<td>Aggregate Import Share</td>
<td>0.36</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>Fixed cost import status ($\tilde{F}_M$)</td>
<td></td>
<td>0.06</td>
<td>Fraction Importers</td>
<td>0.42</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>Dispersion in efficiency ($\sigma_\phi$)</td>
<td></td>
<td>0.63</td>
<td>Dispersion sales</td>
<td>1.71</td>
<td>1.71</td>
<td></td>
</tr>
<tr>
<td>Dispersion in importing fixed costs ($\tilde{\sigma}_f$)</td>
<td></td>
<td>3.24</td>
<td>Dispersion imp. shares</td>
<td>0.27</td>
<td>0.27</td>
<td></td>
</tr>
<tr>
<td>Corr. efficiency - importing fixed cost ($\rho_{\phi f}$)</td>
<td></td>
<td>0.87</td>
<td>Corr. sales-imp. shares</td>
<td>0.27</td>
<td>0.27</td>
<td></td>
</tr>
</tbody>
</table>

Notes: The dispersion in value added is the standard deviation of the log of value added. The dispersion in import shares is the standard deviation of import shares. The correlation of value added and import shares is the coefficient of correlation between log value added and import shares (in levels). To compute the fraction of importers, all firms engaged in importing are considered, regardless of their export status.

Table 38: Model with Importing (GE): Calibration to Mexican Data

<table>
<thead>
<tr>
<th>Rate of growth in ...</th>
<th>Model, 20% depreciation</th>
<th>Mexico 94-99</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate Import Share</td>
<td>-15.98</td>
<td>15.85</td>
</tr>
<tr>
<td>Price Index</td>
<td>8.40</td>
<td>-</td>
</tr>
</tbody>
</table>

Notes: The table depicts changes in the aggregate imported input share and the price index of domestically produced goods resulting from the devaluation. The data rows contains changes between 1994 and the average of 1995-1999 in the Mexican manufacturing sector. The model rows depict changes in the model generated data resulting from a 20% depreciation in the real exchange rate. All entries are growth rates expressed in percentage points. Source: EIA.

Table 39: Effects of a Counterfactual Devaluation: Model of Importing (GE)

<table>
<thead>
<tr>
<th>Change in...</th>
<th>Model, 20% depreciation</th>
<th>Mexico 94-99</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fraction Importers</td>
<td>-1.18</td>
<td>2.70</td>
</tr>
<tr>
<td>Corr. sales-imp. shares</td>
<td>-0.03</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Notes: The table depicts changes in the fraction of importers and the correlation between firm size and import shares resulting from the devaluation. The data rows contains changes between 1994 and the average of 1995-1999 in the Mexican manufacturing sector. The model rows depict changes in the model generated data resulting from a 20% depreciation in the real exchange rate. The set of importers includes all firms engaging in importing activity regardless of their export status. The entries for the fraction of importers are in percentage points. The entries for the correlation between firm sales and import shares are differences in the coefficient of correlation before and after the devaluation. Source: EIA.

Table 40: Model of Importing (GE): Other Non-Targeted Moments

<table>
<thead>
<tr>
<th>Within</th>
<th>Between</th>
<th>Covariance</th>
<th>Net Entry</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model, 20% depreciation</td>
<td>-2.95</td>
<td>-12.99</td>
<td>0.07</td>
<td>-0.00</td>
</tr>
</tbody>
</table>

Mexico 94-99 |

| -2.79  | 9.99  | 4.27  | 6.24  | 17.70 |

Notes: The Table contains the Baily et al. (1992) decomposition in (2) performed on model-generated data of counterfactual devaluations. All entries are in percentage points.

Table 41: Model of Importing (GE): Decomposition of Increase in Import Share

6.8 Baseline Model in Partial Equilibrium

This section reports the results of a counterfactual increase in foreign prices of 20% on the baseline model when the domestic price index $P$ and the level of spending $S$ are not allowed to adjust following the devaluation.
Tables 42, 43, 44 and 45 contain the results.

Table 42: Effects of a Counterfactual Devaluation (Baseline Model in Partial Equilibrium)

<table>
<thead>
<tr>
<th>Rate of growth in ...</th>
<th>Model, 20% depreciation</th>
<th>Mexico 94-99</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate Import Share</td>
<td>-15.00</td>
<td>15.85</td>
</tr>
<tr>
<td>Aggregate Export Share</td>
<td>72.59</td>
<td>78.32</td>
</tr>
</tbody>
</table>

Notes: The Table contains the rate of growth in the aggregate import share, the aggregate export share and the consumer price index resulting from a counterfactual devaluation in the model and for the Mexican manufacturing sector. The figures for Mexico correspond to changes between 1994 and the average of 1995-1999. The model corresponds to the baseline calibration of Section 4.2.1. Following the devaluation, $S$ and $P$ are kept at their pre-devaluation equilibrium values. All entries are in percentage points.

Table 43: Changes in Distribution of Import and Export Shares (Baseline Model in Partial Equilibrium)

<table>
<thead>
<tr>
<th>Change in...</th>
<th>Model (Baseline)</th>
<th>Model (Partial Equilibrium)</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fraction Importers-Only</td>
<td>-2.97</td>
<td>-9.19</td>
<td>-7.05</td>
</tr>
<tr>
<td>Fraction Exporters-Only</td>
<td>2.57</td>
<td>4.90</td>
<td>3.70</td>
</tr>
<tr>
<td>Fraction Importer-Exporters</td>
<td>8.25</td>
<td>4.68</td>
<td>9.74</td>
</tr>
<tr>
<td>Corr. sales-imp. shares</td>
<td>0.03</td>
<td>0.00</td>
<td>0.06</td>
</tr>
<tr>
<td>Corr. sales-exp. shares</td>
<td>0.07</td>
<td>0.08</td>
<td>0.08</td>
</tr>
<tr>
<td>Corr. imp.-exp. shares</td>
<td>0.05</td>
<td>0.06</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Notes: The data rows depict changes in the percentiles of the distribution of import (export) shares between 1994 and the average of 1995-1999 in the Mexican manufacturing sector. The model rows depict changes in the model-generated data resulting from a 20% depreciation in the real exchange rate. The correlation between firm sales and import shares is computed on the sample of importers. The correlation between firm sales and export share is computed on the sample of exporters. The correlation between import shares and export shares is computed on the sample of importers or exporters (i.e., the sample that excludes purely domestic firms). All entries are in percentage points. Source: EIA.

Table 44: Changes in Other Non-Targeted Moments (Baseline Model in Partial Equilibrium)

<table>
<thead>
<tr>
<th>Change in...</th>
<th>Within</th>
<th>Between</th>
<th>Covariance</th>
<th>Net Entry</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model (Baseline)</td>
<td>-1.66</td>
<td>8.96</td>
<td>0.42</td>
<td>0.26</td>
<td>7.07</td>
</tr>
<tr>
<td>Model (Partial Equilibrium)</td>
<td>-6.00</td>
<td>-9.67</td>
<td>1.56</td>
<td>-0.89</td>
<td>-15.00</td>
</tr>
<tr>
<td>Mexico 94-99</td>
<td>-2.79</td>
<td>9.99</td>
<td>4.27</td>
<td>6.24</td>
<td>17.70</td>
</tr>
</tbody>
</table>

Notes: The Table contains the Baily et al. (1992) decomposition in (2) performed on model-generated data resulting from a 20% counterfactual real depreciation as well as on data from the Mexican manufacturing sector between 1994 and 1999. All entries are in percentage points.

Table 45: Decomposition of Import Share Growth: Model (Baseline in Partial Equilibrium) vs Data

Notes: The data rows depict changes in the percentiles of the distribution of import shares (first panel) and export shares (second panel) between 1994 and the average of 1995-1999 in the Mexican manufacturing sector. The figures for Mexico correspond to changes between 1994 and the average of 1995-1999. The model corresponds to the baseline calibration of Section 4.2.1. Following the devaluation, $S$ and $P$ are kept at their pre-devaluation equilibrium values. All entries are in percentage points. Source: EIA.