Global Firms in Large Devaluations*

Joaquin Blaum†

June 2019

Abstract

I investigate the consequences of firms' joint import and export decisions in the context of large devaluations. I provide empirical evidence that large devaluations are characterized by an increase in the aggregate share of imported inputs in total input spending, and by reallocation of resources towards import intensive firms, contrary to what standard quantitative trade models predict. These facts are 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. After a counterfactual devaluation, the model predicts that the aggregate import share increases as exporters gain market share. The model predicts that the devaluation has a positive effect on aggregate productivity, in contrast to the negative effect predicted by the standard model of importing used in the literature. JEL Codes: F11, F12, F14, F62, D21, D22

1 Introduction

Understanding the effects of changes in exchange rates is an important task in international economics (Burstein and Gopinath (2014)). In explaining the macroeconomic adjustment to large devaluations, imported inputs have been shown to play an important role. As the real exchange rate depreciates and foreign inputs become relatively more expensive, firms adjust their import demand and production costs increase. At the same time, the devaluation effectively increases foreign demand for exporters, which tend to be intense importers. Using data and theory, this paper shows that this observation is key to understand the pattern of reallocation and overall macroeconomic adjustment to large devaluations.

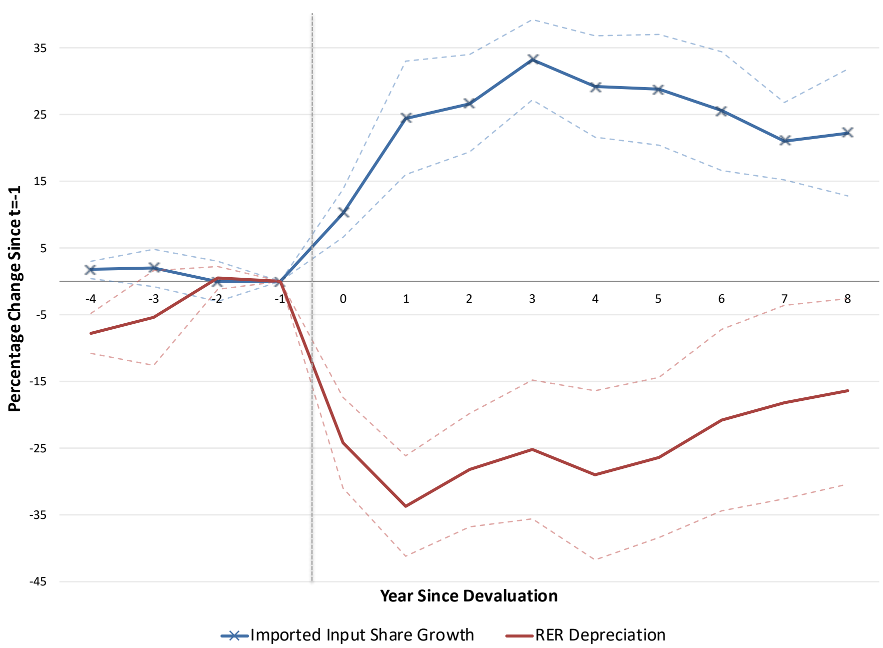
The paper is motivated by two novel empirical facts. Large devaluations are associated with an increase in the overall import intensity of the economy, and with reallocation of economic activity towards import intensive firms. These facts are puzzling from the point of view of existing models of input trade (Gopinath and Neiman (2014), Halpern et al. (2015), Blaum et al. (2018)), which predict exactly the opposite pattern. When foreign inputs become more expensive, these frameworks predict a decrease in the aggregate import share and a contraction of intense importers. The data shows that the reallocation towards import intensive firms seen during large devaluations can be explained by the expansion of exporters, which tend to be intense importers. I show that a theory that incorporates firms' global behavior as importers and exporters can come

*I thank Ariel Burstein, Lorenzo Caliendo, Arnaud Costinot, Ben Faber, Pablo Fajgelbaum, Javier Cravino, Andrei Levchenko, Michael Peters, Jesse Schreger, Jon Vogel, Ivan Werning, and seminar participants at Atlanta Fed, Brown, Chicago Booth (International Macro-Finance Conference), LACEA-TIGN in Montevideo, Di Tella University, Harvard, Nottingham GEP, NBER IFM SI Meeting, Michigan, Minneapolis Fed, MIT, SED in Edinburgh, SAET in Faro, Tufts, UCLA, UT Austin, RIDGE in Buenos Aires and Yale. I am grateful to Rob Johnson for an excellent discussion at the NBER IFM SI meeting. I also thank the International Economics Section of Princeton University for its hospitality and funding during part of this research. I thank Marcel Peruffo for superb research assistance. This paper circulated previously under the title "Importing, Exporting and Aggregate Productivity in Large Devaluations".

†Brown University. Email: joaquin_blaum@brown.edu

to terms with these facts and that doing so significantly affects the normative implications of a devaluation. In a calibration exercise to the Mexican economy, an increase in the relative price of foreign goods, as observed after 1995, has a positive effect on aggregate productivity, in contrast to the negative effect predicted by the benchmark model in the literature.

Figure 1 depicts the behavior of 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. The graph shows the average experience of a sample of 9 recent episodes including Argentina 2002, Brazil 1999 and the East Asian events 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. The pattern in Figure 1 also holds in a broader sample of 26 large devaluations in the 1970-2011 period and is not driven by potentially confounding factors, including financial crises, recessions, tariff changes, or time trends.



Notes: The blue line (with crosses) 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 a measure of the real exchange rate. When available, a measure of the bilateral PPI-based real exchange rate with the US is used. A decline in this measure corresponds to a real depreciation. When producer prices are not available, wholesale or consumer prices are used. The lines in the Figure are averages of the experiences of Argentina in 2002, Brazil 1999, Indonesia 1998, Iceland 2008, Korea 1998, Malaysia 1997, Russia 1998, Thailand 1998 and Turkey 2001. The averages are computed according to (3) in footnote 16. 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: OECD, WIOD, IFS.

Figure 1: Aggregate Imported Input Share After a Large Devaluation

Micro data for Mexico and Indonesia reveals that the increase in the aggregate import share observed after the 1995 and 1998 devaluations was driven by compositional effects. In particular, intense importers tended to gain market share, pushing the aggregate import intensity up. In contrast, holding firm size constant, the within-firm changes in import shares contributed to decreasing the aggregate import share. The micro data also shows that the expansion of import intensive firms is fully explained by the fact that these firms are also exporters. The fact that intense exporters tend to be intense importers is not exclusive of the Mexican and Indonesian data, but is a robust feature of the international trade data.

To account for these findings, I propose a theory where firms can participate in the international economy both as importers of materials and as exporters of their output, in the spirit of Fieler et al. (2018). Firms live in a small open economy and choose the set of countries from which to import and to which to export. Importing materials is a means to lower the unit cost of production, while exporting allows to increase revenue. Both activities are limited by per-country fixed costs. Importantly, there is a complementarity between importing and exporting as profits are multiplicative in the scale of demand and the unit cost. This complementarity renders firms' international decisions interdependent, and generates a positive association between importing and exporting intensities.

I calibrate this model of global firms to data of the Mexican manufacturing sector in 1994, before the devaluation. Given the prominent role played by firms' heterogeneous adjustments in explaining the above empirical findings, I allow for a rich pattern of firm heterogeneity whereby firms differ in their efficiency, their fixed cost of importing and their fixed cost of exporting. I discipline this distribution of firm heterogeneity with salient features of the observed joint distribution of firm size, import intensity and export intensity across firms in 1994. To match the high correlation between import and export intensities seen in the data, the model requires that the fixed costs of importing and exporting be positively correlated.

To evaluate the model, I simulate a counterfactual devaluation by increasing the price of foreign goods relative to domestic labor along the lines of Mexico in 1995.[1] This shock makes imported inputs relatively more expensive and at the same time effectively increases foreign demand for domestic products, improving the terms for exporters. The model predicts an increase in the aggregate import share, consistent with the macro finding in Figure 1. This pattern of low aggregate substitution emerges from the combination of: (i) a widespread reduction in the cross-sectional distribution of import shares and (ii) an increase in the correlation between market shares and import shares. This correlation increases because firms with high import shares tend to gain market share. All of these patterns are consistent with what was observed following the Mexican and Indonesian devaluations.[2]

Why are intense importers expanding with the devaluation? One the one hand, these firms see their unit cost grow more when foreign inputs become more expensive, a force that makes them lose market share. This is the channel emphasized in models of importing. On the other hand, the terms for exporting improve and intense exporters, which tend to be intense importers, gain market share. On net, for sufficiently intense importers, the model predicts a positive relation between initial import intensity and market share growth, as seen in the data.

In contrast, the standard model of importing used in the literature predicts the opposite pattern of reallocation. Setting the fixed costs of exporting to prohibitively large values, the model with global firms reduces to a framework of importing with firm heterogeneity similar to Gopinath and Neiman (2014), Halpern et al. (2015), or Blaum et al. (2018). This model predicts a sharp decrease in the aggregate import share following a devaluation, which is mostly explained by a stark pattern of reallocation whereby firms with low import intensity expand and intense importers contract.[3]

This difference in the pattern of reallocation is intimately related to how production costs and prices

[1] I model the devaluation as an exogenous increase in the relative price of foreign goods, following the approach of Gopinath and Neiman (2014) and Alessandria et al. (2010), among others. In this way, I am agnostic about the causes of the devaluation. I study the consequences of a given change in relative prices, as is common in the small open economy literature.

[2] The model is also consistent with other patterns in the post-devaluation data, such as a positive relation between changes in export intensity, changes in import intensity, and changes in market share; an increase in the aggregate export intensity; a rightward shift in the cross-sectional distribution of export shares; an increase in the proportions of importer-exporters and pure-exporters, and a decrease in the proportion of pure-importers.

[3] Similar outcomes are obtained with an alternative parametrization of the baseline model with global firms where importing and exporting are not correlated. In particular, I re-calibrate the baseline model to the same moments of the Mexican economy used before, except that the target correlation between export and import shares is set to zero. Thus, while this model features meaningful heterogeneity in importing and exporting, these activities are carried out, on average, by different firms. Like the model of importing, this "uncorrelated" model predicts a large decrease in the aggregate import share which is mostly explained by the contraction of ex ante intense importers.

adjust to the devaluation in each model. In the model of importing, there is a strongly increasing relation between initial import intensity and unit cost growth, which is the counterpart of the contraction of intense importers discussed above. In the model with global firms, this relationship is tempered by the expansion of intense exporters, which tend to be intense importers. As these firms grow, they increase their import intensity and reduce their unit cost. The model with global firms thus features smaller increases in production costs and a weaker association between costs increases and initial import intensity. Consequently, this model predicts a smaller increase in the consumer price index relative to the model of importing (4.91 vs 7.69 percent, respectively).

The effect of the devaluation on productivity and welfare is also significantly different in the two models. In the model of importing, ex ante intense importers feature sharp reductions in the Solow residual, as they decrease their scale of production and material intensity.[4] As a result, aggregate productivity falls after the devaluation (by -2.4 percent). Consumer welfare also falls (by -4.17 percent). In contrast, in the model with global firms, the changes in firm productivity are higher and less correlated with initial import intensity, as exporters increase their scale and material intensity. Overall, aggregate productivity goes up with the devaluation (by 9.4 percent). Consumer welfare also increases (by 5.8 percent), as aggregate profits increase and compensate for the higher prices. Thus, for the calibration to the Mexican economy, the increase in foreign demand for exporters is strong enough to make welfare and productivity increase with the devaluation.[5]

While several other shocks affected the Mexican economy in 1995, these results highlight that an increase in the relative price of foreign goods does not generate by itself a decrease in aggregate productivity.[6] Rather than contributing to the crises, the change in relative prices can act as a factor mitigating it. In this way, taking into account firms' global behavior as exporters and importers in devaluations leads to a significantly different pattern of changes in production costs, prices, and productivity across firms and in the aggregate.

Related literature. First and foremost, the paper is closest to a literature that studies the effect of input trade on firm and aggregate productivity in models with heterogeneity in import behavior - see Halpern et al. (2015), Gopinath and Neiman (2014), Blaum et al. (2018) or Ramanarayanan (2018). These frameworks predict a decrease in the aggregate import share when foreign inputs become more expensive, a pattern that is at odds with the evidence of Figure 1.[7] Two features are crucial in generating a high degree of aggregate substitution in these models. First, they 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 and reduce their import shares.[8] Second, an increase in the price of

[4] I rely on the welfare relevant measure of firm-level productivity proposed by Gopinath and Neiman (2014) which follows Basu and Fernald (2002). With imperfect competition, this productivity residual increases with primary inputs and with material intensity.

[5] The change in welfare and aggregate productivity has to be higher in the model with global firms compared to the model of importing, though not necessarily positive. In the model with global firms, the impact of the devaluation on welfare depends on a horse race between the increased cost of foreign inputs and the improved terms for exporters. In turn, the outcome of this race depends on all model parameters, including the elasticity of export revenue to foreign prices, the elasticity of substitution between domestic and foreign inputs in firms' technologies, and the distribution of firm heterogeneity.

[6] Note that I have modeled the devaluation purely as a change in relative prices, abstracting from other shocks that Mexico experienced in 1995, including an increase in foreign interest rates and a full-blown financial crises. In addition to rising foreign interest rates, Mendoza (2006) and Meza and Quintin (2007) rely on a negative shock to firms' technology to explain the Mexican crises.

[7] Other recent quantitative frameworks with input trade, which abstract from importer heterogeneity, share this property - see e.g. Eaton et al. (2011), Caliendo and Parro (2014) or Costinot and Rodríguez-Clare (2014). 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.

[8] Relying on different methods, the international trade literature has found estimates of the elasticity of substitution between domestic and imported inputs that exceed unity. Halpern et al. (2015) find a value of 4 with Hungarian data; Antras et al. (2017) estimates a value of 2.8 with cross-country data; Blaum et al. (2018) find 2.4 with French data; and Gopinath and Neiman (2014) use a value of 4 based on estimates from Broda and Weinstein (2006). More broadly, a large literature in international trade finds values of the trade elasticity which also exceed unity - see Eaton and Kortum (2002); Simonovska and Waugh (2014); Eaton

foreign inputs disproportionally affects the more intense importers, making them lose market share and further reducing the aggregate import share. Using micro data for Mexico and Indonesia, I show that an opposite pattern of reallocation is observed after large devaluations, and that this explains the rise in the aggregate import share.

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 dropped products and countries from their import basket in the aftermath of the 2001 devaluation. Then, in the context of a model of importing, they show how these adjustments of import demand at the extensive margin lead to a fall in a welfare relevant measure of productivity.[9] I provide complementary evidence on the aggregate substitutability between domestic and foreign inputs as well as on the pattern of firm reallocation following devaluations. To be consistent this evidence, I argue that it is necessary to take into account firms' export behavior, in addition their import behavior. I show that doing so leads to significantly different normative predictions, with the devaluation having a positive effect on aggregate productivity.

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 changes 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, as the exchange rate affects their marginal cost. Building on their mechanism, I focus on the pattern of reallocation of resources between firms at home following large devaluations, and the corresponding macroeconomic implications in the context of a general equilibrium model. The theoretical framework is closely related to the one in Fieler et al. (2018), who focus on the large increase in the skill premium observed after trade liberalizations in developing countries. In their model, firms can import and export from/to a single foreign country, and they have a quality choice. I abstract from quality choice and consider an environment with multiple foreign countries and rich variation in firms' extensive margin of trade.[10] Lapham and Kasahara (2013) study how the complementarity between importing and exporting affects the gains from trade, but do not focus on devaluations. Finally, 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, Amiti et al. (2014) for Belgium, and Albornoz and Lembergman (2019) for Argentina, among others.

The paper is also related to a literature that studies large devaluations. Burstein et al. (2005) show how the real exchange rate is persistently depreciated after large nominal devaluations. Cravino and Levchenko (2017) study the distributional impact of the Mexican 1995 devaluation. Alessandria et al. (2015) provide evidence that the dollar value of exports increases gradually in a sample of recent large devaluations. I focus on the medium term and reassuringly find that the compositional effects associated with the expansion of exporters get gradually stronger.

The paper is organized as follows. Section 2 provides empirical evidence on the behavior of the aggregate

et al. (2011), among others. The evidence with Mexican and Indonesian micro data presented in this paper is consistent with such high values of this elasticity. Following a devaluation, the within-firm changes in import shares contributed to decreasing the aggregate import share.

Estimates of this elasticity from high frequency data, as used in the international real business cycle literature, tend to yield lower values, sometimes below unity - see Ruhl (2008). Given my focus on large devaluations, which display large and persistent changes in relative prices, I do not consider the high frequency estimates as a plausible explanation for the finding of Figure 1.

[9] In the literature that studies sudden stops in emerging market economies, imported inputs play a key role in explaining the observed fall in measured aggregate productivity - see Korinek and Mendoza (2014) or Mendoza (2006). Mendoza and Yue (2012) also rely on imported inputs to explain the output cost of sovereign defaults. These frameworks typically feature an aggregate elasticity of substitution between domestic and foreign inputs that is greater than or equal to unity.

[10] In Fieler et al. (2018), the variation in import and export intensities is driven by the choice of quality. In contrast, in my model the variation in import and export intensities is driven by variation in firms' extensive margin of importing and exporting. For importing, Gopinath and Neiman (2014) provide evidence of the prominent role played by adjustments in firms' extensive margin of trade in the context of a large devaluation.

import share and the pattern of reallocation following large devaluations. Sections 3 and 4 contain the model and quantitative exercise, respectively. Section 5 concludes.

2 Empirical Evidence

This Section documents the pattern of aggregate substitutability between foreign and domestic inputs observed during large devaluations. Section 2.1 details the data sources used. Section 2.2 contains the behavior of the aggregate imported input share in a sample of 26 devaluations in the 1970-2011 period. Section 2.3 provides robustness of these findings to a number of potentially confounding factors, such as time trends, tariff changes or financial crises. Section 2.4 relies on micro data from Mexico and Indonesia to decompose the growth in the aggregate imported input share into a within and a between firm component. Section 2.5 shows that the pattern of reallocation associated with the between component, and the growth in the aggregate import share, are explained by firms' export decisions.

2.1 Data Sources

Input-output tables are obtained from three sources. First, I employ the World Input Output Database (WIOD) which covers 40 countries over the 1995-2011 period. Second, I rely on the OECD national input-output tables which provide information for the OECD countries as well as 27 non-member economies over 1995- 2011. Both of these sources provide data at sector-level, with sectors defined at the 2-digit level according to the ISIC Rev. 3, resulting in 34 sectors. Finally, I rely on Johnson and Noguera (2017) - henceforth JN- which provides information for the 1970-2009 period for 42 countries and 4 broad sectors.[11] The empirical results of Section 2.2 are robust to using any of these sources to compute imported input shares.

To identify large devaluations, I rely on the list of currency crises provided by Laeven and Valencia (2012) - henceforth LV - for the 1970–2011 period.[12] A currency crises is defined as an annual nominal depreciation relative to the US dollar of at least 30% which is more than 10 percentage points higher than the previous year's rate of depreciation. This dataset also provides information on systemic banking and sovereign debt crises. To measure the real exchange rate, I obtain measures of producer price indices and nominal exchange rates from the IMF's International Financial Statistics (IFS) database. I employ wholesale or consumer price indices when producer prices are not available. I also consider the measure of the real effective exchange rate constructed by the IFS.

I rely on establishment-level data of the Manufacturing sector in 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 for the 1993-2003 period.[13] This survey does not include the Maquiladora plants.[14] 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

[11] See Table 41 in the Online Appendix for a list of the 34 sectors in the OECD input output tables. The OECD data can be accessed online at http://oe.cd/i-o. See Timmer et al. (2015) for a description of WIOD. The WIOD groups sectors somewhat differently resulting in 35 sectors - see Table A2 in Timmer et al. (2015) for a list. The data can be downloaded from www.wiod.org. The 4 broad sectors in the JN tables are: (i) agriculture, hunting, forestry and fishing, (ii) non-manufacturing industrial production, (iii) manufacturing, and (iv) services. The JN data can be accessed online from https://doi.org/10.7910/DVN/RZU4WX.

[12] The database can be downloaded from https://perma.cc/ET7Z-44DZ.

[13] 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.

[14] 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.

Country	Crises Years	Country	Crises Years
Argentina	1975, 1981, **2002**	Malaysia	**1997**
Brazil	1983, 1991, **1999**	Mexico	1977, 1982, 1995
Chile	1973, 1982	Russia	**1998**
Finland	1993	South Africa	1984
Iceland	**2008**	Spain	1983
Indonesia	1979, **1998**	Sweden	1993
Israel	1975	Thailand	**1998**
Korea	**1998**	Turkey	1980, 1994, **2001**

Table 1: Sample of Large Devaluations

Notes: The Table lists the episodes of large real devaluations used throughout the paper. The years in bold correspond to recent events for which 2-digit sector-level data from WIOD or OECD is available. See Section 6.2 in the Appendix for details on how the sample is constructed. Sources: LV, WIOD, OECD, JN, IFS.

employees for the 1991-2001 period. Both datasets provide information on spending in domestic and foreign material inputs.

Tariffs are measured with an average (simple or import-value weighted) of effectively applied tariffs across all products taken from the UNCTAD's TRAINS database. Quarterly data on the value of imports of goods and services, nominal GDP, real GDP and an index of the volume of imports are taken from the IFS database.

2.2 The Behavior of Imports around Large Devaluations

Sample of Large Devaluations. I start from the set of currency crises identified by LV for 1970-2011. I restrict to episodes for which input-output table data is available. This results in a sample of 41 currency crises listed in Table 13 in the Appendix. The bilateral real exchange rate (RER) of country i with the US is defined as

$$e_{i,US} \equiv \frac{P_i}{NER_{i,US} \times P_{US}}, \tag{1}$$

where $NER_{i,US}$ is the nominal exchange rate between country i and the US expressed in units of country-i national currency per US dollar and P_i is the price index of country i. A decrease in e corresponds to a real depreciation. Given the focus on domestically produced inputs, the preferred measure of the RER is based on producer prices (PPI), which tend to exclude the prices of imported goods. The results of this section are robust to relying on a measure of the real effective exchange rate instead of the bilateral one in (1). All the details of the construction of the sample and the real exchange rate measure are contained in Section 6.2 in the Appendix.

While the events in LV feature a large nominal depreciation, I further require that there be a large enough real depreciation. This is done to focus on events with large changes in the effective relative price of foreign inputs (see Section 6.5 of the Appendix for evidence on this). I restrict to events with a real depreciation of at least 8 percent which results in the sample of 26 episodes listed in Table 1. All results are robust to using different values for this threshold as they hold in the full sample of 41 episodes. For the events that take place after 1995, data at the two-digit sector level is available from WIOD and OECD. This results in a subsample of 9 recent events that is marked in bold in Table 1.[15]

[15] The event of Mexico 1995 is not contained in the sample of recent events because no sector-level pre-devaluation data is available in WIOD or OECD (both databases start their coverage in 1995). The sample of recent episodes is close to the one in Alessandria et al. (2015).

Evidence on the Aggregate Imported Input Share. The aggregate imported input share is defined as the ratio of total spending in imported intermediate inputs to total spending in intermediate inputs. Formally,

$$s_{I,AGG} = \frac{m_{I,AGG}}{m_{I,AGG} + m_{D,AGG}}, \tag{2}$$

where $m_{I,AGG}, m_{D,AGG}$ denote total spending in foreign and domestic inputs, respectively. These objects are computed at the economy-wide level with information from input output tables.

For the sample of recent events, Figure 1 in the Introduction depicts the behavior of the aggregate imported input share and the RER in a window of 12 years around the devaluation. The lines depict the cumulative growth rate of each variable relative to the year before the devaluation (labeled -1). The figure shows the average experience over the 9 recent episodes listed in Table 1 (marked in bold).[16] The Figure displays a striking pattern: in the 8 years following the devaluation, while the RER is persistently depreciated, the aggregate imported input share is higher than in the pre-devaluation period. More precisely, the aggregate imported input share increases by about 30 percent within the first three years and remains about 20 percent above its pre-devaluation level after 8 years. On the other hand, the RER drops by more than 30 percent on impact and recovers very slowly, remaining 15 percent below its pre-devaluation level by the end of the post-devaluation period.[17]

This pattern also holds in a broader sample of devaluations going back to the 1970s. Figure 2 depicts the average experience over the 26 events listed in Table 1.[18] Again, the aggregate imported input share is elevated while the RER is persistently depreciated in the 8 years following the devaluation. Figures 13-17 in the Appendix depict the experience of each of the 26 episodes separately. Figure 18 further confirms that the pattern seen in Figures 1-2 holds in the sample of 41 nominal depreciations identified by LV (listed in Table 13).[19] While the aggregate imported input share shown in Figures 1-2 is computed at the economy-wide level, Section 2.3 below shows that similar results are obtained within two-digit industries as well as at the Manufacturing sector level.

The large and persistent depreciation of the RER observed in Figures 1-2 suggests that imports become more expensive relative to domestic goods after large devaluations. Using import prices for a subset of events for which data is available, Figure 28 in the Appendix shows that indeed the relative price of imports to the PPI is persistently elevated after large devaluations. These findings are consistent with those of Burstein et al. (2005). Section 6.5 in the Appendix contains the details. An increase in the aggregate import share in a context where foreign inputs are relatively more expensive, as documented in the section, is at odds with recent quantitative models of input trade- e.g. Halpern et al. (2015), Gopinath and Neiman (2014) or Blaum et al. (2018). Finally, Section 6.3 in the Appendix shows that, while the aggregate import share increases, the

[16] This average is computed by first calculating the growth rates for each episode and then averaging across episodes. Formally, let g_{it}^x be the growth rate in variable x between period t and period -1 for episode i. The Figure depicts the across-episode average growth rates:

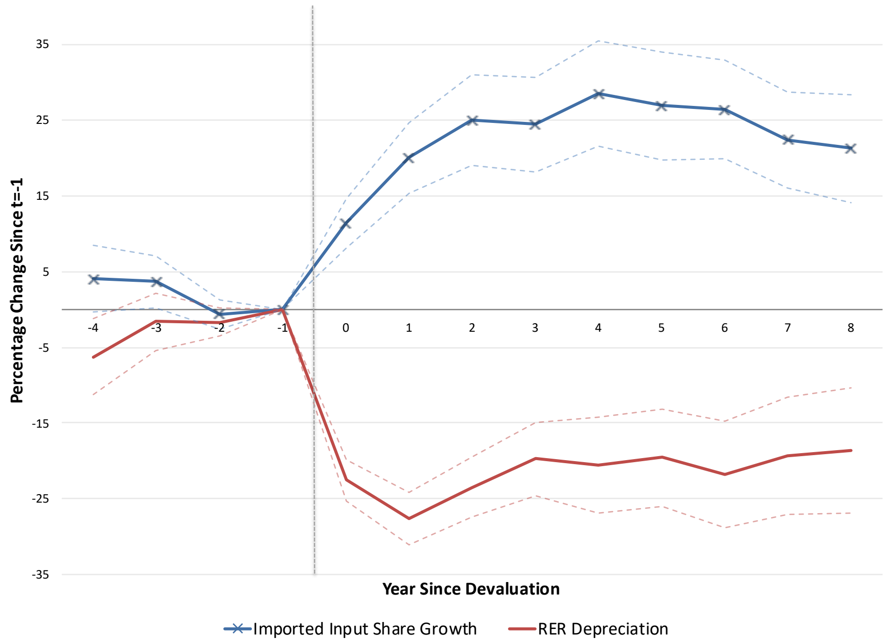
$$g_t^x \equiv \frac{1}{N_e} \sum_i g_{it}^x \tag{3}$$

for $-4 \leq t \leq 8$, where N_e is the number of episodes in the sample. In Figure 1, x can be either the aggregate imported input share or the RER.

[17] This persistence of the RER after large devaluations is consistent with the findings in previous literature. Burstein et al. (2005) find a similar pattern for the CPI-based RER in the 2 years following the devaluations of Argentina, Brazil, Korea, Mexico and Thailand. The real appreciation before the collapse in the RER, followed by a slow and gradual recovery seen in Figure 1 is consistent with the findings of Korinek and Mendoza (2014), and references therein, for sudden stops in emerging markets.

[18] For events that belong to the same country and which take place less than 13 years apart, the sample period is adjusted to avoid any overlap. This ensures that each country-year observation is used in at most one devaluation event. Table 26 in Section 6.2 of the Appendix provides details on the adjustments made to the sample period of the overlapping events. Figure 32 in Section 7.2 of the Online Appendix shows that the patterns of Figure 2 hold after removing the overlapping events from the sample.

[19] This is the sample of all currency crises identified by LV for which input-output data can be obtained in the 1970- 2011 period. The results of this section therefore do not depend on the selection process of large real depreciations described above.



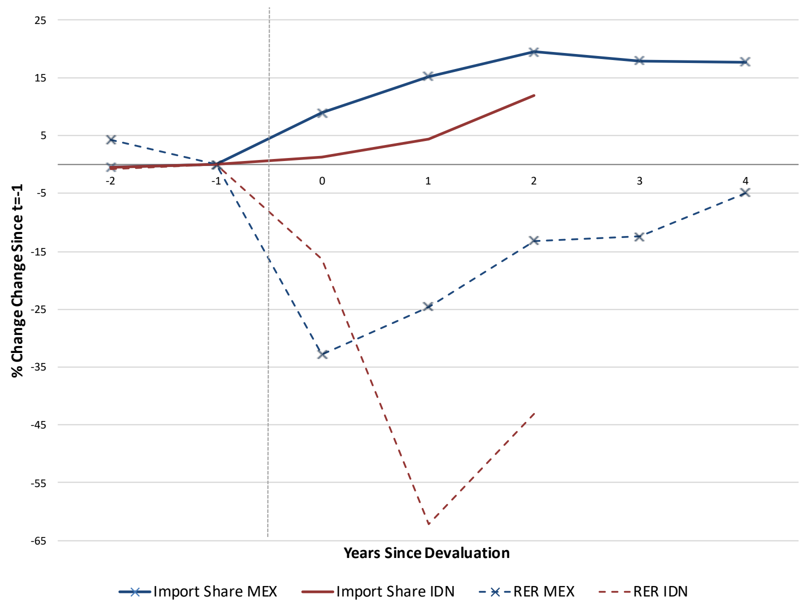
Notes: The blue line (with crosses) is the rate of growth in the aggregate imported input share between a given year and the year before the devaluation (labeled -1). The year of the devaluation is labeled 0. The aggregate imported input share is defined as the ratio of total spending in imported materials to total spending in materials (imported plus domestic). The red line depicts the rate of growth in the measure of the real exchange rate defined in (1). The lines in the Figure are averages of the experiences of the episodes in Table 1, computed according to (3) in footnote 16. 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: WIOD, OECD, JN, IFS.

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

dollar import value and import quantity fall for the average devaluation in the sample of Table 1.

A Measure with Micro Data. As additional evidence, I construct aggregate imported input shares from micro data of Mexican and Indonesian manufacturing establishments around the 1995 and 1998 devaluations, respectively. The data is taken from Manufacturing surveys and contains information on spending on domestic and foreign materials at the establishment level - see Section 2.1 for details. Figure 3 contains the growth in the aggregate imported input share around the Mexican and Indonesian devaluations. For Mexico, the aggregate import share increases by about 20 percent in the first three years and remains 15 percent above its pre-devaluation level after five years. For Indonesia, the import share is about 12 percent above its pre-devaluation value after 3 years.[20]

[20]The post-devaluation period for Indonesia lasts 3 years because the micro data is available until 2001.



Notes: The Figure shows the rate of growth in the aggregate imported input share of the Manufacturing sector following the devaluations of Mexico in 1995 (blue line with crosses) and Indonesia in 1998 (red line). The aggregate imported input share is the ratio of total imported materials to total materials (imported plus domestic) as defined in (2). The dashed lines depict the rate of growth in a measure of the real exchange rate for Mexico (blue line with crosses) and Indonesia (red line). All growth rates are computed relative to the year before the devaluation (labeled -1). The year of the devaluation is labeled 0. The data for Mexico does not include Maquiladora plants. Sources: Survey of Manufacturing in Mexico (EIA) and Indonesia (SI), IFS.

Figure 3: Aggregate Imported Input Share after Mexican and Indonesian Devaluations

A caveat about the case of Mexico is that the devaluation happened soon after the introduction of NAFTA.[21] This trade agreement reduced import tariffs gradually between 1994-2005 - see e.g. Faber (2014), Caliendo and Parro (2014) or Figure 21 in the Appendix. A concern is therefore whether the pattern in Figure 3 is driven by the reduction in tariffs. Section 2.4 below provides evidence that casts doubt on this view. If tariff reductions had offset the effect of the real devaluation, making foreign inputs effectively cheaper, we should observe that the increase in the aggregate import share is explained by within-firm changes in import shares. Table 2 below shows, however, that the increase in the aggregate imported input share in Mexico was driven by compositional effects and not by within-firm increases in import intensity. In fact, on average across firms, the firm-level import share fell after 1995 - see Table 27 in the Appendix. In addition, Section 2.3 below shows that, for the sample of large devaluations considered in Figure 2, changes in tariffs do not explain the observed increase in import intensity following devaluations.

2.3 Robustness

This section shows that the increase in the aggregate imported input share observed during large devaluations, documented in Section 2.2, is not driven by potentially confounding factors. I consider a sample of 44 countries in the 1970-2011 period which are present both in the LV crises dataset and in the input output tables.[22]

[21] Mexico entered into various other free trade agreements in this period, including the ones with Costa Rica in 1995, Nicaragua in 1998 and Chile in 1999.

[22] This sample is constructed similarly to the sample of large devaluations considered in Section 2.2, except that the country-year observations that did not experience a currency crises are kept. This sample therefore includes the 26 large devaluations considered above. The full list of countries included is contained in Table 42 in the Online Appendix.

Time trends. It is well known that import shares have tended to increase in the last decades - see e.g. Campa and Goldberg (1997) and Feenstra and Hanson (1996). To address this concern, I regress the log of the import share on an devaluation indicator as well as country and year fixed effects according to:

$$log(s_{I,AGG,ct}) = \alpha_c + \alpha_t + \beta deva_{ct} + \varepsilon_{ct}, \tag{4}$$

where $s_{I,AGG,ct}$ is the aggregate import share of country c in year t, α_c, α_t are country and year fixed effects and $deva_{ct}$ is an indicator variable that equals unity when country c had a large devaluation in year t or in the previous seven years. Table 14 in the Appendix contains the results of estimating (4) in a sample of 44 countries over 1970-2011. After controlling for country and sector fixed effects, devaluations are associated with a 6 percent increase in the aggregate imported input share. This effect is 16 percent for recent devaluations (those in marked in bold in Table 1). Similar effects are obtained when, instead of year fixed effects, I include a linear or quadratic time trend, or a country-specific linear time trend.[23]

Tariffs. Reduction in import tariffs lower the effective relative price of foreign inputs faced by domestic producers. If large devaluations tend to coincide with trade liberalizations, the increase in the aggregate imported input share seen in Figures 1-3 could arise from changes in trade policy. This concern is particularly relevant for the devaluations of the nineties, a period characterized by reductions in import tariffs (see Figures 20-21 in the Appendix). I address this concern by directly controlling for tariffs in a regression analysis following (4). I again consider the sample of 44 countries over 1970-2011 employed above and augment it with effectively applied tariffs at the country-year level from UNCTAD-TRAINS. Table 15 in the Appendix contains the results. Column two shows that, after controlling for tariffs, as well as year and country fixed effects, the aggregate imported input share is 8 percent higher in the 8-years following a large devaluation. Column three shows that, for recent devaluations, this effect is 11 percent.[24] The estimated coefficient for tariffs is negative but not statistically significant.

Financial Crises, Sovereign Default and Recessions. The devaluation episodes considered above were often accompanied by severe contractions in output, distress in financial markets and sovereign debt defaults. I now assess the effect of each of these factors on the economy's import intensity and whether they can account for the findings of Section 2.2. Regarding recessions, column four in Table 15 shows that, after controlling for real GDP, large devaluations are still associated with an increased aggregate imported input share. In fact, the coefficient of real GDP is positive and statistically significant, so that recessions are associated with a lower import intensity.[25] The findings of Figures 1-3 are therefore not likely driven by the behavior of the overall economic activity.

Financial crises and sovereign debt defaults are two other types of crises that tend to occur around large devaluations. To control for these potential confounders, I rely on LV who identify 52 systemic banking crises and 12 sovereign debt default episodes for which input output data is available (Table 13 in the Appendix).[26]

[23] The country-specific time trend control is done as follows. For each country in the sample, using the data between 1970-2011, I regress the log of the import share on a linear time trend and extract the residuals. Pooling across all countries, I then regress these residuals on a devaluation indicator and country and year fixed effects following (4). Column six in Table 14 in the Appendix contains the results.

[24] Without the control for tariffs, this effect is 16 percent - see Table 14. This suggests that the higher increase in the aggregate imported input share observed after recent large devaluations can be partially explained by changes in tariffs.

[25] This is consistent with models of input trade, such as Halpern et al. (2015), where a contraction in total domestic spending tends to lower the aggregate import share due to the presence fixed costs to importing. As additional evidence, Table 17 in the Appendix shows that the recessions tend to lower the import-to-GDP ratio.

[26] A systemic banking crises is defined as an episode with (i) significant signs of financial distress in the banking system (e.g., bank runs, losses in the banking system, or bank liquidations) and (ii) significant banking policy intervention measures (e.g., liquidity support, bank nationalizations, or deposit freezes). See Laeven and Valencia (2012) for additional details.

While crises tend to come in waves (Reinhart and Rogoff (2011)), the resulting sample features substantial variation in the occurrence of the different types of crises. For example, out of the 26 currency crises in the sample, 10 were not accompanied by a banking crises (Table 18 in the Appendix). In a specification akin to (4), including indicator variables of whether a banking crisis, a sovereign debt default or a sovereign debt restructuring took place in the previous 5 years, large devaluations are associated with a 9 percent higher aggregate imported input share (column five in Table 15). As an example, consider the devaluation of Brazil in 1999, which was not accompanied by a banking crises and displays an increase in the aggregate imported input share (Figure 23 in the Appendix). As for the effect of banking crises, column five in Table 15 suggests that, if anything, they are associated with lower imported input shares.[27] As an example, the 16 countries which experienced a banking crises in 2008 but did not experience a currency crisis display, on average, a reduction in the aggregate imported input share after 2008 (Figure 24 in the Appendix). Finally, sovereign defaults are associated with a large fall in the import share, which is precisely estimated, while debt restructuring has the opposite effect.

Sectoral reallocation. I now show that the increase in the aggregate imported input share observed after large devaluations also holds within two-digit industries. To do so, I rely on the OECD input-output tables which contain data on 34 two-digit sectors and 62 countries over 1995-2011. This sample includes the 9 events that took place after 1995 listed in Table 1 (marked in bold). Recall that input-output data for the pre-1995 devaluations is not available at the two-digit sector level. I regress the log of the aggregate imported input share at the sector-country-year level on sector, country and year fixed effects as well as an indicator of whether the devaluation took place in the last seven years. Table 16 in the Appendix contains the results. I find that sector-level import shares are 10 percent higher after large devaluations. This effect is virtually unchanged when controlling for linear time trends (instead of year fixed effects), country-sector fixed effects, and tariffs. As complementary evidence, Figure 19 in the Appendix shows that the pattern in Figure 2 also holds for the manufacturing sector.

In addition, relying on the Mexican and Indonesian firm-level data, Section 6.4.2 in the Appendix decomposes the growth in the aggregate import share of the Manufacturing sector seen in Figure 3 into a within and a between (two-digit) industry component. The growth in the aggregate import share of the Mexican and Indonesian devaluations is mostly accounted by within-sector increases in import intensity, rather than changes in the sizes of the different sectors.

We conclude that the findings of Figures 1-3 are not driven by time trends, changes in tariffs, recessions, financial crises, sovereign debt crises, or a pattern of sectoral reallocation.

Small Real Exchange Rate Fluctuations. The analysis so far has focused on large devaluations. The reason is that these events are characterized by large and highly persistent changes in the real exchange rate and the relative price of foreign inputs, as shown in Figures 2 and 28.[28] I now show that the findings of Section 2.2 are not peculiar to large devaluations but hold also for yearly changes in the real exchange rate. To do so, I reconsider the specification in (4) replacing the devaluation indicator by a measure of the real effective exchange rate provided by the IFS. This approach exploits yearly changes in the real exchange rate for 44

[27] This relationship, however, is not statistically significant. When the indicator for banking crises is defined over the previous two years (instead of the previous 5 years), the coefficient for the banking crises indicator is negative and statistically significant.

[28] Estimates of the Armington elasticity tend to be lower when obtained from higher frequency data. For example, using quarterly data on import and domestic price indices for the US, Reinert and Roland-Holst (1992) find sector-level estimates of the Armington elasticity between 0.15 and 3.49. The international real business cycle literature uses values between 0.5 and 2 to account for the behavior of the terms of trade and the trade balance at the quarterly frequency. In contrast, estimates based on more permanent variation, such as geography or tariffs, tend to give much higher estimates of this elasticity, usually in the range between 4 and 15. See Ruhl (2008) for a survey.

countries in the 1970-2011 period. Column three in Table 14 shows that real depreciations are associated with higher imported input shares. Quantitatively, a 25 percent depreciation in the real exchange rate, i.e., roughly the average depreciation in the episodes in Table 1, is associated with a 5 percent higher imported input share. Column five in Table 16 finds a similar result in the two-digit industry-level regressions. Table 17 further confirms this result exploiting quarterly changes in the real exchange and the imports-to-GDP ratio (discussed below).

Imports-to-GDP Ratio. I now consider the imports-to-GDP ratio as an alternative measure of the economy's overall import intensity. An advantage of this measure is that it can be computed at the quarterly frequency and thus allows to zoom in around the time of the devaluation.[29] Figure 22 in the Appendix contains the evolution of the imports-to-GDP ratio and the real exchange rate in a window of 28 quarters around the devaluation, averaged over the 9 recent episodes in Table 1. The imports-to-GDP ratio jumps in the quarter of the devaluation, grows by about 30 percent within 3 quarters and remains 15 percent above its pre-devaluation level even 5 years after the devaluation.[30]

These findings are confirmed with regression analysis on a sample of 64 countries between 1959 and 2015 at the quarterly frequency, which includes the large devaluations listed in Table 1 above. The series of imports and GDP are detrended by removing a country-specific log linear trend and quarter dummies.[31] Then, pooling all countries, a specification akin to (4) is estimated with country and quarter-year fixed effects. Table 17 in the Appendix contains the results. Large devaluations are associated with a 4 percent higher imports-to-GDP ratio. This effect is 9 percent for the recent devaluations in Table 1 (marked in bold). As found in Tables 14 and 16, this result is not specific to large devaluations but also holds for quarterly changes in the real exchange rate. Indeed, column three shows that real depreciations are associated with elevated imports-to-GDP ratios. Consistent with Tables 15 and 16, these results are robust to controlling for tariffs and real GDP.

2.4 The Expansion of Import Intensive Firms

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. The goal is to distinguish within-firm increases in import intensities from compositional effects associated with the reallocation of resources between firms. To do so, I consider the following decomposition of the growth rate in the aggregate import share:

$$\frac{\Delta s_{I,AGG}}{s_{I,AGG1}} = \{\underbrace{\sum_{CI} m_{i1}\left(s_{i2}-s_{i1}\right)}_{Within} + \underbrace{\sum_{CI}\left(m_{i2}-m_{i1}\right)s_{i1}}_{Between} + \underbrace{\sum_{CI}\left(m_{i2}-m_{i1}\right)\left(s_{i2}-s_{i1}\right)}_{Covariance} + ... \tag{5}$$

$$+\underbrace{\sum_{NI} m_{i2}s_{i2} - \sum_{OI} m_{i1}s_{i1}\}}_{\text{Net Entry}} \frac{1}{s_{I,AGG1}},$$

[29] The imported input share measure considered above (see (2)) was constructed from input-output tables and hence only available at the yearly frequency. Note also that the imports-to-GDP ratio differs from the aggregate imported input share in two ways. First, the numerator includes imports of final goods instead of imports of intermediate inputs only. Second, the denominator is total value added instead of total spending in inputs. The movements in the imports-to-GDP ratio may therefore reflect changes in the share of inputs to total value added or in the share of total imports accounted by inputs.

[30] Figures 29-30 in the Online Appendix report the experiences for each of the 9 country episodes in the sample. Figure 31 reports the experience of Uruguay in 2002, which is not included in the main sample of Table 1 because of lack of input-output data. The data for Uruguay is at the yearly frequency because no quarterly data is available from IFS.

[31] Similar results are obtained when using the X-12-ARIMA method from the US Census to seasonally adjust the data.

Panel A: Mexico

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

Panel B: Indonesia

Year	Within	Between	Covariance	Net Entry	All
1998	-2.09	2.03	2.01	-0.65	1.3
1999	-2.74	-0.02	1.71	5.37	4.32
2000	-1.99	8.86	1.26	3.8	11.92

Notes: The Table contains the decomposition of the growth in the aggregate import share given in (5) for the devaluations of Mexico in 1995 (Panel A) and Indonesia in 1998 (Panel B). Each row performs the decomposition over a different time horizon keeping the pre-devaluation year fixed (at 1994 for Mexico and 1997 for Indonesia). 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. Sources: Encuesta Industrial Anual (Mexico) and Survei Industri (Indonesia).

Table 2: Accounting for the Increase in the Aggregate Imported Input Share

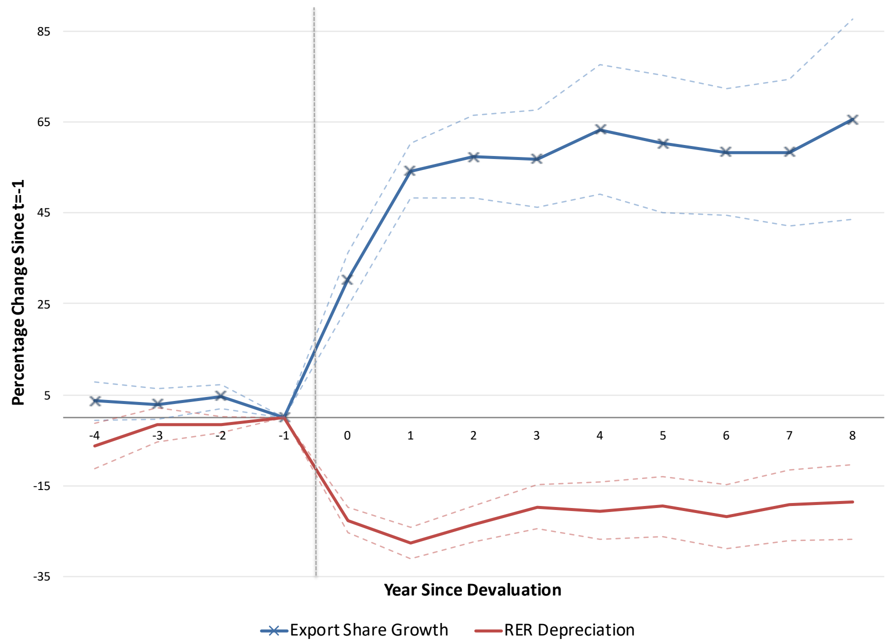
where $\Delta s_{I,AGG} = s_{I,AGG2} - s_{I,AGG1}$ is the change in the aggregate import share, m_{it} is the share of firm i in total manufacturing materials, s_{it} is the share of imported materials in total materials of firm i, and $t = 1, 2$ denote the periods before and after the devaluation, respectively. CI,NI and OI denote the sets of continuing importers (i.e., active importers in both periods), new importers (i.e., non-importers in period 1 that become importers in period 2) and old importers (importers in period 1 that become non-importers in period 2), respectively.[32] The first term in (5), labeled Within, aims to capture the contribution of the changes in import intensities holding firm size constant. The terms labeled Between and Covariance aim to capture the contribution of changes in market shares holding initial import intensities constant, as well as the covariance between market share changes and import share changes. Finally, the Net Entry term captures the contribution of the entrants into importing, net of the effect of the exiters.

Table 2 contains the results of applying this decomposition to the Mexican and Indonesian devaluations of 1995 and 1998. The decomposition is performed over different time horizons keeping the pre-devaluation year fixed. Three features stand out. First, over sufficiently long horizons, the Within component is negative. For Mexico (Panel A), the Within is monotonically decreasing with the time horizon. It starts positive over 1 or 2 year horizons and becomes negative with horizons of 3 years and longer. This pattern is consistent with an elasticity of substitution between foreign and domestic inputs in firms' technologies that is smaller than unity in the short run and increases with the time horizon, becoming larger than unity after 3 years or more. For Indonesia (Panel B), the Within is negative over all horizons. Second, the Between and Covariance terms are positive and jointly account for the majority of the increase in the aggregate import share.[33] Third, net entry tends to contribute positively to the growth in the aggregate import share and can be sizable - for Mexico it accounts for about one third of the total effect two years after the devaluation.

As an additional approach, I consider the dynamic Olley Pakes decomposition proposed by Melitz and Polanec (2015) which, rather than tracking firms over time, measures changes in the joint distribution of

[32]This decomposition follows Baily et al. (1992). The firms that enter the sample in period 2 are included in the set of new importers NI. Likewise, the firms that exit the sample in period 2 are included with the set of old importers OI. A derivation of (5) is contained in Section 6.4 of the Appendix.

[33]For Mexico, the sum of the between and covariance explain about 3/4 of the increase in the aggregate import share across the different horizons. For Indonesia, with the exception of 1999, they account for more than 80 percent of the growth in the aggregate import share.



Notes: The blue line (with crosses) is the rate of growth in the aggregate export 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: WIOD, OECD, JN, IFS.

Figure 4: Export Share After Large Devaluation, Full Sample

import shares and market shares. For the set of surviving firms, this exercise shows that the average import share tended to decrease while the covariance between market shares and import shares tended to increase following the devaluation. All derivations and results are contained in Section 6.4.1 of the Appendix.

To summarize, the increase in the aggregate import share observed after the large devaluations in Mexico and Indonesia is not explained by within-firm changes in import intensities. Instead, it is the consequence of compositional effects by which intense importers expand, as well as by the entry of firms into importing. This suggests that a low elasticity of substitution in firms' production technologies is likely not the explanation for the findings of Section 2.2.

2.5 The Link to Exporting

What explains the expansion of intense importers and the increase in the aggregate import share documented above? This section shows that these findings can be linked to the expansion of exporters, which tend to be intense importers, following the devaluation. I start by showing that the aggregate export share tends to strongly increase following large devaluations. Using the sample of 26 devaluations of Section 2.2, Figure 4 shows that the aggregate export share, defined as the fraction of total sales accounted by foreign sales, increases by about 60 percent on impact and remains elevated in the entire post-devaluation period.[34] Figure 25 in the Appendix replicates this finding using the firm-level data of Mexico and Indonesia. In the Mexican event, for example, the aggregate export share grew by about 80 percent following the devaluation.

I then rely on the firm-level data for the Mexican and Indonesian devaluations to explore whether firms' export behavior can account for the increase in import intensity observed after large devaluations. This

[34]For exports values, Alessandria et al. (2015) document a gradual expansion of total exports in a sample of recent large devaluations close to the one used for Figure 1.

mechanism is based on the fact that intense exporters are typically also intense importers, a regularity that has been widely documented 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 (2019) for Argentina, among others. Figure 26 in the Appendix confirms this pattern in the cross-section of Manufacturing establishments in both Mexico and Indonesia. To assess this mechanism, I decompose the growth rate in the aggregate import share into a term accounted by exporters and one that is not. Formally,

$$\frac{\Delta s_{I,AGG}}{s_{I,AGG1}} = \underbrace{\frac{1}{s_{I,AGG1}} \left\{ \sum_{E_2} m_{i2}s_{i2} - \sum_{E_2 \cap I_1} m_{i1}s_{i1} \right\}}_{\text{Exporters}} + \underbrace{\frac{1}{s_{I,AGG1}} \left\{ \sum_{NE_2} m_{i2}s_{i2} - \sum_{\{NE_2 \cap I_1\} \cup X} m_{i1}s_{i1} \right\}}_{\text{Rest}}, \tag{6}$$

where E_2 and NE_2 are the sets of exporters and non-exporters, respectively, after the devaluation. I_1 denotes the set of active firms in period 1 and X contains the firms that exit the sample. This decomposition isolates the contribution of firms that are exporters in the post-devaluation period to the growth in the aggregate imported input share.[35] The results are contained in the first two columns of Table 3. As before, the decomposition is performed for different time horizons keeping the pre-devaluation year fixed. For both Mexico (Panel A) and Indonesia (Panel B), in almost all time horizons, exporters account for more than the totality of the aggregate import share growth. It follows that the contribution of non-exporters tended to reduce the aggregate import share.

Next, I assess whether exporters can account for the compositional effects that were shown to explain the increase in aggregate import share in Section 2.4. To do so, I go back to the decomposition in (5) and consider the sum of the Between and Covariance components, which measures the contribution of economic reallocation to the growth in the aggregate import share. I compute the sum of these components over the set of post-devaluation exporters. Formally,

$$\underbrace{\frac{1}{s_{I,AGG1}} \sum_{CI} (m_{i2} - m_{i1})\, s_{i2}}_{\text{Between+Covariance}} = \frac{1}{s_{I,AGG1}} \{ \underbrace{\sum_{CI \cap E_2} (m_{i2} - m_{i1})\, s_{i2}}_{\text{Exporters}} + \underbrace{\sum_{CI \cap NE_2} (m_{i2} - m_{i1})\, s_{i2}}_{\text{Non-Exporters}} \}, \tag{7}$$

where as before CI denotes the set of continuing importers. The results are contained in the third and fourth columns of Table 3. I find that, in almost all time horizons, exporters tend to account for more than the totality of the reallocation terms which positively contribute to the growth of the aggregate import share. In other words, the expansion of ex-ante import-intensive firms documented in Section 2.4 tends to be fully accounted by exporting. Applying a similar breakdown to the net entry term in (5), I find that exporters fully explain the positive contribution of net entry to the growth in the aggregate import share - see last two columns of Table 3. Finally, Section 6.4.3 of the Appendix shows that similar conclusions are obtained when, in the decompositions in (6) and (7), firms are split according to whether they expanded their export intensity following the devaluation.

To further explore the mechanism, Figure 5 depicts a binned scatter plot of the changes in import intensities and the changes in export intensities associated with the devaluations in Mexico and Indonesia. The data is grouped into bins of equal size according to the difference in the export share, $\Delta s_{Xi} = s_{Xi2} - s_{Xi1}$ where s_{Xit} denotes the export share of firm i in period t. The figure then plots the within-bin averages of the changes in import shares ($\Delta s_i = s_{i2} - s_{i1}$) and changes in export shares Δs_{Xi}. I find that larger changes in export shares

[35] The set of post-devaluation exporters (E_2) includes firms that may or may not have been exporters in the pre-devaluation period, as well as firms that entered the sample. The decomposition in (6) partitions the set of active firms in period 1 into those that are exporters in period 2 ($E_2 \cap I_1$) and those that are either non-exporters in period 2 or exited the sample ($\{NE_2 \cap I_1\} \cup X$).

Panel A: Mexico

	Import Share Growth		Between + Covariance		Net Entry	
Year	Total	Exporters	Total	Exporters	Total	Exporters
1995	8.95	9.68	7.03	7.44	-0.99	-0.25
1996	15.27	17.34	8.24	8.67	5.48	6.94
1997	19.41	21.78	13.82	14.47	6.56	8.39
1998	17.91	20.80	13.89	14.26	5.93	8.88
1999	17.70	21.66	14.26	15.34	6.24	9.55

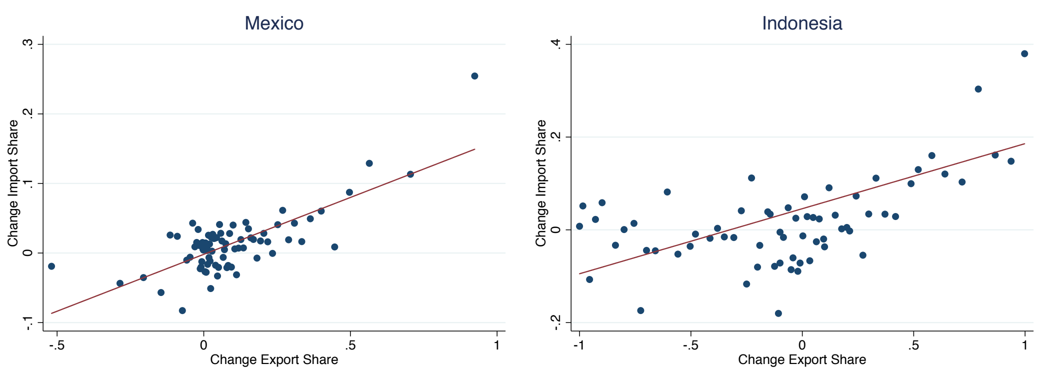
Panel B: Indonesia

	Import Share Growth		Between + Covariance		Net Entry	
Year	Total	Exporters	Total	Exporters	Total	Exporters
1998	1.30	5.43	4.04	3.86	-0.65	1.01
1999	4.32	9.31	1.69	2.98	5.37	6.91
2000	11.92	8.04	10.11	0.77	3.80	6.50

Notes: The table contains the contribution of exporters to the growth in the aggregate import share, and various of its components, observed after the devaluations of Mexico in 1995 (Panel A) and Indonesia in 1998 (Panel B). The first two columns report the contribution of exporters to the growth in the aggregate import share according to (6). The third and fourth columns report the contribution of exporters to the sum of the Between and Covariance components as outlined in (7). The last two columns provide a similar decomposition of the Net Entry component. Each row performs the corresponding decomposition over a different time horizon keeping the pre-devaluation year fixed (at 1994 for Mexico and 1997 for Indonesia). All values are in percentage points. Sources: Encuesta Industrial Anual (Mexico) and Survei Industri (Indonesia).

Table 3: The Growth in the Aggregate Import Intensity and Exporting

are strongly associated with larger changes in import shares. In addition, firms with higher pre-devaluation export share tended to display higher subsequent growth in market share (Figure 6 in Section 4 below).



Notes: The Figure depicts a binscatter plot of the changes in import shares Δs_i and the changes in export shares Δs_{Xi} associated with the devaluations in Mexico in 1995 and Indonesia in 1998. The changes in import shares are defined as $\Delta s_i = s_{i2} - s_{i1}$, while the changes in export shares are defined as $\Delta s_{Xi} = s_{Xi2} - s_{Xi1}$, where s_{Xit} is the export share of firm i, computed as the ratio of foreign sales to total sales (domestic plus foreign). The pre-devaluation year is kept fixed (at 1994 for Mexico and 1997 for Indonesia), while the post devaluation year is any of the ones considered in Table 2. The figures pool data across different horizons after taking out year fixed effects. For each figure, the data is grouped into equal-sized bins according to Δs_{Xi}. The figure then plots the within-bin average of Δs_{Xi} and Δs_i across bins. Only firms with non-zero changes (i.e., $\Delta s_i \neq 0, \Delta s_{Xi} \neq 0$) are displayed. Sources: Encuesta Industrial Anual (Mexico) and Survei Industri (Indonesia).

Figure 5: Expanding Exporters and Importers After Mexican and Indonesian Devaluations

3 A Theory of Global Firms

The goal of this section is to provide a theory that can account for the facts documented above and can be used for counterfactual analysis. Given the prominent role of firms shown in Sections 2.4-2.5, this section develops a model of trade with firm heterogeneity where firms participate in the international economy along two margins: as exporters of their output and as importers of intermediate inputs. As is standard, exporting allows firms to increase their revenue by accessing foreign demand. Importing materials is a 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. (2018). A key feature of the theory is a complementarity between importing and exporting that renders firms' decisions to participate in international markets interdependent. 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 calibrated model can come to terms with the firm-level and aggregate 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 $\mathcal{C}$. 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 the labor market. The model is of partial equilibrium in the sense that the relative price of foreign goods in terms of domestic labor is determined outside of the model. That is, market clearing is not imposed in the labor market.[36] All goods are used both for final consumption and as inputs. There is a single sector of production.[37]

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

$$y_i = \varphi_i l_p^{1-\gamma} x^{\gamma}, \tag{8}$$

where y_i is the output of firm i, φ_i is the firm's idiosyncratic efficiency, l_p is labor used for production, $\gamma \in (0,1)$, and x is a bundle of material inputs given by

$$x = \left((q_D z_D)^{\frac{\varepsilon-1}{\varepsilon}} + x_I^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon-1}}, \tag{9}$$

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

$$x_I = \left(\int_{\Sigma} (q_c z_c)^{\frac{\kappa-1}{\kappa}} dc \right)^{\frac{\kappa}{\kappa-1}}. \tag{10}$$

Here q_c and z_c are the quality and quantity of the input from country c, $\kappa > 1$, and Σ denotes the set of countries from which the firm imports its inputs. I refer to this set as the firm's sourcing strategy.

[36] Section 6.9 of the Appendix considers a version of the model where the labor market clears. There, it is shown that the quantitative results of Section 4 below are preserved and hence do not depend on assumptions about the labor market equilibrium.

[37] Table 16 showed, with regression analysis, that sector-level imported input shares tend to increase after large devaluations. Section 6.4.2 of the Appendix shows, in a decomposition exercise, that the increase in the aggregate import share observed after the Mexican and Indonesian devaluations holds within two-digit Manufacturing sectors. Indeed, Table 29 shows that most two-digit Manufacturing sectors in Mexico and Indonesia displayed an increase in the imported input share after the devaluation.

Input Prices. The prices, denoted by p_c, and qualities of all foreign inputs are exogenously given. I assume a perfectly elastic supply of foreign inputs at price p_c. Without loss of generality, I assume that input prices are constant across countries so that all variation in price-adjusted qualities is driven by country quality. More precisely, I assume that $p_c = ep^*$ for all c, where p^* is the price of foreign inputs and e is a parameter used to model a devaluation. In particular, a devaluation is thought of as an exogenous increase in the price of foreign goods.[38] Country quality q_c is assumed to be distributed Pareto with scale parameter $q_{min} > 0$ and shape parameter ξ, where $\xi > \min\{1, \kappa - 1\}$. Finally, the price of the bundle of domestic inputs is denoted by p_D.

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

$$U \quad = \quad \left(\int_i c_i^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}}, \tag{11}$$

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.[39] In addition, there is a structure of roundabout production by which firms use the output of all other domestic firms as inputs in production.[40] In particular, the domestic variety z_D is produced with an aggregator given again by (11). This assumption ensures that both sources of domestic demand feature the same isoelastic form and thus can be easily aggregated.[41] Total domestic demand for the output of firm i stemming from consumers and other firms is therefore given by

$$y_{iD} = p_i^{-\sigma} P^{\sigma-1} S, \tag{12}$$

where y_{iD} is the total quantity produced for the domestic market, p_i is the price charged by the firm in the domestic market, $P \equiv \left(\int p_i^{1-\sigma} di \right)^{\frac{1}{1-\sigma}}$ is the consumer price index associated with (11) and S is total domestic spending, which is the sum of consumer and intermediate spending at Home. Note that, because of the symmetry between consumer utility and the domestic input aggregator, it follows that the consumer price index and the price of the domestic input coincide, i.e., $P = p_D$.

Foreign Demand. The demand for the output of domestic firm i stemming from country j is given by

[38] I am agnostic about the causes of the devaluation. The goal of the model is to study the implications of an exogenously given change in relative prices, as in Gopinath and Neiman (2014), Alessandria et al. (2010) and many contributions in the small open economy literature.

Note also that the distinction between e and p^* is immaterial and, in terms of the cost of foreign inputs, a devaluation can be thought of as an increase in input prices coming from either e or p^*.

[39] 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.

[40] Roundabout production is a standard assumption in the literature - see e.g. Gopinath and Neiman (2014); Blaum et al. (2018); 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.

[41] More precisely,

$$z_D = \left(\int_\nu h_{i\nu}^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}},$$

where $h_{i\nu}$ is the demand of firm i for firm $\nu's$ output. The assumption that the domestic variety aggregator features the same functional form as consumer utility in (11) 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 (12) below. It follows that firms use the same pricing rule regardless of whether they sell to consumer or other firms.

$$y_{ij} = p_{ij}^{-\sigma} e^{\sigma-1} b_j, \tag{13}$$

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. In this way, a devaluation (i.e., an increase in e) leads to an increase in the cost of foreign inputs and at the same time a boost in foreign demand for Home goods. Finally, b_j is assumed to be distributed Pareto across countries with scale parameter $\underline{b} > 0$ and shape $\theta > 1$. We denote this distribution by $G(b_j)$.

Trade costs. Exporting to any destination entails a firm-specific fixed cost f_{Xi} per destination and a variable cost τ, which are assumed to be common across destinations for simplicity. Importing from any origin has a firm-specific fixed costs of f_i, assumed to be common across origins for tractability.[42] Variable trade costs are included in input prices p^*. In addition, there are fixed costs associated with the overall international strategy of the firm. These are given by F_M, F_X and F_{XM} for an importer-only, an exporter-only, and an importer-exporter, respectively. All fixed costs are paid in units of labor.

Market Structure. Firms are price takers in foreign input markets: they can buy any quantity z_c of the input from country c at given price p_c. Likewise, firms are price takers in the domestic labor market and can hire any amount of labor l_p at wage w. In domestic output markets, there is CES monopolistic competition.

3.2 Firm Problem

The firm's problem consists of deciding its domestic output price p_i, domestic quantity produced y_{iD}, import status and import sourcing strategy Σ_i, quantities of all inputs $\{l_{pi}, z_{Di}, \{z_{ci}\}_{c\in\Sigma_i}\}$, export status and export strategy, as well as the prices and quantities in each export destination $\{p_{ij}, y_{ij}\}$. In this framework, all of these decisions are interdependent and cannot be studied separately. I start by characterizing the unit cost of production given the extensive margin of importing Σ_i. I then characterize the optimal prices and quantities at Home and in each foreign market the firm decides to export to. It turns out that all of the firm's decisions can be summarized by a single object: the importing sourcing strategy, Σ. I conclude by expressing the profits associated with each global status (i.e., importer-exporter, importer-only, exporter-only, or purely domestic) in terms of Σ_i.

Unit Cost given Sourcing Strategy. Given the sourcing strategy Σ, the firm chooses the quantities of production labor, the domestic bundle and the foreign inputs $\{l_p, z_D, \{z_c\}_{c\in\Sigma}\}$ to solve:

$$C(y, \varphi_i, \Sigma) = \min_{l_p, z_D, \{z_c\}} \left\{ wl_p + p_D z_D + \int_\Sigma ep^* z_c dc \text{ s.t. } \varphi l_p^{1-\gamma} x^\gamma \geq y \right\},$$

and (9)-(10). Standard calculations imply that the optimal expenditure on foreign inputs m_I satisfies:

$$\begin{aligned} m_I &= \int_\Sigma ep^* z_c dc = \left(\int_\Sigma (ep^*/q_c)^{1-\kappa} dc \right)^{\frac{1}{1-\kappa}} x_I \\ &\equiv eA(\Sigma) x_I, \end{aligned}$$

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

where $A(\Sigma) \equiv \left(\int_{\Sigma} (p^*/q_c)^{1-\kappa} \, dc\right)^{\frac{1}{1-\kappa}}$ is the price index associated with the foreign bundle x_I. The cost function is given by:

$$C(y, \varphi_i, \Sigma) = \varphi_i^{-1} \left(\frac{w}{1-\gamma}\right)^{1-\gamma} \left(\frac{Q(\Sigma)}{\gamma}\right)^{\gamma} y, \tag{14}$$

where w is the wage and Q is the price index associated with the material bundle x, given by

$$Q(\Sigma; e) = \left((p_D/q_D)^{1-\varepsilon} + e^{1-\varepsilon} A(\Sigma)^{1-\varepsilon}\right)^{\frac{1}{1-\varepsilon}}. \tag{15}$$

An increase in e, which we refer to as a devaluation, 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 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

$$A(\Sigma) = p^* \left(\frac{\xi q_{min}^{\xi}}{(1+\xi-\kappa)} \bar{q}^{\kappa-\xi-1}\right)^{\frac{1}{1-\kappa}} = z n^{-\eta}, \tag{16}$$

where $n \equiv (q_{min}/\bar{q})^{\xi}$ is the mass of countries in the sourcing set and z and η are auxiliary parameters determined by (q_{min}, ξ, κ).[43] Combining (14), (15) and (16) 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 the unit cost.

In what follows, I characterize the firm's extensive margin in terms of the share of material spending allocated to domestic inputs, given by $s_D \equiv p_D z_D / (p_D z_D + m_I)$. Given input prices and model parameters, there a one-to-one mapping between the domestic share s_D and the mass of countries sourced n - see equation (43) in Section 6.6 of the Appendix. Expressing the firm's problem in terms of the domestic share, which is observable in the data, will prove convenient for the calibration of the model in Section 4 below. Additionally, the domestic share summarizes how input trade affects the unit cost - see Blaum et al. (2018). To see this, note that the firm's unit cost can be expressed as

$$u_i = \varphi_i^{-1} \left(\frac{w}{1-\gamma}\right)^{1-\gamma} \left(\frac{p_D}{\gamma q_D}\right)^{\gamma} s_{Di}^{\frac{\gamma}{\varepsilon-1}}. \tag{17}$$

In this way, the domestic share, raised to an appropriate power, captures the extent to which firms benefit from input trade. In particular, a low domestic share results in a low unit cost. All input sourcing decisions, including foreign sourcing, are summarized in the unit cost. I next work out the price and quantity decisions in Home as well as abroad.[44]

[43] In particular, these are given by:

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

The expression in (16) requires the assumption that $\kappa - \xi - 1 < 0$.

[44] In what follows, I normalize the wage to unity. Section 6.6 of the Appendix shows that this is without loss of generality.

Domestic Pricing. Given the sourcing strategy and associated unit cost, the 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

$$p_i = \frac{\sigma}{\sigma - 1} u_i, \tag{18}$$

and the following expression for domestic variable profits:

$$\pi_{Di} = \sigma^{-\sigma} (\sigma - 1)^{\sigma-1} u_i^{1-\sigma} P^{\sigma-1} S. \tag{19}$$

Foreign Pricing and Export Participation. Consider now the price, quantity and participation decisions in foreign markets. The variable profits from exporting to market j are:

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

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:

$$\pi_{ij}^{v} = \sigma^{-\sigma} (\sigma - 1)^{\sigma-1} (1+\tau)^{1-\sigma} u_i^{1-\sigma} e^{\sigma-1} b_j. \tag{20}$$

Exporting to market j is optimal if these variable profits exceed the corresponding fixed cost, i.e., $\pi_{ij}^{v} > f_{Xi}$, which reduces to:

$$b_j > \underbrace{\sigma^{\sigma} (\sigma - 1)^{1-\sigma} (1+\tau)^{\sigma-1} u_i^{\sigma-1} e^{1-\sigma} f_{Xi}.}_{\equiv b^*(u_i)} \tag{21}$$

The optimal export strategy is to export to destinations where the demand shifter b_j exceeds a threshold, given by $b^*(u_i)$. (20)-(21) make clear that the exporting and importing decisions are interconnected, as the profits of exporting to any destination depend on the unit cost. Thus, being a more intense importer (i.e., having a lower s_{Di}), makes it more likely and more profitable to export to any destination. Note also that a devaluation (an increase in e) boosts the profits from exporting to any destination, and this effect is stronger for more intense importers.

Integrating over the countries in the optimal export strategy yields an expression for total profits from exporting, net of the country-level exporting fixed costs:

$$\begin{aligned}\pi_{Xi} &= \int_{b^*}^{\infty} \left(\pi_{ij}^{v} - f_{Xi}\right) dG(b_j) \\ &= \frac{1}{\theta - 1} \underline{b}^{\theta} e^{\theta\sigma-1} \sigma^{-\theta\sigma} (\sigma-1)^{\theta(\sigma-1)} (1+\tau)^{-\theta(\sigma-1)} u_i^{-\theta(\sigma-1)} f_{Xi}^{1-\theta}.\end{aligned} \tag{22}$$

Global Status and Sourcing Strategy. I now study the choice of the optimal sourcing strategy, s_{Di}, conditional on the firm's global status (i.e., importer-exporter, importer-only, exporter-only or purely domestic).

The firm then selects the global status with highest profits. The profits associated with being an importer-exporter are obtained by combining the expressions for domestic and export profits in (19) and (22), the unit cost in (17), and netting out the importing and global status fixed costs. After some manipulations, these profits are

$$\tilde{\Pi}_{XMi} = \varphi_i^{\sigma-1} s_{Di}^{-\frac{\gamma}{\varepsilon-1}(\sigma-1)} + \frac{1}{\theta}\varphi_i^{\theta(\sigma-1)} s_{Di}^{-\theta(\sigma-1)\frac{\gamma}{\varepsilon-1}} \tilde{f}_{Xi}^{1-\theta} - \gamma\eta\left(\sigma-1\right)\left(s_{Di}^{-1}-1\right)^{\frac{1}{\eta(\varepsilon-1)}} \tilde{f}_i - \tilde{F}_{XM}, \qquad (23)$$

where a tilde denotes that the variable has been re-scaled by general equilibrium variables (i.e., S and P) and parameters - see Section 6.6 in the Appendix for details.[45] Working with the re-scaled fixed costs will be useful for the calibration of the model in Section 4 below. The firm chooses its sourcing strategy, s_{Di}, to maximize the expression in (23). Importing more intensively (i.e., a lower s_{Di}) increases domestic and foreign profits (the first two terms) at the expense of increasing the bill of country-level importing fixed costs (third term). The optimal sourcing strategy balances these two forces.

The remaining global strategies can be studied as special cases of (23). The profits of being an importer-only, $\tilde{\Pi}_M$, are given by (23) when $f_{Xi} \to \infty$ and $\tilde{F}_{XM}$ is replaced by $\tilde{F}_M$.The profits of an exporter-only, $\tilde{\Pi}_X$, are given by (23) with $s_{Di} = 1$ and $\tilde{F}_X$ instead of $\tilde{F}_{XM}$. Finally, the profits of being purely domestic, $\tilde{\Pi}_D$, are given by (23) when $f_{Xi} \to \infty$, $s_{Di} = 1$ and $\tilde{F}_{XM}$ is omitted.The firm selects the global status that yields the highest profits:

$$\pi_i = \max\left\{\tilde{\Pi}_{Di}, \tilde{\Pi}_{Xi}, \tilde{\Pi}_{Mi}, \tilde{\Pi}_{XMi}\right\}. \qquad (24)$$

3.3 Equilibrium

Equilibrium Definition. The equilibrium is defined as follows. Given foreign input prices ep^*, the levels of foreign demand $\left[e^{\sigma-1}b_j\right]_j$, and transfers T, an equilibrium is a set of sourcing strategies $[s_{Di}]_i$, prices and differentiated product quantities for home $[y_{iD}, p_i]_i$ and all export destinations $[y_{ij}, p_{ij}]_{ij}$, input demands $[l_{pi}, [h_{i\nu}]_\nu, [z_{ci}]_c]_i$, and domestic consumption levels $[c_i]_i$ such that:

1. Firms maximize profits given by (24),
2. Consumers maximize utility given in (11) subject to their budget constraint:
$$\int_i p_i c_i di = L + \int_i \pi_i di + T, \qquad (25)$$
3. Goods markets clear:
$$y_{iD} = c_i + \int h_{\nu i} d\nu, \qquad (26)$$
where $h_{\nu i}$ is the amount demanded by firm ν of firm $i's$ output.

[45] For example, the re-scaled fixed cost of importing, $\tilde{f}_i$, is related to the fixed cost of importing, f_i, by:

$$\tilde{f}_i \equiv \gamma^{-1-\gamma(\sigma-1)} \frac{1}{\eta} (1-\gamma)^{-(1-\gamma)(\sigma-1)} \left(\frac{p_D}{q_D}\right)^{1-\frac{1}{\eta}} \left(\frac{\sigma}{\sigma-1}\right)^{\sigma} z^{\frac{1}{\eta}} e^{\frac{1}{\eta}} P^{1-\sigma} S^{-1} f_i.$$

The corresponding expressions for $\tilde{f}_X, \tilde{F}_{XM}, \tilde{F}_M, \tilde{F}_X, \tilde{\Pi}_{XM}, \tilde{\Pi}_{XM}, \tilde{\Pi}_{XM}$, as well as a derivation of (23), are contained in Section 6.6 in the Appendix.

Trade Balance. Combining the consumer budget constraint in (25) and the goods market clearing conditions in (26), the trade balance is given by

$$TB \equiv X - M = -T - (L - L_d)\,, \tag{27}$$

where L_d is the total labor demand and L is the labor endowment of the consumer. Thus, 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. In other words, a trade deficit with the rest of the world can be financed with a labor surplus with the rest of the economy. Unlike the transfers, the size of the gap in the labor market is endogenous. In Section 6.9 of the Appendix, an alternative version of the model with labor market clearing is presented.

Equilibrium Characterization. All equilibrium objects and outcomes can be recovered from the level of total domestic spending S and the price index P.[46] An equilibrium is thus fully described by the pair (S, P). I adopt a two-step approach to find the equilibrium values of (S, P). First, I characterize (S, P) given data on domestic and export shares (s_{Di}, s_{Xi}) for all firms.[47] Second, I require that firms optimally choose (s_{Di}, s_{Xi}) given (S, P) . This approach is useful for two reasons. It helps shed light on how firms' international behavior affects the general equilibrium objects, as shown in the following result. The approach is also computationally useful in the calibration exercise of Section 4 below.

Proposition 1. *Given firms' domestic expenditure and export shares (s_{Di}, s_{Xi}), the consumer price index associated with preferences in (11) is given by*

$$P = \kappa_0 \left(\int_i \varphi_i^{\sigma-1} s_{Di}^{\frac{\gamma}{\varepsilon-1}(1-\sigma)} di \right)^{-\frac{1}{(1-\gamma)(\sigma-1)}}, \tag{28}$$

and aggregate domestic spending S is given by

$$S = (L+T)\left(1 - \frac{1}{\sigma} - \left(\kappa_1 \Upsilon \frac{1}{\sigma} + \gamma \frac{\sigma-1}{\sigma}\kappa_1 \Gamma - \Psi\right) P^{(1-\gamma)(\sigma-1)}\right)^{-1}, \tag{29}$$

where Υ, Γ , and Ψ are functions of (s_{Di}, s_{Xi}) given by

$$\Upsilon \equiv \int_i \varphi_i^{\sigma-1} s_{Di}^{\frac{\gamma}{\varepsilon-1}(1-\sigma)} \frac{s_{Xi}}{1-s_{Xi}} di, \Gamma \equiv \int_i \varphi_i^{\sigma-1} s_{Di}^{1+\frac{\gamma}{\varepsilon-1}(1-\sigma)} \frac{1}{1-s_{Xi}} di,$$

$$\Psi \equiv \int_i \left(\kappa_2 \left(s_{Di}^{-1} - 1\right)^{\frac{1}{\eta(\varepsilon-1)}} \tilde{f}_i + \kappa_3 \left(\frac{\theta-1}{\theta}\right) \left(\frac{s_{Xi}}{1-s_{Xi}}\right)^{\frac{\theta}{\theta-1}} \tilde{f}_{Xi} + \kappa_3 \mathbb{I}_{Mi} \tilde{F}_M + \kappa_3 \mathbb{I}_{Xi} \tilde{F}_X + \kappa_3 \mathbb{I}_{XMi} \tilde{F}_{XM} \right) di,$$

and κ_0, κ_1, κ_2 and κ_3 are constants determined by model parameters defined in (54),(59), (66) and (67) in

[46] To see this, note that the only general equilibrium objects that enter into the expression for firm profits are S/w and P/w - see equation (44) in Section 6.6 of the Appendix. Recall that e/w is exogenously given and the wage is normalized to unity.

[47] The export share is defined as:

$$s_{Xi} \equiv \frac{R_{Xi}}{R_{Di} + R_{Xi}},$$

where R_{Xi} and R_{Di} are firm i's total export and domestic revenue, respectively. The export share is related to the domestic share by

$$\frac{1}{s_{Xi}} - 1 = \varphi_i^{(\sigma-1)(1-\theta)} s_{Di}^{(\theta-1)(\sigma-1)\frac{\gamma}{\varepsilon-1}} \tilde{f}_{Xi}^{\theta-1}.$$

See Section 6.6 in the Appendix for a derivation of this relationship.

Section 6.8 of the Appendix. $\mathbb{I}_{Mi} = \mathbb{I}\left((s_{Di} < 1) \cap (s_{Xi} = 0)\right), \mathbb{I}_{Xi} = \mathbb{I}\left((s_{Di} = 1) \cap (s_{Xi} > 0)\right)$ *and* $\mathbb{I}_{XMi} = \mathbb{I}\left((s_{Di} < 1) \cap (s_{Xi} > 0)\right)$ *are indicator functions of whether the firm is an importer-only, exporter-only or importer-exporter, respectively. The rescaled fixed costs* $\left(\tilde{f}_i, \tilde{f}_{Xi}, \tilde{F}_M, \tilde{F}_X, \tilde{F}_{XM}\right)$ *are obtained from firms' optimality conditions (69)-(70) in the Appendix.*

Proof. See Section 6.8 of the Appendix. □

Proposition 1 highlights how firms' joint import and export behavior affects the equilibrium price index and level of domestic spending. Equation (28) shows that the consumer price index is an efficiency-weighted average of $s_{Di}^{\frac{\gamma}{\varepsilon-1}}$, which in turn capture how much unit costs are reduced by input trade - see (17) above. When more efficient firms feature lower domestic shares, the consumer price index is lower. Equation (29) shows how equilibrium spending depends on terms related to export revenue, spending in domestic materials and labor used for fixed costs. The term Υ captures the effect of aggregate exports in total firm profits and hence consumer income. This term increases when firms are more import intensive or more export intensive. Because importing and exporting are complements in generating profits, more correlated import and export shares, all else equal, lead to an increased Υ and hence higher equilibrium spending. The term Γ captures firms' spending in domestic materials and hence also affects positively the equilibrium total spending.[48] Finally, the term Ψ captures the effect of the labor used for fixed costs on aggregate spending. More resources spent on fixed costs, as captured by a higher Ψ, tends to reduce aggregate spending.

Welfare and Productivity. Consumer welfare is given by the ratio of consumer income I, defined by the right hand side of equation (25) above, and the price index: $W = I/P$. In turn, consumer income is obtained by subtracting firms' spending in domestic materials from aggregate spending. As shown in Section 6.8 of the Appendix, this yields:

$$I = S\left[1 - \gamma\frac{\sigma-1}{\sigma}\kappa_1 \Gamma P^{(1-\gamma)(\sigma-1)}\right]. \tag{30}$$

Following Basu and Fernald (2002) and Gopinath and Neiman (2014), firm-level productivity growth is measured with the Solow residual:

$$\Delta \ln PR_i \equiv \Delta \ln y_i^{va} - s_{Li}\Delta \ln l_i,$$

where $\Delta \ln y_i^{va}$ is the growth rate of real value added, $\Delta \ln l_i$ denotes the growth rate of labor (including the one used for production as well as for fixed costs) and s_{Li} is the share of labor in value added. Real value added growth is computed with the Divisia index:

$$\Delta \ln y_i^{va} = \frac{1}{1 - s_{Xi}^Y}\Delta \ln y_i - \frac{s_{Xi}^Y}{1 - s_{Xi}^Y}\Delta \ln x_i, \tag{31}$$

where $\Delta \ln y_i$ is the growth rate of gross output, $\Delta \ln x_i$ is the growth rate of materials and s_X^Y is the share of

[48] The effect of the domestic share s_{Di} on Γ depends on the sign of $1 + \frac{\gamma}{\varepsilon-1}(1-\sigma)$. The bundle of parameters $(1-\sigma)\times\gamma/(\varepsilon-1)$ controls how the domestic share affects revenue, which in turn determines total material spending. Because $1-\sigma<0$, a lower domestic share tends to increase revenue and hence material spending. However, the fraction of this spending that is allocated to the domestic variety is lower.

materials in revenue which is equal to $\gamma(\sigma-1)/\sigma$ for all firms.[49] Gopinath and Neiman (2014) show that:

$$\begin{aligned}\Delta \ln PR_i = & \frac{1}{(\sigma-1)(1-\gamma)}\left[s_{Li}\Delta \ln l_i - \frac{\gamma(\sigma-1)}{\sigma-\gamma(\sigma-1)}(1-\gamma)\left(\Delta \ln p_D + \frac{1}{\varepsilon-1}\Delta \ln s_{Di}\right)\right] \\ & - \frac{\sigma-\gamma(\sigma-1)}{(\sigma-1)(1-\gamma)} s_{Li}\frac{\Delta l_{Fi}}{l_i} + \Delta \ln \varphi_i.\end{aligned} \tag{32}$$

The productivity residual is increasing in the scale of production, captured by primary input growth $\Delta \ln l_i$. The reason is that, in computing productivity, labor growth is discounted using its share in value added, s_{Li}, which, under imperfect competition, does not fully capture the contribution of labor to output growth. Productivity is also increasing in the intensity of intermediate-input usage, as captured by the second term in (32).[50] The reason is again that real value added growth is computed by subtracting material growth using its revenue share, which does not fully capture the productive contribution of materials with imperfect competition.[51] As emphasized by Basu and Fernald (2002), the growth in primary inputs and material intensity captured in (32) are relevant for welfare because, with imperfect competition, firms produce a suboptimal amount. Finally, the third term in (32) captures the change in the use of labor for fixed costs. A reduction in the use of labor for fixed costs tends to increase the productivity residual because, all else equal, fixed cost labor has no effect on output.

Aggregate productivity growth is given by a value-added weighted average of firm-level productivity:

$$\Delta \ln PR = \sum \omega_i \Delta \ln PR_i, \tag{33}$$

where ω_i denotes firm i's share in industry-level value added.

4 Quantitative Exercise

In this Section, the model is calibrated to salient features of the Mexican micro data. Sections 2.4-2.5 have shown that changes in firm size, import intensities and export intensities are central in accounting for the pattern of low aggregate substitution observed after large devaluations. The calibration therefore targets key moments from the joint distribution of firm size, import and export intensities. The model parameters are mostly identified from pre-devaluation cross-sectional moments. The calibrated model is evaluated by comparing the predicted changes in these moments after a counterfactual devaluation with the observed changes in the Mexican case. The calibrated model is then used to measure how production costs, prices and productivity across firms and in the aggregate are affected by the devaluation. The baseline model with global firms is compared to the standard model of importing used in the literature.

[49] The Divisia index corresponds to the growth rate in value added keeping output and material prices fixed. That is, (31) is obtained from:

$$\Delta \ln y_i^{va} = \frac{p_i \Delta y - Q_i \Delta x_i}{p_i y_i - Q_i x_i},$$

where Q_i is the price index of materials.

[50] The second term in (32) is proportional to $\Delta lnx_i - \Delta lny_i$, i.e., to the growth in material intensity. This follows from the fact that

$$\frac{x_i}{y_i} \propto \frac{p_i}{Q_i} \propto Q_i^{\gamma-1},$$

where Q_i is the price of materials which is related to the price of the domestic input and the domestic share by

$$Q_i = p_D s_{Di}^{\frac{1}{\varepsilon-1}}.$$

[51] The fact that material intensity growth, as opposed to simply material growth, is what matters is due to the fact that when materials grow proportionally to output their effect on the productivity residual is captured by the growth in primary inputs.

4.1 Calibration

4.1.1 Parametrization and Moments

To generate rich distributions in the model, three dimensions of firm heterogeneity are allowed: efficiency φ_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 μ_φ, μ_f and μ_{f_X}, variances σ^2_φ,σ^2_f and $\sigma^2_{f_X}$, and correlations $\rho_{\varphi f}, \rho_{\varphi f_X}$ and $\rho_{f f_X}$.[52] These parameters, as well as the global status parameters F_M,F_X 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 standard deviations of firm sales, import and export shares, (iii) all pairwise correlations between sales, import shares 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 θ, 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.[53] In the model, the devaluation is generated via an increase in e/w, which controls foreign prices relative to domestic labor. Finally, the values for σ, γ, ε, and η are taken from Blaum et al. (2018).[54]

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 θ. 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 $\left(\varphi_i, \tilde{f}_i, \tilde{f}_{Xi}\right)$, $\tilde{F}_{XM}, \tilde{F}_M$ and $\tilde{F}_X$ - see Section 3.2 above. In other words, conditional on θ, the model is 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, θ is chosen to match the growth rate in total exports following a counterfactual 20 percent devaluation (i.e., increase in e). In this step, after e is increased, the equilibrium values of S and P need to be re-computed. The details of the solution algorithm are contained in Section 6.7 of the Appendix.

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

[53] Recall that θ controls the elasticity of export revenue to the price of foreign goods e - see equation (50) in Section 6.6 of the Appendix. Intuitively, a change in e moves the threshold level of foreign demand above which it is profitable to export to a destination, b^* - see (21). The value of θ controls the elasticity of the mass of destinations with demand above this cutoff to a change in the cutoff. Also, in the model, exports are measured in units of foreign goods. In the data, exports are measured in US dollars.

[54] Blaum et al. (2018) estimate these parameters from data of French manufacturing firms. The demand elasticity σ is measured from profit margins (i.e., sales to costs ratios) and yields a value of 3.8, while the output elasticity of materials γ is measured from the material cost shares and yields a value of 0.61. These values are standard in the literature. For example, relying on average markups, Oberfield and Raval (2014) find estimates of the demand elasticity between 3 and 5 for US industries. Blaum et al. (2018) estimate the elasticity of substitution between domestic and foreign inputs, ε, via a production function estimation exercise. More precisely, when output is expressed in terms of materials spending rather than quantities, ε 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. (2018) estimate a value of $\varepsilon = 2.38$. This value is close to what other recent studies of firm-level importing have found, including Antras et al. (2017), Halpern et al. (2015) and Kasahara and Rodrigue (2008). Finally, Blaum et al. (2018) estimate the sensitivity of the price index of foreign varieties to the mass of countries sourced, η, from the cross-sectional relationship between the domestic expenditure share and the number of countries sourced. This yields a value of $\eta = 0.38$.

4.1.3 Calibration Results and Model Fit

Table 4 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 but imperfect correlation between firm sales and import (export) shares requires a positive correlation between firm efficiency and the fixed costs of importing (exporting).[55] Tables 5- 6 present non-targeted moments of the joint distribution of sales, import shares and export shares. The model is able to replicate well the marginal distributions of size, import and export intensity (Table 5), as well as the positive association between these variables seen in the data (Table 6).[56]

Parameter		Targeted Moment		
Description	Value	Description	Model	Data
Average importing fixed cost ($\mu_{\tilde{f}}$)	-0.44	Aggregate Import Share	0.36	0.36
Average exporting fixed cost ($\mu_{\tilde{f}_X}$)	104.93	Aggregate Export Share	0.16	0.16
Fixed cost importer-only $(\tilde{F}_M)$	0.01	Fraction Importers-Only	0.25	0.25
Fixed cost exporter-only $(\tilde{F}_X)$	0.019	Fraction Exporters-Only	0.07	0.07
Fixed cost importer-exporter $(\tilde{F}_{XM})$	0.02	Fraction Importer-Exporters	0.17	0.17
Dispersion in efficiency (σ_φ)	0.61	Dispersion in sales	1.71	1.71
Dispersion in importing fixed costs ($\sigma_{\tilde{f}}$)	3.15	Dispersion in imp. shares	0.27	0.27
Dispersion in exporting fixed costs ($\sigma_{\tilde{f}_X}$)	71.63	Dispersion in exp. shares	0.18	0.18
Corr. efficiency - importing fixed cost ($\rho_{\varphi\tilde{f}}$)	0.86	Corr. sales-imp. shares	0.27	0.27
Corr. efficiency - exporting fixed cost ($\rho_{\varphi\tilde{f}_X}$)	0.48	Corr. sales - exp. shares	0.15	0.15
Corr. importing - exporting fixed costs ($\rho_{\tilde{f}\tilde{f}_X}$)	0.19	Corr. imp. - exp. shares	0.18	0.18
Dispersion in Foreign Demand (θ)	1.03	Growth in Exports	81%	84%

Notes: Firm sales, given by (53) in the Appendix, are computed in logs. The import share corresponds to $1 - s_D$ in the text. The aggregate import share is the ratio of total spending in foreign inputs to total spending in inputs. The aggregate export share is the ratio of total foreign sales to total sales. Dispersion refers to the standard deviation. The fractions of importers-only, exporters-only and importer-exporters are computed as the number of firms in each group divided by the total number of firms in the economy. To compute the growth of exports in the model, exports are measured in units of foreign goods. The moments in the data are computed for the Mexican manufacturing sector in 1994. Exports are measured in US dollars. Source: Encuesta Industrial Anual (Mexico).

Table 4: Calibrated Parameters and Targeted Moments

[55] To see this, consider the case where the fixed cost of importing is 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 the import share. By assigning higher fixed costs to more efficient firms, the correlation between firm size and the import share is decreased.

[56] In the model generated data, export shares are, on average, higher for larger firms except for the top quartile of sales (Table 6). Recall that the correlation between efficiency and the fixed cost of exporting ($\rho_{\varphi\tilde{f}_X}$) is calibrated to be positive. This correlation can offset the positive effect of firm size on the export share (due to the presence of fixed costs to exporting), leading to a decrease in export intensity for larger firms. A similar logic explains why export shares can be, on average, lower for the top quartile of import shares.

	Percentiles				
	10th	25th	50th	75th	90th
Normalized log domestic sales					
Data	-12.05	-11.19	-10.17	-9.12	-8.06
Model	-12.63	-11.39	-10.28	-9.23	-8.26
Import Shares, Importers					
Data	3.37	10.71	29.79	58.98	83.31
Model	3.93	8.83	26.73	61.58	87.19
Export Shares, Exporters					
Data	0.54	2.45	9.73	34.41	74.16
Model	2.32	6.47	19.02	45.70	72.59

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

	Quartiles of Sales			
	1	2	3	4 (largest)
Import Share				
Data	7.92	15.21	19.89	27.91
Model	1.96	18.28	20.13	21.42
Export Share				
Data	3.49	5.26	7.3	9.98
Model	0.72	9.12	9.63	8.13
	Quartiles of Import Shares			
	1	2	3	4 (largest)
Export Share, Exporters				
Data	19.63	18.59	21.69	27.29
Model	21.85	31.15	37.86	33.27

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.

Table 6: Conditional Distributions: Model vs Data

4.2 A Counterfactual Devaluation

This section studies the effect of an increase in the price of foreign goods on firms' international behavior and the aggregate pattern of substitution between domestic and foreign inputs. In particular, it considers an across-the-board increase in the prices of foreign goods relative to domestic labor. This includes the prices of foreign inputs as well as of foreign goods that compete with the Home-produced goods in export markets.

4.2.1 Baseline Model of Global Firms

I consider an increase in the price of foreign inputs relative to domestic labor (e/w) of 20 percent which corresponds to the observed increase in the Mexican devaluation of 1995.[57] Tables 7-9 contain the effects

[57] More precisely, e/w is measured as the ratio of the import price index to an index of wages provided by the IFS. In Mexico, this ratio increased by 20 percent between the average of 1991-1994 and the average of 1995-1999. Relatedly, Mendoza (2006) documents that the price of imported inputs increased by 15% in 1995 and remained high for about 6 years in Mexico.

predicted by the calibrated model. For comparison, the tables also report outcomes in the Mexican experience, defined as changes between 1994 and the average of the 1995-99 period. The data figures are included to assess whether the model outcomes are consistent with the Mexican experience, while acknowledging that various shocks other than the change in the relative price of foreign goods hit the Mexican economy in 1995, e.g., an increase in the foreign interest rate (Mendoza (2006)).[58] Section 7.3 in the Online Appendix considers a 10 percent and a 30 percent increase in the price of foreign goods and shows that the qualitative insights of this section are preserved.

The calibrated model predicts that, as a result of the devaluation, the aggregate import share increases by about 2.5 percentage points (a growth rate of 7 percent) - see Table 7.[59,60] An increase in the aggregate import share following a large devaluation is consistent with what was observed in the Mexican experience, as well as in the sample of devaluations considered in Section 2 above. As will be shown below, standard models of importing, or models where importing and exporting are uncorrelated, feature the opposite prediction.

	Model		Mexico 94-99
Change in ...	Baseline	Importing	
Aggregate Import Share	2.55	-5.25	5.68
Aggregate Export Share	10.19	-	12.75
Corr. sales-imp. shares	0.03	-0.03	0.06
Corr. sales-exp. shares	0.07	-	0.08
Corr. imp.-exp. shares	0.06	-	0.06
Fraction Importers-Only	-2.97	-0.42	-7.05
Fraction Exporters-Only	2.57	-	3.70
Fraction Importer-Exporters	8.26	-	9.74

Table 7: Effects of a Counterfactual Devaluation: Models and Data

Notes: The changes in the moments are computed as differences in levels (i.e., the value of the moment post devaluation minus its value pre devaluation). The change in the aggregate import share, the aggregate export share, and the fractions of importers-only, exporters-only and importer-exporters are all expressed in percentage points. The correlation entries correspond to the difference in the correlation coefficient post-pre devaluation. 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). The data rows depict changes between 1994 and the average of 1995-1999 in the Mexican manufacturing sector. The model columns depict changes in the model-generated data resulting from a 20 percent increase in the price of foreign goods. The "Baseline" column corresponds to the model of global firms calibrated in Section 4.2.1. The "Importing" column corresponds to the model of importing calibrated in Section 4.2.2.

While the aggregate import share increases, the model predicts a shift to the left in the marginal distribution of import shares following the devaluation. Table 8 shows that the 10th, 25th, 50th, 75th, 90th and 95th percentiles of the distribution of import shares all tend to decrease.[61] How can this widespread reduction in

[58] The empirical evidence presented in Section 2 above suggests that these other shocks are not associated with increases in the aggregate import share. See Section 2.3 for evidence on financial crises and recessions using a sample of 44 countries in 1970-2011. As for tariff reductions, the negative Within component in Table 2 suggests that foreign inputs became relatively more expensive after 1995, casting doubt on the view that tariff changes can explain the increase in the aggregate import share observed in Mexico.

[59] The calibrated model predicts that the aggregate imported input share increases from 36% to about 38.5%. In the Mexican manufacturing sector, the increase was from 36% in 1994 to an average of 41.5% in the 1995-1999 period. Section 2.4 documents that about half of the increase seen in Mexico can be attributed to within-sector changes. The model's prediction is therefore quantitatively closer to the within-sector increase in the import share seen in the data. See equation (39) for the decomposition used and Table 28 in the Appendix for the results.

[60] Section 2 above documented the change in the aggregate imported input share in terms of its growth rate. This was done for comparability across different episodes of large devaluations. In this Section, we express the change in the aggregate import share (and other moments) as the difference in levels, expressed in percentage points.

[61] Note that this shift in the marginal distribution of import shares does not imply that all firms reduce their import shares. Table 8 documents changes in the cross-sectional distribution of import shares; it does not follow individual firms over time. In the model-generated data, about 15% of the firms increase their import shares, about 32% reduce their import share, while the rest leaves their import share unchanged.

firm-level import shares be consistent with the increase in the aggregate share? The reason is that firm size and import shares become more correlated after the devaluation (Table 7). Importantly, this pattern of widespread reduction in import shares together with increased correlation between firm size and import intensity was also observed in the Mexican experience (Tables 7 and 8).

	Percentiles					
	10th	25th	50th	75th	90th	95th
Import Shares, Importers, final - initial						
Data	-0.40	-0.46	-0.38	-0.47	-1.62	-1.02
Baseline Model	-1.61	-2.00	-5.09	-7.05	-3.14	-1.33
Model of Importing	-0.83	-1.35	-2.79	-3.9	-2.18	-1.06
Export Shares, Exporters, final - initial						
Data	0.42	1.26	3.73	4.78	2.42	-0.91
Baseline Model	0.14	0.47	1.22	2.02	2.06	1.78
Model of Importing	-	-	-	-	-	-

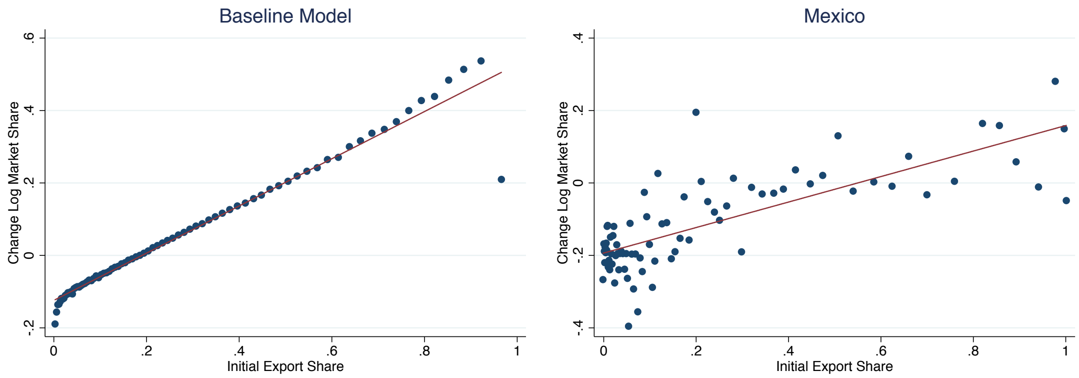
Notes: The data rows depict changes in the percentiles of the distribution of import shares (first panel) and export shares (second panel) between 1994 and the average of 1995-99 in the Mexican manufacturing sector. For the data, the figures are constructed as the difference between the average percentile in the 1995-99 period and the percentile in 1994. The model rows depict changes in the model generated data resulting from a 20 percent increase in the price of foreign goods. The "Baseline" column corresponds to the model of global firms calibrated in Section 4.2.1. The "Importing" column corresponds to the model of importing calibrated in Section 4.2.2. All entries are in percentage points. Source: Encuesta Industrial Anual (Mexico).

Table 8: Changes in Distribution of Import and Export Shares

How can firm size and import intensity become more correlated after a devaluation that makes imported inputs more expensive? The answer is related to firms' export behavior. First, note that intense importers are more exposed to the increase in the price of foreign inputs and as a result, all else constant, their unit cost tends to grow more, a force that makes them lose market share. This is the standard channel emphasized in models of importing. In the model with global firms, there is the additional effect that the devaluation effectively improves the terms faced by exporters in foreign markets, making exporters grow and increase their export shares (Table 8). Naturally, this effect is more pronounced for more efficient exporters (i.e., firms with low f_{Xi}), which as a result tend to grow more. Figure 6 contains a binscatter of growth rates in market share and initial export intensity. Indeed, initially more export intensive firms displayed stronger growth in market share following the devaluation, both in the model and in the data. Because intense exporters tend to be intense importers, this mechanism tends to make ex-ante intense importers relatively expand. The left panel of Figure 7, which depicts a binscatter of market share growth and initial import share for the model generated data, shows that for firms with sufficiently high import intensity the effect of improved terms of exporting tends to dominate, generating an increasing relationship between the ex-ante import share and market share growth. In the Mexican data, this positive relation holds more broadly across all degrees of initial import intensity (right panel of Figure 7). This expansion of import intensive firms, both in the model and in the data, results in an increased correlation between firm size and import intensity and an increase in the aggregate import share. A similar pattern was observed after the Indonesian devaluation of 1998 (see Table 27 in the Appendix).

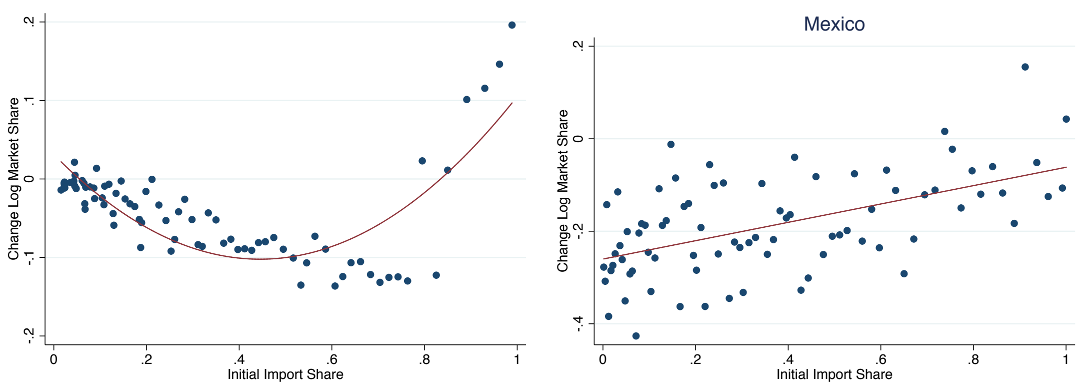
To assess the quantitative importance of this pattern of reallocation, I perform the decomposition of the growth in the aggregate import share following Baily et al. (1992) used in Section 2.4 above (see equation (5)) to the model generated data. Table 9 contains the results.[62] The model generates a Within component that is negative, as is the case in the data. Thus, holding firm size constant, the changes in import intensities tend to

[62]For the data, the decomposition is performed between 1994 and 1999. I select a single year as post devaluation period, rather than the average of 1995-1999 as used in Table 7, to ensure that all the terms of the decomposition add up to the total growth rate. Table 2 of Section 2.4 shows the decomposition using any of the years in 1995-1998 as post devaluation period.



Notes: The Figure depicts binscatter plots of the changes in log market shares $\Delta log\,(\omega_i)$ and the pre-devaluation export share s_{Xi1} associated with the counterfactual devaluation generated in the baseline model calibrated in Section 4.1.3 (left panel) and the experience of Mexico in 1995 (right panel). The changes in log market shares are defined as $\Delta log\,(\omega_i) = log\,(\omega_{i2}) - log\,(\omega_{i1})$, where ω_{it} denotes firm $i's$ share in total value added in period t. For each figure, the data is grouped into equal-sized bins according to the pre-devaluation export share s_{Xi1}. The figure then plots the within-bin average of s_{Xi1} and $\Delta log\,(\omega_i)$ across bins. Only firms with positive pre-devaluation export share (i.e., $s_{Xi1} > 0$) are included. For the data, the initial period is 1994 and the final period is any of the years in 1995-1999. The data used are residuals after taking year fixed effects. Sources: Encuesta Industrial Anual (Mexico).

Figure 6: The Growth of Intense Exporters: Baseline Model vs Data



Notes: The Figure depicts binscatter plots of the changes in log market shares $\Delta log\,(\omega_i)$ and the pre-devaluation import share s_{i1} associated with the counterfactual devaluation generated in the baseline model calibrated in Section 4.1.3 and the experience of Mexico in 1995. The changes in log market shares are defined as $\Delta log\,(\omega_i) = log\,(\omega_{i2}) - log\,(\omega_{i1})$, where ω_{it} denotes firm $i's$ share in total value added in period t. For each figure, the data is grouped into equal-sized bins according to the pre-devaluation import share s_{i1}. The figure then plots the within-bin average of s_{i1} and $\Delta log\,(\omega_i)$ across bins. Only firms with positive pre-devaluation import share (i.e., $s_{i1} > 0$) are included. For the data, the initial period is 1994 and the final period is any of the years in 1995-1999. The data used are residuals after taking year fixed effects. Sources: Encuesta Industrial Anual (Mexico).

Figure 7: Growth By Import Intensity: Baseline Model vs Data

	Within	Between	Covariance	Net Entry	Total
Mexico 94-99	-2.79	9.99	4.27	6.24	17.70
Baseline Model	-1.67	8.06	0.42	0.26	7.07
Model of Importing	-2.69	-11.97	0.07	-0.06	-14.65

Notes: The Table contains the Baily et al. (1992) decomposition in (5) performed on model-generated data resulting from a 20 percent increase in foreign prices as well as on data from the Mexican manufacturing sector between 1994 and 1999. All entries are in percentage points.

Table 9: Decomposition of Import Share Growth: Models vs Data

decrease the aggregate import share. Importantly, the model generates a Between component that is positive and large, of about 8 percentage points, explaining more than the totality of the growth in the aggregate import share. This shows that the expansion of ex ante intense importers plays a crucial role in generating the increase in the aggregate import share, as in the data. Applying a breakdown by export status similar to the one in (7) in Section 2.4, I find that exporters account for more than the totality of the Between.[63,64]

The model predicts a sharp increase in the aggregate export intensity (Table 7). This increase arises from the combination of a shift to the right in the marginal distribution of export shares except at the very top (Table 8) and a stronger correlation between firm size and export intensity (Table 7). This again is related to the fact initially more export intensive firms tend to grow more after the devaluation. In addition, the model predicts a reduction in the proportion of pure-importers and an increase in the proportions of pure-exporters and importer-exporters.[65] These model predictions are all consistent with the Mexican experience.

The model is also consistent with the cross-sectional pattern of changes in export shares, import shares and market shares seen after the Mexican devaluation. Figure 8 depicts a binscatter of the changes in the export intensity and the changes in the import intensity for both the model generated devaluation and the experience of Mexico. The model predicts that 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.[66,67] Additionally, firms that increase their export share tend to increase their market share, both in the model and data (Figure 9).

Finally, the devaluation leads to an improvement in the trade balance, which changes from deficit to surplus - see Table 19 in the Appendix. Because exogenous transfers are kept constant, the trade surplus is used to finance a deficit of labor with the rest of the economy. The increase in labor demand by the manufacturing sector is intuitive. As the relative price of labor in terms of foreign goods decreases, firms demand for locally produced inputs increases. At the same time, expanding exporters also demand more labor. Quantitatively,

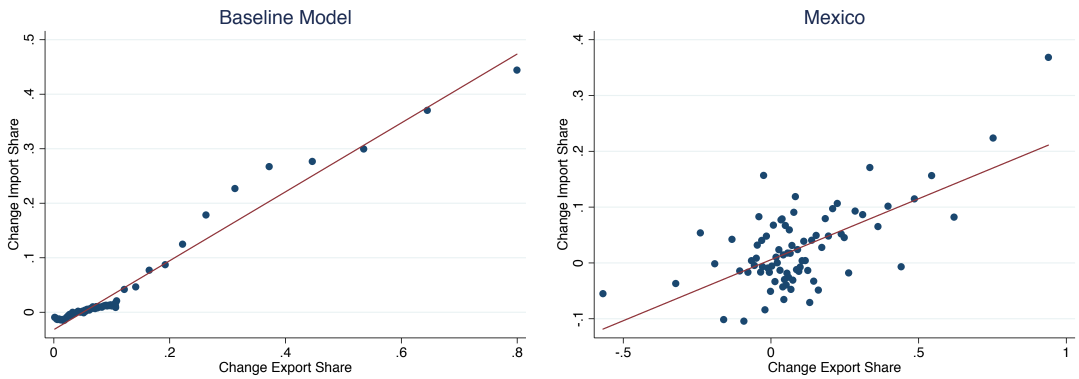
[63] More specifically, computing the sum of the Between and Covariance components over the set of post-devaluation exporters, as in (7), yields a value of about 13 percentage points.

[64] The contribution of net entry in the model is positive but very small. In the data, however, this is an important margin. Recall that entry and exit are defined as entry and exit into / out of the importing status. In the data, this includes firms that enter and exit the sample. In the model, the set of active firms in the economy is fixed.

[65] According to the model, the increase in the fraction of importer-exporters more than offsets the reduction in the fraction of pure-importers. As a result, the proportion of firms doing any importing increases. This model prediction is supported by the data. As shown below, the standard model of importing cannot come to terms with this feature of the data.

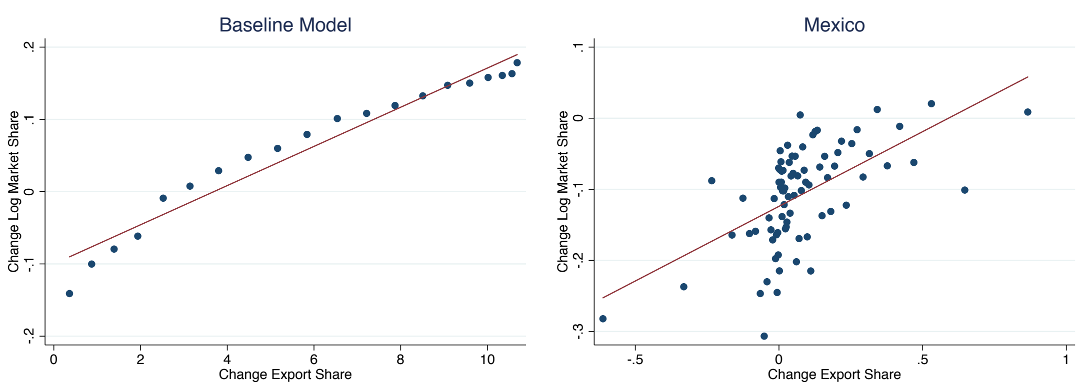
[66] Note that in the model, a positive relationship between growth in export shares and growth in import shares is not mechanical. Holding prices constant, a firm with a lower domestic share will feature a higher export share - see equation (51) in Section 6.6 of the Appendix. The reason is that a lower domestic share implies a reduction in the unit cost which makes exporting more profitable. However, an increase in foreign prices (e) leads to an increase in the export share for a given value of the domestic share. Thus, it is possible for a firm to both increase its domestic share and increase its export share after the devaluation. Figure 8 shows that in the calibrated model this does not happen.

[67] The graphs show a substantial number of firms featuring an increase in their import share. For the model generated data (left panel), about 50% of the firms in the graph increase their import intensity. Note that the graphs are constructed using firms with non-zero changes in export shares and import shares. In the full population, only 15% of the firms increase their import share. This number is about 30% if we condition in the population of firms with non-zero changes in their import share. Note also that the model features no firm for which the export share decreases.



Notes: The Figure depicts binscatter plots of the changes in import shares Δs_i and changes in export shares Δs_{Xi} associated with the counterfactual devaluation generated in the baseline model calibrated in Section 4.1.3 and the experience of Mexico in 1995. The changes are defined as $\Delta s_i = s_{i2} - s_{i1}$ and $\Delta s_{Xi} = s_{Xi2} - s_{Xi1}$ where 1 and 2 are the pre and post devaluation periods, respectively. For each figure, the data is grouped into equal-sized bins according to the changes in export shares Δs_{Xi}. The figure then plots the within-bin average of Δs_i and Δs_{Xi} across bins. Only firms with non-zero changes in export shares and import shares are included (i.e., the firms for which $\Delta s_i = 0$ or $\Delta s_{Xi} = 0$ are excluded). For the data, the initial period is 1994 and the final period is any of the years in 1995-1999. The data used are residuals after taking year fixed effects. Sources: Encuesta Industrial Anual (Mexico).

Figure 8: Expanding Exporters and Expanding Importers: Baseline Model vs Data



Notes: The Figure depicts binscatter plots of the changes in log market shares $\Delta log\left(\omega_i\right)$ and the changes in export shares Δs_{Xi} associated with the counterfactual devaluations generated in the baseline model and the experience of Mexico in 1995. The changes in log market shares are defined as $\Delta log\left(\omega_i\right) = log\left(\omega_{i2}\right) - log\left(\omega_{i1}\right)$, where ω_{it} denotes firm $i's$ share in total value added in period t. The changes in export shares are defined as $\Delta s_{Xi} = s_{Xi2} - s_{Xi1}$, where s_{Xit} is the export share of firm i in period t. For each figure, the data is grouped into equal-sized bins according to Δs_{Xi}. The figure then plots the within-bin average of Δs_{Xi} and $\Delta log\left(\omega_i\right)$ across bins. Only firms with non-zero changes (i.e., $\Delta log\left(\omega_i\right) \neq 0, \Delta s_{Xi} \neq 0$) are displayed. For the data, the initial period is 1994 and the final period is any of the years in 1995-1999. The data used are residuals after taking year fixed effects. Sources: Encuesta Industrial Anual (Mexico).

Figure 9: The Growth of Expanding Exporters: Baseline Model vs Data

Parameter		Targeted Moment		
Description	Value	Description	Model	Data
Average importing fixed cost ($\mu_{\tilde{f}}$)	1.471	Aggregate Import Share	0.36	0.36
Fixed cost import status ($\tilde{F}_M$)	0.062	Fraction Importers	0.42	0.42
Dispersion in efficiency (σ_φ)	0.604	Dispersion sales	1.71	1.71
Dispersion in importing fixed costs ($\sigma_{\tilde{f}}$)	3.113	Dispersion imp. shares	0.27	0.27
Corr. efficiency - importing fixed cost ($\rho_{\varphi \tilde{f}}$)	0.870	Corr. sales-imp. shares	0.27	0.27

Notes: Firm sales, given by (53) in the Appendix, are computed in logs. The import share corresponds to $1 - s_D$ in the text. The aggregate import share is the ratio of total spending in foreign inputs to total spending in inputs. Dispersion refers to the standard deviation. The fraction of importers is the number of importers divided by the total number of firms in the economy. In the data, all firms engaged in importing are considered regardless of their export status. The model corresponds to the theory of Section 3 where the fixed costs of exporting are made arbitrarily large, i.e., $F_X \to \infty, F_{XM} \to \infty, f_{Xi} \to \infty$ for all firms.

Table 10: Model of Importing: Calibration

the model predicts a reduction in the trade deficit of about 10 percentage points of domestic absorption, which is close to what was observed in data. Section 6.9 in the Appendix presents a version of the model with equilibrium in the labor market where the trade balance is kept constant. The conclusions of this section are preserved in this version of the model.

4.2.2 A Model of Importing

In this section, I consider a 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. In this case, the model reduces to a framework of importing with firm heterogeneity akin to the ones considered in the literature - e.g. Gopinath and Neiman (2014), Halpern et al. (2015), Ramanarayanan (2018) or Blaum et al. (2018).[68] Section 6.10 in the Appendix considers an alternative case where all fixed costs of exporting are set to zero and all firms export a common fraction of their sales.[69] There it is shown that this alternative version of the standard model of importing yields the same conclusions as the one considered in this section.

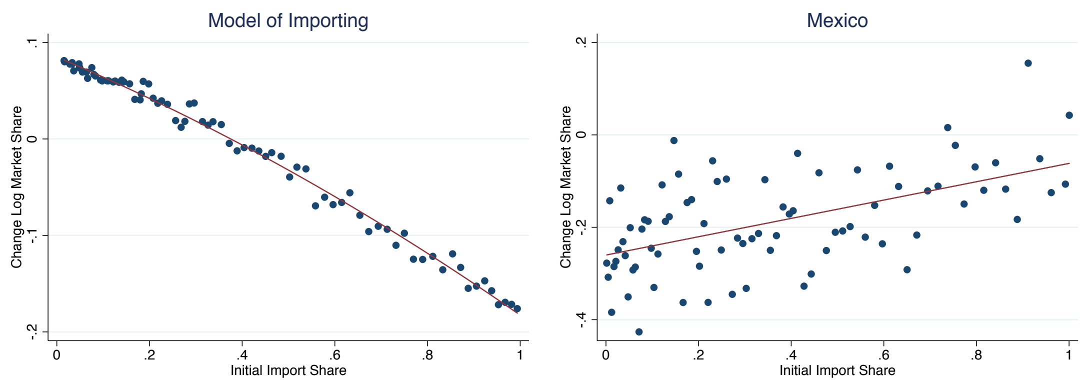
After setting the costs of exporting to an arbitrarily large value, the remaining parameters are recalibrated to the importing-related moments targeted in the baseline case above. These are moments of the joint distribution of firm sales and import shares, namely: (i) the aggregate import share, (ii) the standard deviations of firm sales and import intensities, (iii) their correlation, and (iv) the fraction of importers. Table 10 contains the results of the recalibration. The model is able to perfectly match all moments.

Tables 7-12 contain the effect of a 20 percent increase in the price of foreign inputs. The main result is that the aggregate import share falls by about 5 percentage points (a growth rate of -15%). This reduction in the aggregate import share arises both from the widespread reduction in firm-level import shares (Table 8) and the reduction in the correlation between firm size and import intensity (Table 7). Additionally, there is a reduction in the proportion of importers.[70] These outcomes are intuitive. In the standard model of importing, the devaluation works only through increasing the price of foreign inputs, thus discouraging importing. Crucially, ex-ante more import intensive firms are more exposed to the increase in the cost of foreign inputs and hence

[68] In the models of Gopinath and Neiman (2014) and Ramanarayanan (2018), firms differ only in their efficiency φ_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., $\sigma_f = \rho_{\varphi f} = 0$. 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).

[69] In particular, Section 6.10 of the Appendix considers a version of the model of Section 3 where the fixed costs of exporting are set to zero, i.e., $F_X = f_{Xi} = 0 \; \forall i$ and $F_M = F_{XM} > 0$.

[70] In addition, in the model of importing, the devaluation leads to an improvement in the trade balance as imports fall. Quantitatively, the reduction in the trade deficit is close to what the baseline model with global firms predicts (about 10 percentage points of domestic absorption). See Table 19 in the Appendix.



Notes: The Figure depicts binscatter plots of the changes in log market shares $\Delta log\left(\omega_i\right)$ and the pre-devaluation import share s_{i1} associated with the counterfactual devaluations generated in the model of importing and the experience of Mexico in 1995. The changes in log market shares are defined as $\Delta log\left(\omega_i\right) = log\left(\omega_{i2}\right) - log\left(\omega_{i1}\right)$, where ω_{it} denotes firm $i's$ share in total value added in period t. For each figure, the data is grouped into equal-sized bins according to the pre-devaluation import share s_{i1}. The figure then plots the within-bin average of s_{i1} and $\Delta log\left(\omega_i\right)$ across bins. Only firms with positive pre-devaluation import share (i.e., $s_{i1} > 0$) are included. For the data, the initial period is 1994 and the final period is any of the years in 1995-1999. The data used are residuals after taking year fixed effects. Sources: Encuesta Industrial Anual (Mexico).

Figure 10: Growth By Import Intensity: Model of Importing vs Data

are disproportionally affected. This gives rise to a stark pattern of reallocation by which firms with low import intensity expand while intense importers contract, depicted in the left panel Figure 10. In contrast, after the Mexican devaluation, an opposite pattern of reallocation was observed, with initially more import intensive firms featuring higher growth in market share (right panel of Figure 10). Consequently, there was an increase in the correlation between firm size and import shares and an increase in the aggregate import share (third column in Table 7). Additionally, the proportion of importers increased.[71] The baseline model with global firms is able to come to terms with these facts, as seen in Table 7 above.

Table 9 contains a decomposition of the growth in the aggregate import share predicted by the model, following the methodology of Baily et al. (1992) used in Section 2.4 above (see (5)). We see that, in the model of importing, the decrease in the aggregate import share is mostly explained by a large and negative Between component, of about -12 percent. A negative Between arises whenever initially import intensive firms tend to contract, as shown in the left panel of Figure 10. In contrast, the Between component observed after the Mexican devaluation was large and positive, of about 10 percent.

Uncorrelated Importing and Exporting. I now consider another parametrization of the baseline model which, in contrast to the model of importing considered above, allows for meaningful heterogeneity in export intensities but features no correlation between importing and exporting. In particular, the model with global firms is re-calibrated to the same moments as in Section 4.1.3 above except that the target correlation between import and export shares is set to zero.[72] In this way, this exercise explores the effects of a devaluation when the importing and exporting activities are carried out, on average, by different firms. Table 20 in the Appendix contains the results of the calibration. To attain a zero correlation between importing and exporting, the model

[71] Note that, while the baseline model predicts a decrease in the fraction of importers-only, it also predicts an increase in the fraction of importer-exporters. The net effect is an increase in the fraction of importers of about 5 percentage points. In the Mexican data, the fraction of importers increased by 2.7 percentage points. See Table 7.

[72] This re-calibration exercise 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 θ is kept constant at the value of the baseline calibration of Section 4.1.3. Section 7.4 in the Online Appendix considers exercises where all parameters, including θ , are recalibrated and shows that the conclusions of this section are preserved.

Change in ...	Uncorrelated Model	Mexico 94-99
Aggregate Import Share	-4.02	5.68
Corr. sales-imp. shares	-0.01	0.06
Between component	-10.65	9.99

Table 11: Uncorrelated Model: Selected Outcomes

Notes: The changes in the moments are computed as differences in levels (i.e., the value of the moment post devaluation minus its value pre devaluation). The change in the aggregate import share is expressed in percentage points. The correlation entry correspond to the difference in the correlation coefficient post-pre devaluation. The correlation between firm sales and import shares is computed on the sample of importers. The data rows depict changes between 1994 and the average of 1995-1999 in the Mexican manufacturing sector. The model columns depict changes in the model generated data resulting from a 20% increase in the price of foreign goods. The "Uncorrelated Model" corresponds to the model with global firms calibrated in Table 20.

requires that the fixed costs of importing and exporting be negatively correlated ($\rho_{\tilde{f}\tilde{f}_X} < 0$).[73] By assigning comparative advantage in exporting and importing in a negatively correlated way, the model generates an effective separation of the importing and exporting activities across firms. This exercise is referred to as the uncorrelated model.

Table 11 contains the effects of a 20 percent increase in foreign prices on selected outcomes in the uncorrelated model.[74] The key finding is that the aggregate import share is predicted to fall by about 4 percentage points (a growth rate of -11%). This result follows from a widespread reduction in firm-level import shares (Table 22 in the Appendix) which is reinforced by a reduction in the correlation between firm size and import shares. Applying the decomposition in (5), I find that the decrease in the aggregate import share predicted by the uncorrelated model is mostly explained by a large, negative Between component, associated with the contraction of ex-ante import intensive firms. The left panel of Figure 11 shows that indeed a higher pre-devaluation import share is strongly associated with lower subsequent market share growth. Thus, the uncorrelated model predicts a pattern of reallocation that is similar to the one predicted by the model of importing (Figure 10), and both models feature a fall in the aggregate import share.[75] In contrast, the Mexican data and the baseline model feature an opposite pattern by which ex-ante import intensive firms grow after the devaluation (see right panel of Figure 11).

4.2.3 Normative Implications

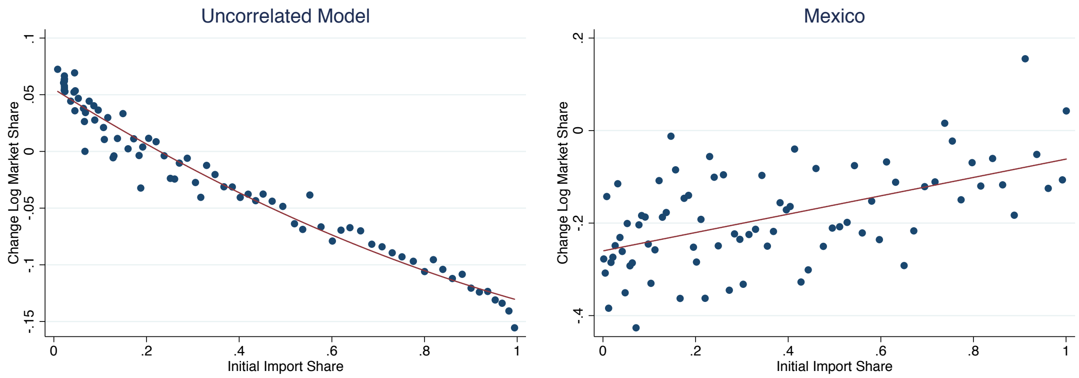
This section compares the normative implications of the devaluation in the baseline model with global firms and the model of importing (contained in Table 12). Consider first production costs and prices. As foreign inputs become more expensive, firms adjust their import demand and production costs tend to increase. The model of importing predicts larger increases in unit costs than the baseline. For the average firm (including importers and non-importers), the unit cost increases by 6.08 percent in the model of importing vs 3.28 percent in the baseline (Table 12).[76] In addition, the extent of this over-prediction is larger for initially more

[73]Absent any correlation between the importing and exporting fixed costs ($\rho_{\tilde{f}\tilde{f}_X} = 0$), the model still delivers positively correlated import and export shares. The reason is that unit cost reductions and increases in revenue enter multiplicatively in the profit function, so that importing and exporting are complements even if the fixed costs are uncorrelated. For this reason, the model requires $\rho_{\tilde{f}\tilde{f}_X}$ to be negative.

[74]The full results are contained in Tables 21-24 in the Appendix.

[75]Similar conclusions are obtained if the pre-devaluation correlation between import and export shares, rather than set to zero, is gradually reduced from the value observed in the Mexican data (and targeted in the baseline calibration of Section 4.1.3). Section 7.4 in the Online Appendix considers these additional recalibration exercises. I find that a lower pre-devaluation correlation between importing and exporting is associated with lower growth in the aggregate import share, a lower Between component, and a lower change in the correlation between size and import intensity, following a 20 percent increase in foreign prices - see Figure 33.

[76]The change in the unit cost is intimately related to the change in the domestic share. As seen in (17) above, an increase in the domestic share leads to an increase in the unit cost. In addition, because of roundabout production, the price of the domestic input bundle increases, putting additional upward pressure on unit costs. Thus, while about 20 percent of the firms become more



Notes: The Figure depicts binscatter plots of the changes in log market shares $\Delta log\left(\omega_i\right)$ and the pre-devaluation import share s_{i1} associated with the counterfactual devaluations generated in the uncorrelated model calibrated in Table 20 (left panel) and the experience of Mexico in 1995 (right panel). The changes in log market shares are defined as $\Delta log\left(\omega_i\right) = log\left(\omega_{i2}\right) - log\left(\omega_{i1}\right)$, where ω_{it} denotes firm $i's$ share in total value added in period t. For each figure, the data is grouped into equal-sized bins according to the pre-devaluation import share s_{i1}. The figure then plots the within-bin average of s_{i1} and $\Delta log\left(\omega_i\right)$ across bins. Only firms with positive pre-devaluation import share (i.e., $s_{i1} > 0$) are included. For the data, the initial period is 1994 and the final period is any of the years in 1995-1999. The data used are residuals after taking year fixed effects. Sources: Encuesta Industrial Anual (Mexico).

Figure 11: Growth By Import Intensity: Uncorrelated Model vs Data

Rate of growth in...	Price Index	Unit Cost (Avg.)	Aggregate Productivity	Welfare
Baseline Model	4.91	3.28	9.39	5.8
Model of Importing	7.69	6.08	-2.42	-4.17

Notes: The Table contains the rates of growth in the consumer price index, aggregate productivity and consumer welfare, as well as the average growth rate in the unit cost, resulting from a counterfactual devaluation in the model. The "Baseline Model" column corresponds to the baseline calibration of Section 4.2.1. The "Model of Importing" column corresponds to calibration in Table 10.The consumer price index P is computed according to (28). The unit cost is computed according to (17). The growth rate in the unit cost is computed for each firm; the Table reports the average growth rate across all firms (including importers and non-importers). Aggregate productivity is computed according to (33). Consumer welfare is I/P where I is given by (30).

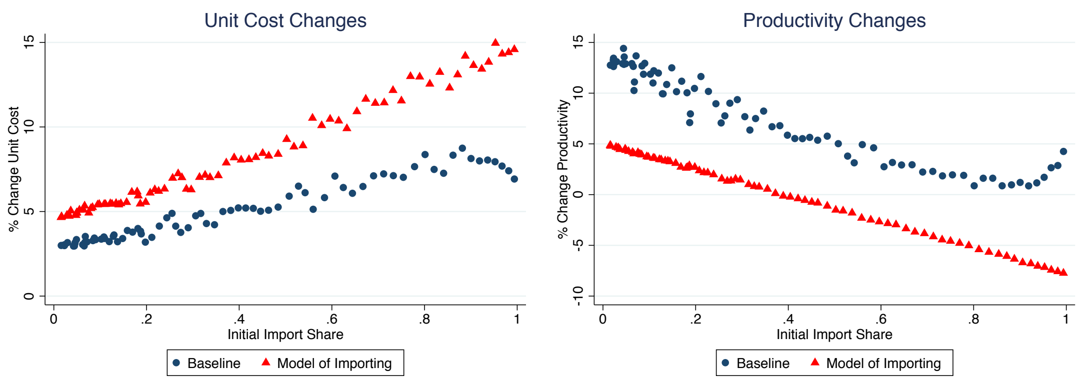
Table 12: Normative Consequences of the Devaluation

import intensive firms, as seen in the left panel of Figure 12. The model of importing predicts a stark pattern where more ex ante intense importers see their unit cost grow by more (see red triangles). In the model with global firms, the relationship between unit cost growth and initial import intensity is shifted downwards and less steep (see blue circles). While the relationship is mostly increasing, for sufficiently high ex ante import share, more intense importers actually feature lower unit cost growth. The reason is, again, that these intense importers tend to be intense exporters who expand to export more.[77] Aggregating these unit cost increases, the consumer price index increases by 7.69 percent in the model of importing vs 4.91 percent in the baseline.

The relationship between changes in unit cost and initial import intensity depicted in Figure 12 for each model is intimately related to the pattern of reallocation of economic activity following the devaluation - see Sections 4.2.1- 4.2.2. The strongly positive association between unit cost growth and initial import intensity in the model of importing is the counterpart of the pattern of reallocation by which intense importers contract shown in Figure 10. Likewise, the reduction in unit cost growth for very intense importers in the model of global firms is the counterpart of the expansion of intense importers shown in Figure 7. It follows that the model's ability to match the compositional effects documented in Section 2.4, which underlie the behavior of

import intensive, only about 5% see their unit cost decrease.

[77]Firms with ex ante high export shares tend to be more efficient exporters, i.e., firms with a lower realization of $\tilde{f}_X$, and hence expand more as a result of the increased foreign demand. As they grow, they increase their import intensity which pushes down their unit cost. An increase in firm size leads to a higher import share due to the presence of country-level fixed costs of importing.



Notes: The figures depict binscatter plots of the growth rate in the unit cost (left panel) or the growth rate in productivity (right panel) and the pre-devaluation import share s_{i1}, generated by a 20 percent increase in foreign prices in the baseline model with global firms calibrated in Section 4.1.3 (blue circles) and the model of importing calibrated in Table 10 (red triangles). The growth rate in the unit cost is defined as $(u_{i2} - u_{i1})/u_{i1} \times 100$, where u_{it} is firm i's unit cost, given in (17), in period t. Period $t = 2$ ($t = 1$) is the post (pre) devaluation period. The growth rate in productivity is defined in (32). For each figure and model, the data is grouped into equal-sized bins according to the pre-devaluation import share s_{i1}. The figure then plots the within-bin average of s_{i1} and either unit cost growth (left panel) or productivity growth (right panel) across bins.

Figure 12: Unit Cost and Productivity Changes

the aggregate import share, has significant consequences for the pattern of changes in productions costs.

The effect of the devaluation on firm-level productivity is depicted in the right panel of Figure 12. Recall that, with imperfect competition, productivity increases with the scale of production and with material intensity - see equation (32) or Basu and Fernald (2002). In the model of importing, there is a steep negative relationship between ex ante import intensity and productivity growth (see red triangles). The reason is that more intense importers face a stronger increase in the effective price of materials and as a result feature larger reductions in their material intensity and scale, both of which make productivity fall.[78] Note that for non-importers and firms with sufficiently low import share, productivity goes up as because they expand their scale of production.[79] Summing across all firms according to (33) above, in the model of importing, aggregate productivity falls by 2.4 percent (Table 12).

In the baseline model with global firms, the increased foreign demand makes firms expand their scale by more, and increase their material intensity, relative to the model of importing. It follows that the changes in firm-level productivity are higher in the baseline (blue circles) than in the model of importing (red triangles) - see right panel in Figure 12.[80] In addition, the expansion in scale and the increase in material intensity associated with the improved terms of exporting are stronger for ex ante intense exporters, which tend to be intense importers. Thus, the relationship between import intensity and productivity growth is less steep (and even reversed at the top) in the baseline model relative to the model of importing. Summing over all firms according to (33), aggregate productivity goes up after the devaluation by about 9.8 percent (Table 12). Consumer welfare also goes up, by about 5.8 percent, as aggregate profits increase and more than compensate for the higher prices. In contrast, in the model of importing, welfare falls (by about 4.2 percent).[81]

[78] Firms with higher initial import shares feature a higher increase in their unit cost, or equivalently, in their domestic expenditure share. As a result, their price index of materials Q_i grows by more and their material intensity falls more sharply. See footnote 50.

[79] This happens because the relative price of labor is lower and there is a boost in demand for the domestic input, as intense importers substitute away from foreign inputs.

[80] In the baseline model with global firms, most firms tend to employ more labor and expand following the devaluation. For about 90 percent of firms, the expansion in scale dominates the reduction in material intensity and productivity increases.

[81] In general, the change in welfare in the model with global firms has to be higher than in the model of importing, though not necessarily positive. In the model with global firms, the impact of the devaluation on welfare depends on a horse race between the increased cost of foreign inputs and the improved terms for exporters. In turn, the outcome of this race depends on all model

These results should be interpreted cautiously. In the exercises considered above, the devaluation was modeled purely as a change in relative prices. In contrast, the Mexican economy experienced several other shocks, including an increase in the foreign interest rate and a full blown financial crises.[82] The results of Table 12 show that, for the baseline calibration to the Mexican economy, an increase in the relative price of foreign goods does not generate by itself a decrease in aggregate productivity and welfare. In other words, rather than contributing to the crises, the change in relative prices was a factor mitigating it.

In this way, the baseline model with global firms and the model of importing predict a very different pattern of changes in production costs, prices and productivity across firms and in the aggregate following a devaluation. In turn, these differences are intimately related to the different patterns of reallocation predicted by each model. The ability of the baseline model to match the low aggregate elasticity of substitution and the compositional effects documented in Section 2 matters significantly for the normative implications of a devaluation.

5 Conclusion

This paper documents two novel empirical facts. First, the aggregate imported input share tends to increase after large devaluations. This empirical regularity holds in a sample of 26 large devaluations in the 1970-2011 period, which are characterized by large and persistent changes in the relative price of foreign goods. Second, following large devaluations, intense importers tend to gain market share. This regularity is established using micro data for the devaluations of Mexico in 1995 and Indonesia in 1998. In turn, the expansion of intense importers can be attributed to the fact that these firms are also exporters, which tend to expand following the devaluation.

These facts are at odds with quantitative models of input trade that have been used to study the effects of devaluations, which abstract from exporting. In these models, an increase in the relative price of foreign goods leads to a decrease in the aggregate imported input share and a pattern of reallocation by which intense importers contract. Intuitively, intense importers are more exposed to an increase in the price of foreign inputs and consequently their production costs tend to increase more.

Taking into account the behavior of exporters is key to reconcile theory and data. The paper presents a theory where firms participate in the international economy both as importers and exporters. In a calibration exercise to Mexican data, the model is able to come to terms with the low aggregate substitution and the reallocation towards intense importers found in the data. Matching these facts has important implications for the normative effects of the devaluation. Compared to the benchmark model of importing of the literature, the model with global firms predicts smaller increases in unit costs (and larger increases in firm productivity), which are less correlated with initial import intensity. For the Mexican parameters, aggregate productivity and welfare increase as a result of the devaluation, while the opposite is true for the benchmark model in the literature. While devaluations are often associated with several shocks that may negatively impact productivity and welfare, this result shows that increases in the relative price of foreign goods per se may not be a factor contributing to the crises but rather one mitigating it.

parameters, including the joint distribution of efficiency and fixed costs, the elasticity of foreign demand (θ) and the elasticity of substitution between domestic and foreign inputs in production (ε). With a sufficiently low elasticity of substitution between domestic and foreign inputs, ε, the devaluation leads to higher increases in production costs and a decrease in welfare. A lower dispersion in foreign demands (i.e., a higher θ) leads to a larger increase in welfare than in the baseline calibration, as it makes export revenue more sensitive to foreign prices e.

[82] Mendoza (2006) models the Mexican crises as a tightening of collateral constraints triggered by shocks to the price of imported inputs, the foreign interest rate and technology. Meza and Quintin (2007) also model the crises as an exogenous shock to the interest rate and technology. Cole and Kehoe (1996) study the role of short term sovereign debt in generating a self-fulfilling debt crises.

References

Albornoz, F. and E. G. Lembergman (2019). Importing after Exporting.

Alessandria, G., J. P. Kaboski, and V. Midrigan (2010, December). Inventories, Lumpy Trade, and Large Devaluations. *American Economic Review 100*(5), 2304–2339.

Alessandria, G., S. Pratap, and V. Z. Yue (2015). Export Dynamics in Large Devaluations.

Amiti, M., O. Itskhoki, and J. Konings (2014). Importers, exporters, and exchange rate disconnect. *American Economic Review 104*(7), 1942–78.

Antras, P., T. C. Fort, and F. Tintelnot (2017). The Margins of Global Sourcing: Theory and Evidence from US Firms. *American Economic Review 107*(9).

Baily, M. N., C. Hulten, and D. Campbell (1992). Productivity Dynamics in Manufacturing Plants. *Brookings Papers on Economic Activity. Microeconomics 1992*, 187.

Basu, S. and J. G. Fernald (2002). Aggregate productivity and aggregate technology. *European Economic Review 46*(6), 963–991.

Bernard, A. B., J. B. Jensen, S. J. Redding, and P. K. Schott (2007). Firms in international trade. *The Journal of Economic Perspectives 21*(3), 105–130.

Blaum, J., C. Lelarge, and M. Peters (2018). The Gains from Input Trade with Heterogeneous Importers. *American Economic Journal: Macroeconomics 10*(4), 77–127.

Broda, C. and D. E. Weinstein (2006). Globalization and the gains from varieties. *Quarterly Journal of Economics 121*(2), 541–585.

Burstein, A., M. Eichenbaum, and S. Rebelo (2005, August). Large Devaluations and the Real Exchange Rate. *Journal of Political Economy 113*(4), 742–784.

Burstein, A. and G. Gopinath (2014). International prices and exchange rates. *Handbook of International Economics 4*, 391–451.

Caliendo, L. and F. Parro (2014). Estimates of the Trade and Welfare Effects of NAFTA. *The Review of Economic Studies*, rdu035.

Campa, J. M. and L. S. Goldberg (1997). The Evolving External Orientation of Manufacturing Industries: Evidence from Four Countries.

Cole, H. and T. J. Kehoe (1996). A Self-Fulfilling Model of Mexico's 1994-1995 Debt Crises. *Journal of International Economics 41*, 309–330.

Costinot, A. and A. Rodríguez-Clare (2014). Trade theory with numbers: Quantifying the consequences of globalization. In *Handbook of International Economics*.

Cravino, J. and A. A. Levchenko (2017). The Distributional Consequences of Large Devaluations. *American Economic Review 107:11*, 3477–3509.

Eaton, J. and S. Kortum (2002). Technology, geography, and trade. *Econometrica 70*(5), 1741–1779.

Eaton, J., S. Kortum, and F. Kramarz (2011). An Anatomy of International Trade: Evidence From French Firms. *Econometrica 79*(5), 1453–1498.

Faber, B. (2014). Trade liberalization, the price of quality, and inequality: Evidence from mexican store prices. *UC-Berkeley Working Paper*.

Feenstra, R. C. and G. H. Hanson (1996). Globalization, Outsourcing, and Wage Inequality. *NBER Working Paper 5424*.

Fieler, A. C., M. Eslava, and D. Y. Xu (2018, January). Trade, Quality Upgrading, and Input Linkages: Theory and Evidence from Colombia. *American Economic Review 108*(1), 109–146.

Gopinath, G. and B. Neiman (2014). Trade Adjustment and Productivity in Large Crises. *The American Economic Review 104*(3), 793–831.

Gregorio, J. D. (1999). Exchange Rate Policy in Chile since 1960: Political Economy and The Choice of Regime.

Halpern, L., M. Koren, and A. Szeidl (2015, December). Imported Inputs and Productivity. *American Economic Review 105*(12), 3660–3703.

Johnson, R. C. and G. Noguera (2017, December). A Portrait of Trade in Value-Added over Four Decades. *Review of Economics and Statistics 99*(5), 896–911.

Kasahara, H. and J. Rodrigue (2008, August). Does the Use of Imported Intermediates Increase Productivity? Plant-Level Evidence. *Journal of Development Economics 87*(1), 106–118.

Korinek, A. and E. G. Mendoza (2014, August). From Sudden Stops to Fisherian Deflation: Quantitative Theory and Policy. *Annual Review of Economics 6*(1), 299–332.

Laeven, L. and F. Valencia (2012). Systemic banking crises database: An update.

Lapham, B. and H. Kasahara (2013). Productivity and the decision to import and export: Theory and evidence. *Journal of International Economics 89*(2), 297–316.

Melitz, M. J. and S. Polanec (2015). Dynamic Olley-Pakes Productivity Decomposition with Entry and Exit. *The RAND Journal of Economics 46*(2), 362–375.

Mendoza, E. G. (2006). Endogenous sudden stops in a business cycle model with collateral constraints: a Fisherian deflation of Tobin's Q. Technical report, National Bureau of Economic Research.

Mendoza, E. G. and V. Z. Yue (2012, May). A General Equilibrium Model of Sovereign Default and Business Cycles. *The Quarterly Journal of Economics 127*(2), 889–946.

Meza, F. and E. Quintin (2007). Factor utilization and the real impact of financial crises. *The BE Journal of Macroeconomics 7*(1).

Oberfield, E. and D. Raval (2014). Micro data and macro technology. Working Paper.

Ramanarayanan, A. (2018). Imported Inputs and the Gains from Trade.

Reinert, K. A. and D. W. Roland-Holst (1992). Disaggregated Armington Elasticities for the Mining and Manufacturing Sectors of the United States. *Journal of Policy Modeling 14*(5).

Reinhart, C. M. and K. S. Rogoff (2011). From financial crash to debt crisis. *The American Economic Review 101*(5), 1676–1706.

Ruhl, K. J. (2008). The International Elasticity Puzzle. *unpublished paper, NYU*.

Simonovska, I. and M. E. Waugh (2014). The elasticity of trade: Estimates and evidence. *Journal of international Economics 92*(1), 34–50.

Timmer, M. P., E. Dietzenbacher, B. Los, R. Stehrer, and G. J. de Vries (2015, August). An Illustrated User Guide to the World Input-Output Database: the Case of Global Automotive Production: User Guide to World Input-Output Database. *Review of International Economics 23*(3), 575–605.

6 Appendix

6.1 Additional Figures and Tables

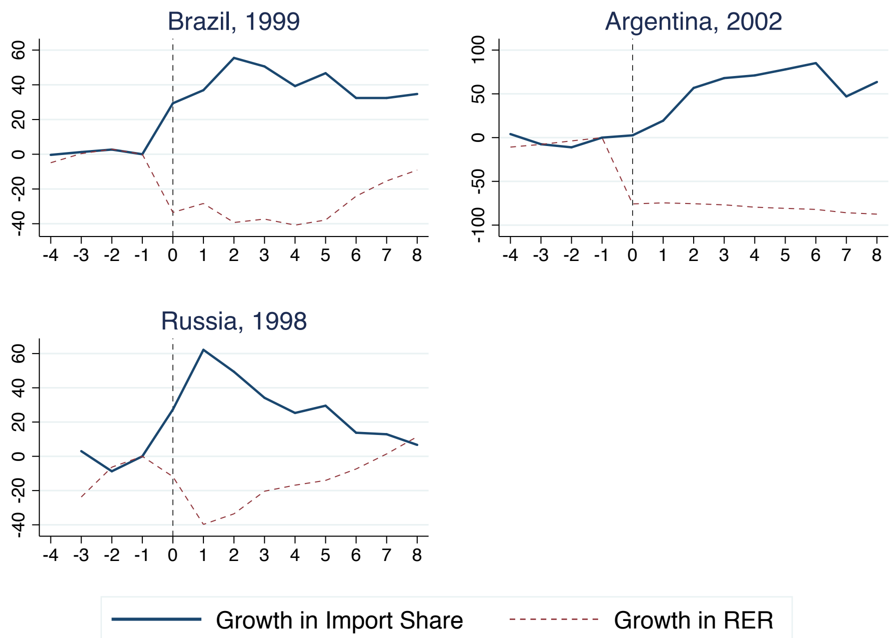


Figure 13: Aggregate Imported Input Share, By Country, Recent Events (1/2)

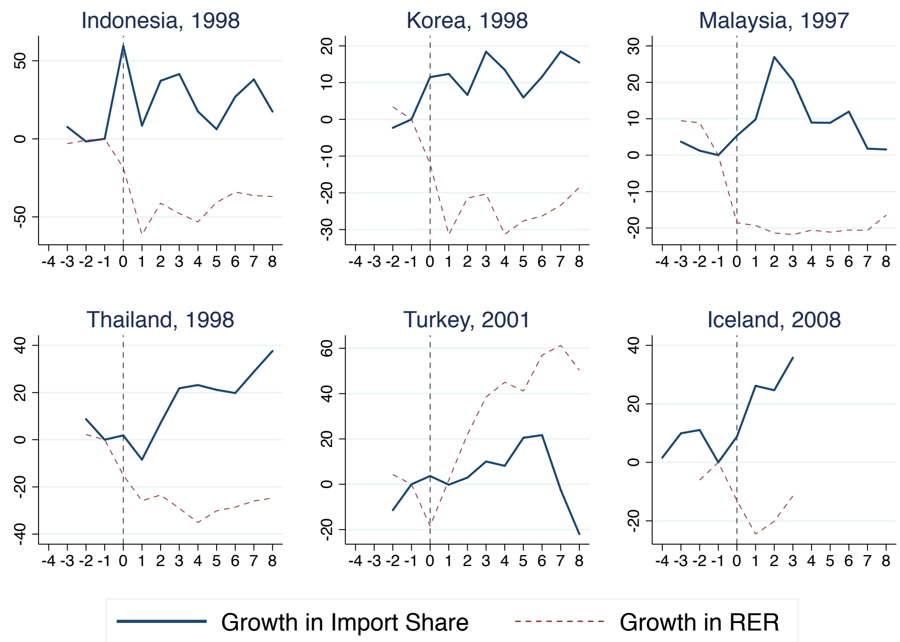


Figure 14: Aggregate Imported Input Share, By Country, Recent Events (2/2)

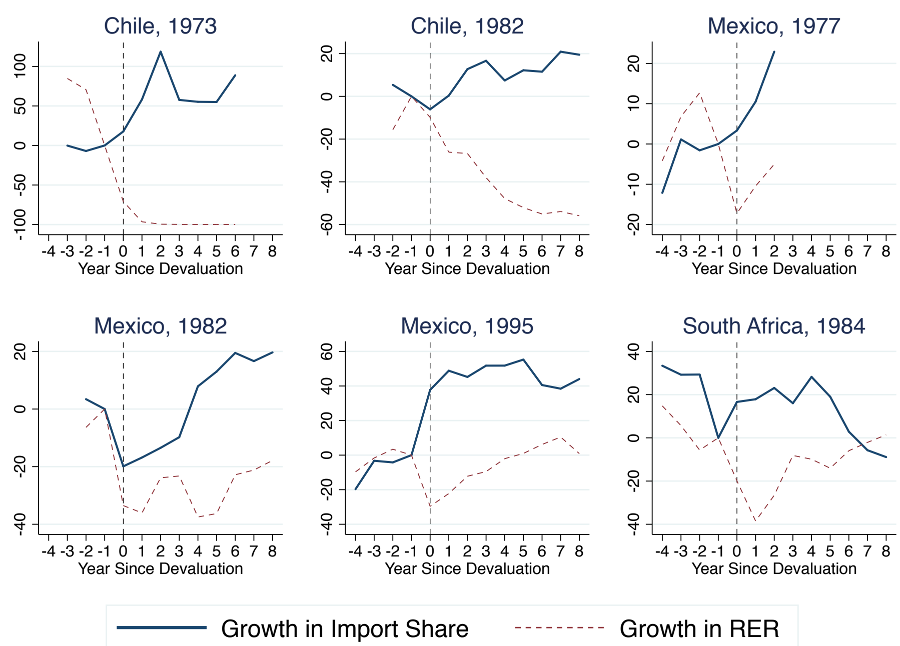


Figure 15: Aggregate Imported Input Share, By Country, Large Sample (1/3)

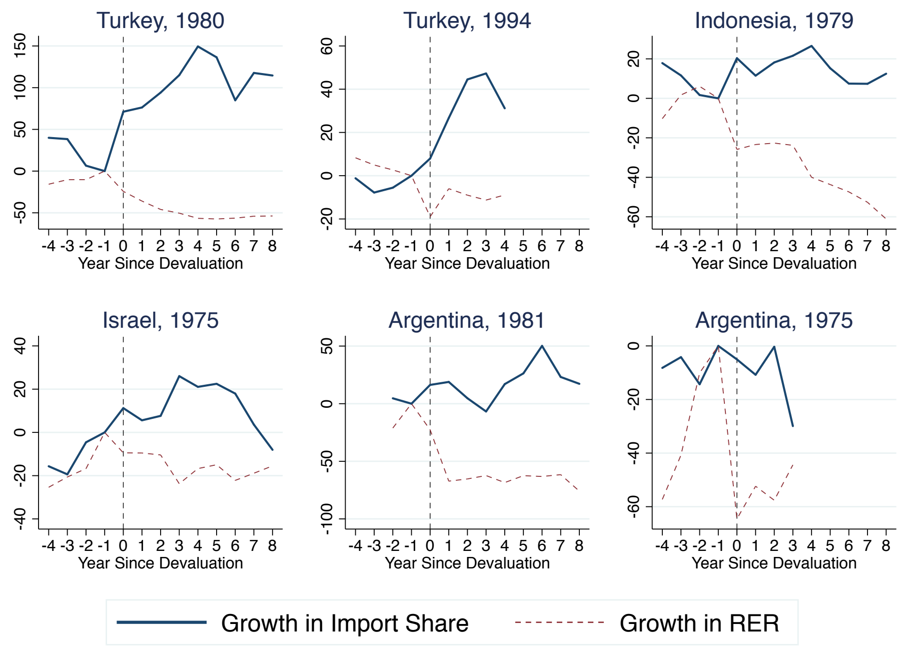


Figure 16: Aggregate Imported Input Share, By Country, Large Sample (2/3)

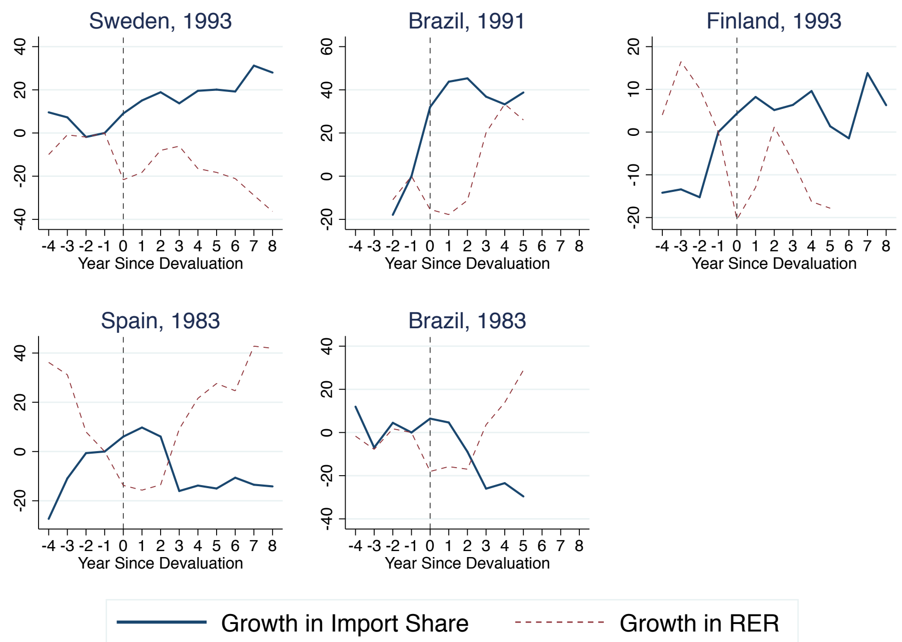
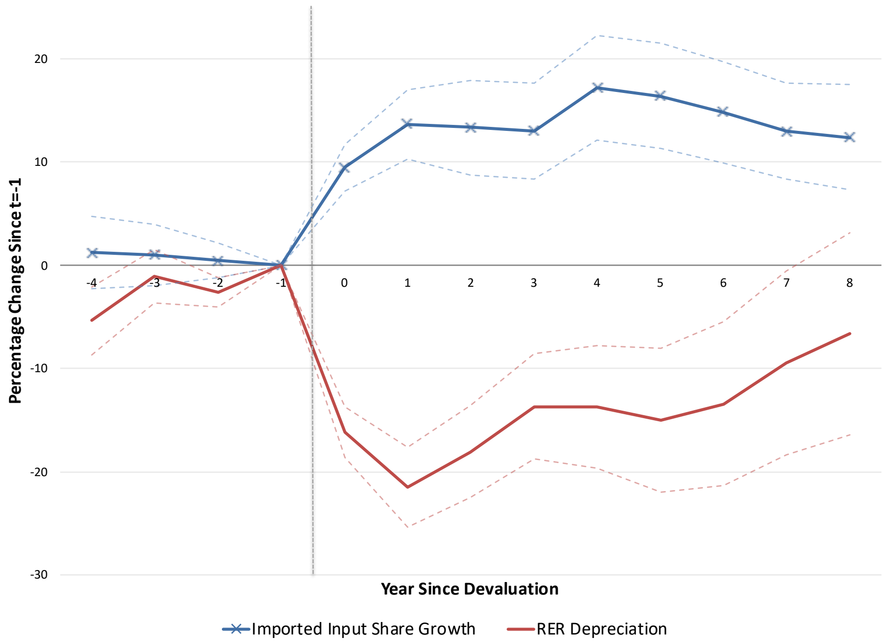
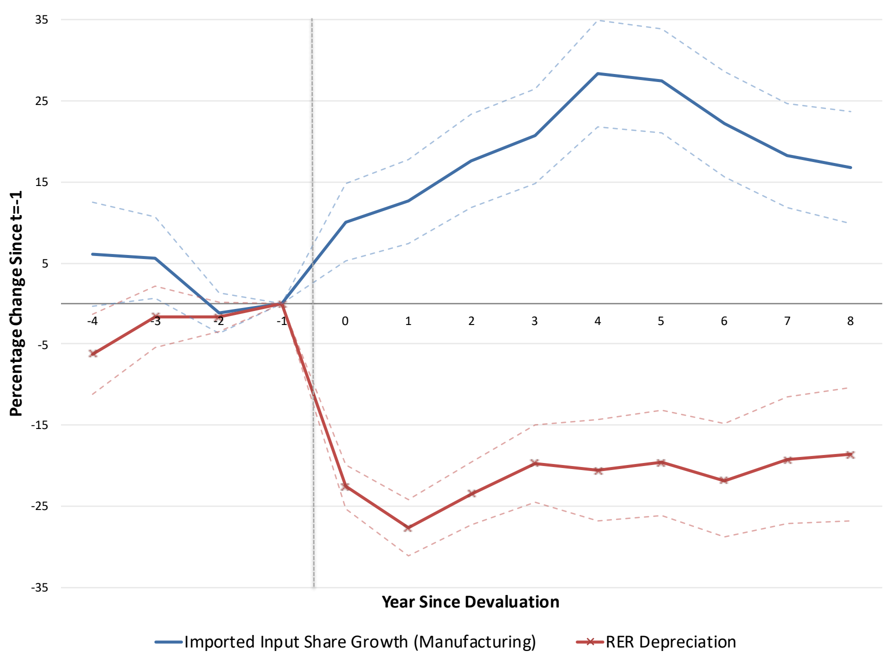


Figure 17: Aggregate Imported Input Share, By Country, Large Sample (3/3)



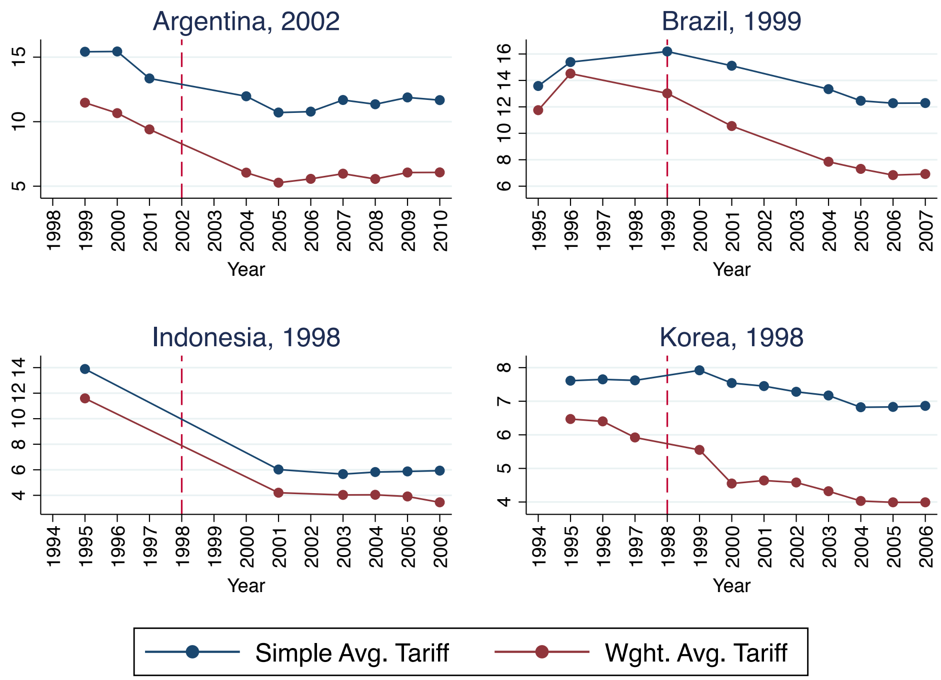
Notes: The blue line (with crosses) is the rate of growth in the aggregate imported input share between a given year and the year before the devaluation (labeled -1). The year of the devaluation is labeled 0. The red line depicts the rate of growth in the real exchange rate. The lines in the Figure are averages of the experiences of the 41 episodes in Table 13. 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: WIOD, OECD, JN, IFS.

Figure 18: Imported Input Share After Large Devaluation, Sample of 41 Events



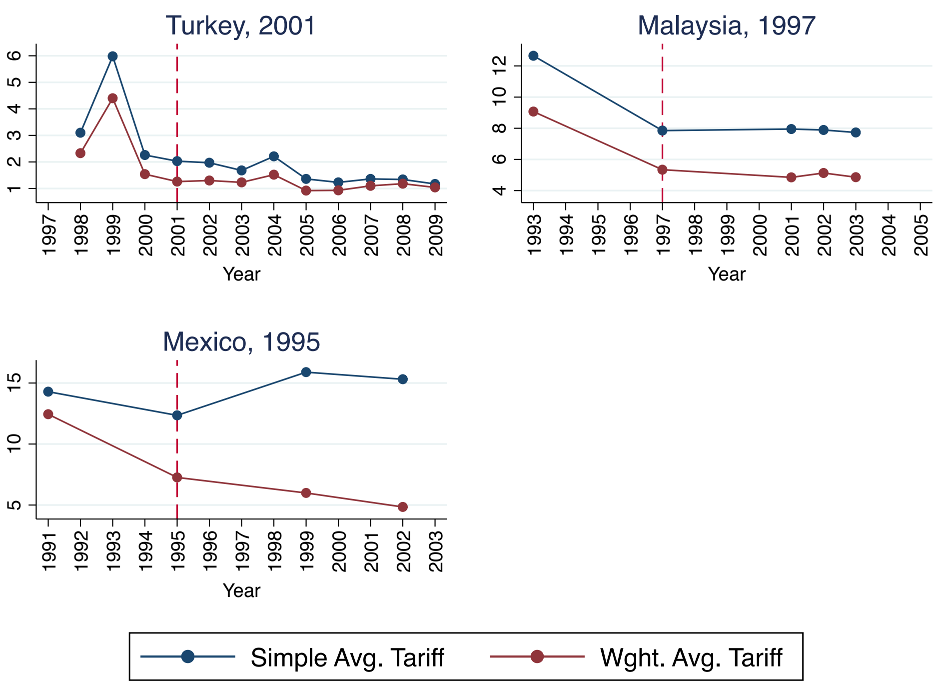
Notes: The blue line is the rate of growth in the aggregate imported input share between a given year and the year before the devaluation (labeled -1). The year of the devaluation is labeled 0. The red line depicts the rate of growth in the real exchange rate. The lines in the Figure are averages of 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: WIOD, OECD, JN, IFS.

Figure 19: Imported Input Share After Large Devaluation, Full Sample, Manufacturing Sector



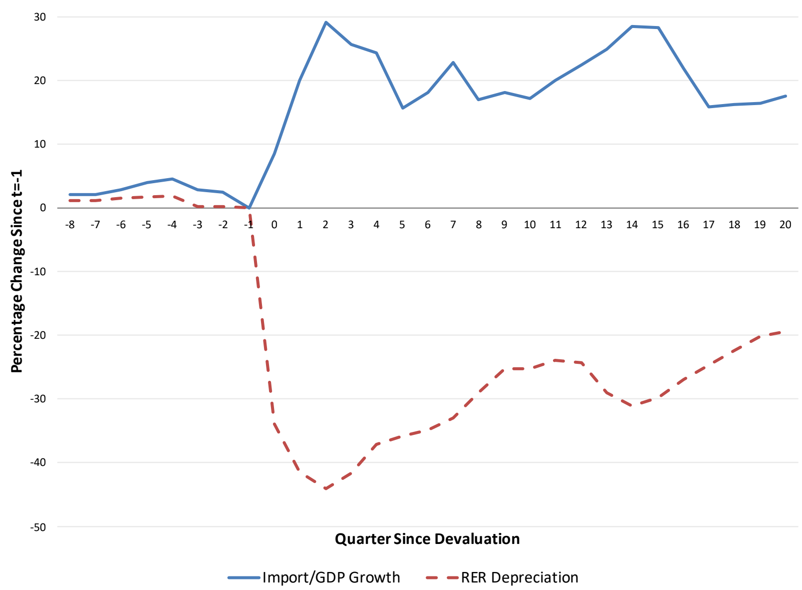
Notes: The Figure depicts the behavior of average ad valorem tariff rate (in percentage points) around the devaluations of Argentina 2002, Brazil 1999, Indonesia 1998 and Korea 1997. The tariff rate is the effectively applied rate (i.e. the lowest available tariff) for non-agricultural products from all partners in the world. "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. Source: WITS-TRAINS.

Figure 20: Tariffs After Recent Devaluations, By Country



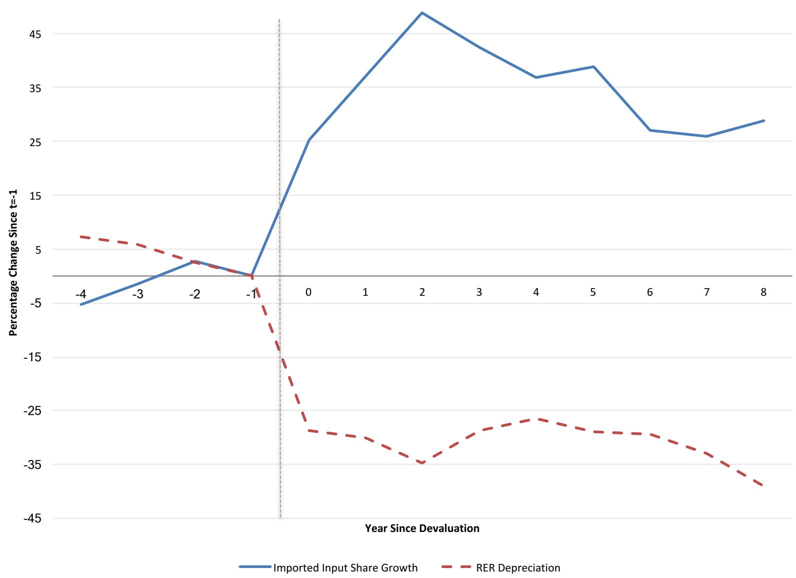
Notes: The Figure depicts the average ad valorem tariff rate (in percentage points) around the devaluations of Turkey 2001, Malaysia 1998 and Mexico 1995. The tariff rate is the effectively applied rate (i.e. the lowest available tariff) for non-agricultural products from all partners in the world. "Simple 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. Source: WITS-TRAINS.

Figure 21: Tariffs After Recent Devaluations, By Country (ctd)



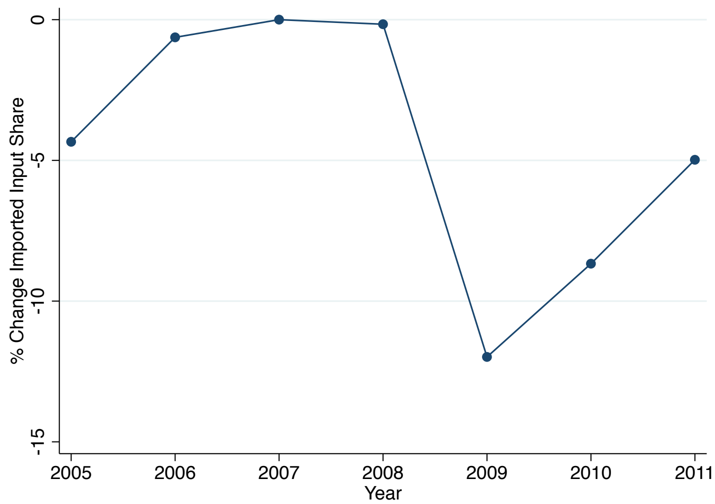
Notes: The blue (solid) line is the rate of growth in the ratio of total imports to GDP between a given quarter and the quarter before the devaluation (labeled -1). The quarter of the devaluation is labeled 0. The red (dashed) line depicts the rate of growth in the bilateral real exchange rate with the US defined in Section 2.2 - see (1). The lines in the Figure are averages of the experiences of Argentina in 2001, Brazil 1998, Indonesia 1998, Korea 1997, Malaysia 1997, Mexico 1994, Russia 1998, Thailand 1997 and Turkey 2001. Source: IFS.

Figure 22: Imports-to-GDP ratio After a Large Devaluation



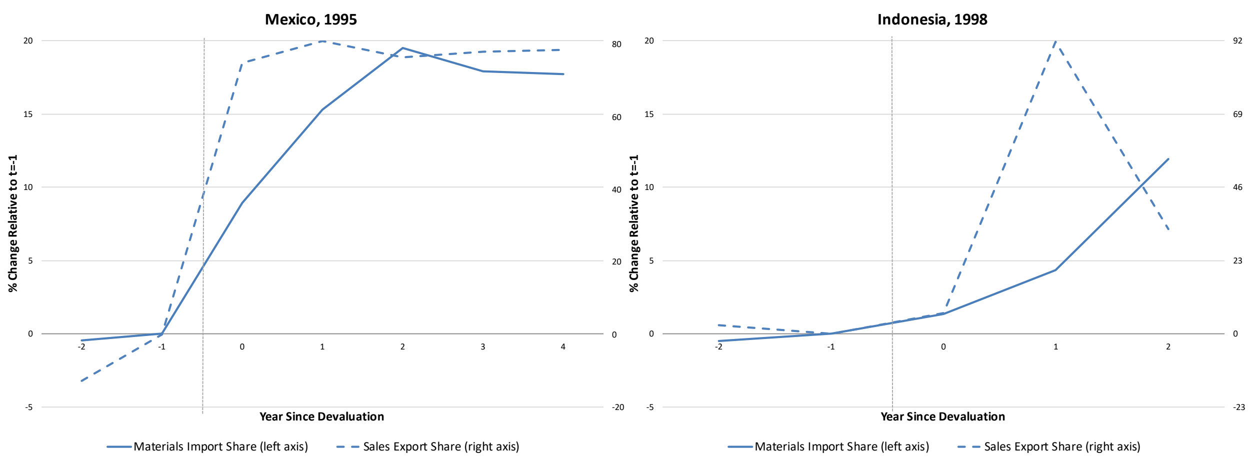
Notes: The blue line is the rate of growth in the aggregate imported input share between a given year and the year before the devaluation (labeled -1). The year of the devaluation was 1999 and is labeled 0. The red (dashed) line depicts the rate of growth in the real exchange rate. Sources: Johnson and Noguera (2017), IFS.

Figure 23: Aggregate Imported Input Share After Brazilian Devaluation



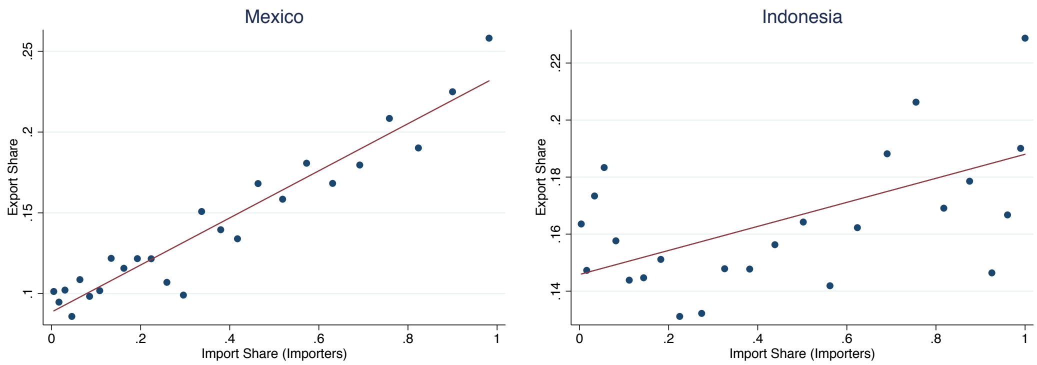
Notes: The blue line is the rate of growth in the aggregate imported input share between a given year and the year before the financial crisis (i.e. 2007, labeled -1). The year of the financial crisis was 2008 and is labeled 0. The graph depicts the average experience of Austria, Belgium, Denmark, France Germany, Greece, Hungary, Ireland, Latvia, Luxembourg, Netherlands, Portugal, Russia, Slovenia, Spain, Sweden. These 16 episodes are identified by LV as having a systemic banking crises in 2008, but not a currency crises. Source: WIOD, LV.

Figure 24: Aggregate Imported Input Share After Financial Crises of 2008



Notes: The figures show the rate of growth in the aggregate import share (solid line, left axis) and the aggregate export share (dashed line, right axis) in the Manufacturing sector following the devaluations of Mexico in 1995 (left panel) and Indonesia in 1998 (right panel). The aggregate import share is defined as the ratio of total spending in imported materials to total spending in materials (imported plus domestic). The aggregate export share is defined as the ratio of total foreign sales to total sales (foreign plus domestic). 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. All data is taken from Manufacturing surveys except the aggregate export share for Indonesia which is taken from input output tables. Source: Manufacturing Surveys in Mexico (EIA) and Indonesia (SI), JN.

Figure 25: Aggregate Import and Export Shares: Mexico and Indonesia



Notes: The Figure depicts a binscatter plot of the import shares s_i and the export shares s_{Xi} in the cross-section of Manufacturing establishments in Mexico and Indonesia. The data is pooled across all years in the sample (1994-1999 for Mexico and 1996-2000 for Indonesia). For each figure, the data is grouped into equal-sized bins according to the import share s_i. Only importers are considered. The figure then plots the within-bin average of export shares s_{Xi} for each bin of import shares s_i. Sources: Encuesta Industrial Anual (Mexico) and Survei Industri (Indonesia).

Figure 26: Import Shares and Export Shares for Mexican and Indonesian Manufacturing Establishments

Country	Currency	Systemic Banking	Default
Argentina	1975, 1981, 1987, 2002	1980, 1989, 1995, 2001	1982, 2001
Austria		2008	
Belgium		2008	
Brazil	1976, 1983, 1987, 1991, 1999	1990, 1994	1983
Chile	1973, 1982	1976, 1981	1983
China		1998	
Czech Republic		1996	
Denmark		2008	
Finland	1993	1991	
France		2008	
Germany		2008	
Greece	1983	2008	
Hungary		1991, 2008	
Iceland	2008	2008	
India		1993	
Indonesia	1979, 1998	1997	1999
Ireland		2008	
Israel	1975, 1980, 1984	1977	
Italy	1981	2008	
Japan		1997	
Korea	1998	1997	
Malaysia	1997	1997	
Mexico	1977, 1982, 1995	1981, 1994	1982
Netherlands		2008	
New Zealand	1984		
Norway		1991	
Poland		1992	1981
Portugal	1983	2008	
Romania	1996	1990	1982
Russia	1998	1998, 2008	1998
Slovak Republic		1998	
Slovenia		2008	
South Africa	1984		1985
Spain	1983	1977, 2008	
Sweden	1993	1991, 2008	
Switzerland		2008	
Thailand	1998	1983, 1997	
Turkey	1980, 1984, 1991, 1996, 2001	1982, 2000	1978
United Kingdom		2007	
United States		1988, 2007	
Vietnam	1972, 1981, 1987	1997	1985

Table 13: Episodes of Currency, Banking and Sovereign Debt Crises

Dep. var. $log(s_{I,AGG,ct})$	(1)	(2) (recent)	(3)	(4)	(5)	(6)
$deva_{ct}$	0.06***	0.16***		0.07***	0.07***	0.05***
	(0.02)	(0.03)		(0.02)	(0.02)	(0.01)
$log(RER_{ct})$			-0.21***			
			(0.03)			
Country FE, Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Linear time trend	No	No	No	Yes	No	No
Quadratic time trend	No	No	No	No	Yes	No
Country-specific time trend	No	No	No	No	No	Yes
Obs	1,586	1,586	1,586	1,586	1,586	1,586
R^2	0.87	0.87	0.90	0.85	0.85	0.93

Table 14: Import Share after Large Devaluations: Controlling for Time Trends

Notes: The dependent variable is the log of the aggregate import share. The data is taken from Johnson and Noguera (2017) and covers 44 countries in the 1970-2011 period including the episodes listed in Table 1. RER is the real effective exchange rate index (with lower values associated with a depreciated currency) and is taken from IFS. Columns (4)-(6) do not include year fixed effects. Robust standard errors in parenthesis with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels.

Dep. var. $log(s_{I,AGG,ct})$	(1)	(2)	(3) recent	(4)	(5)	(6)	(7)
$deva_{ct}$	0.06***	0.08***	0.11***	0.07***	0.09***	0.10***	0.08***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
$tariffs_{ct}$		-0.05	-0.05				-0.05
		(0.05)	(0.05)				(0.05)
$log(RGDP_{ct})$				0.09***		0.09***	-0.11
				(0.03)		(0.03)	(0.07)
$banking_{ct}$					-0.01	0.01	-0.04***
					(0.02)	(0.02)	(0.01)
$default_{ct}$					-0.16***	-0.16***	0.05
					(0.03)	(0.04)	(0.05)
$restructuring_{ct}$					0.04	0.04	-0.05*
					(0.03)	(0.03)	(0.03)
Year, Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	1,586	758	758	1,586	1,586	1,586	756
R^2	0.87	0.94	0.94	0.90	0.87	0.90	0.95

Table 15: Import Share after Large Devaluations: Controlling for Tariffs and Financial Crises

Notes: The dependent variable is the log of the aggregate imported input share at the country level, $log(s_{I,AGG,ct})$. The data covers 44 countries in the 1970-2011 period including the episodes listed in Table 1. $tariffs_{ct}$ denotes the import-value weighted average of effectively applied tariffs across all products of country c in year t taken from UNCTAD. $log(RGDP_{ct})$ is the log of real GDP of country c in year t taken from IFS. $deva_{ct}$ is an indicator of whether a large devaluation, as defined in Section 2.2, took place in country c in year t or in the 7 previous years. $banking_{ct}$, $default_{ct}$,$restructuring_{ct}$ are indicators of whether a banking crises, a sovereign debt default, or a sovereign debt restructuring, respectively, took place in country c in year t or in the previous 4 years. All regressions include country and year fixed effects. Robust standard errors in parenthesis with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. Sources: JN, WIOD, OECD, UNCTAD, IFS, LV.

Dep. var. $log(s_{I,AGG,jct})$	(1)	(2)	(3)	(4)	(5)
$deva_{ct}$	0.10***	0.10***	0.11***	0.10***	
	(0.01)	(0.01)	(0.01)	(0.01)	
$tariffs_{ct}$		-0.08**	-0.11***	-0.09***	-0.03**
		(0.03)	(0.03)	(0.01)	(0.01)
$log(RER_{ct})$					-0.23***
					(0.01)
Year, Country, Sector FE	Yes	Yes	No	No	No
Time trend, Country, Sector FE	No	No	Yes	No	No
Year, Country x Sector FE	No	No	No	Yes	Yes
Obs	34,765	30,579	30,579	30,579	24,519
R^2	0.72	0.74	0.74	0.93	0.94

Table 16: Sector-level Import Shares after Large Devaluations

Notes: The dependent variable is the log of the imported input share at the country-sector level, $log(s_{I,AGG,jct})$, computed from the OECD input-output tables. Sectors are defined at the 2-digit ISIC Rev. 3 level. The sample covers 62 countries in the 1995-2011 period including the 9 episodes listed in Table 1 (marked in bold). $tariffs_{ct}$ denotes the import-value weighted average of effectively applied tariffs across all products of country c in year t taken from UNCTAD. Tariffs are measured in percentage points and the corresponding coefficients displayed in the table have been multiplied by 100. $log(RER_{ct})$ is the log of the real effective exchange rate index of country c in year t (with lower values associated with a real depreciation) taken from IFS. Interest rate corresponds to a measure of the real interest rate taken from WDI. Columns 1 and 2 include fixed effects at the year, country and sector level. Column 3 includes a linear time trend, as well as country and sector fixed effects. Columns 4 and 5 include year and country-sector fixed effects. Robust standard errors in parenthesis with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. Sources: OECD, UNCTAD, IFS, WDI.

Dep. var. log(Imports/GDP)	(1)	(2) recent	(3)	(4)	(5)
$deva_{ct}$	0.04***	0.09***		0.06***	0.09***
	(0.01)	(0.01)		(0.01)	(0.01)
$log(RER_{ct})$			-0.13***		
			(0.02)		
$tariffs_{ct}$				-0.93***	-0.75***
				(0.13)	(0.13)
$log(RGDP_{ct})$					0.24***
					(0.05)
Country FE	Yes	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes	Yes
Obs	5,577	5,577	5,577	3,467	3,191
R^2	0.17	0.18	0.20	0.18	0.21

Table 17: Imports-to-GDP ratio after Large Devaluations

Notes: The dependent variable is the log of the imports-to-GDP ratio, where the numerator is the value of imports of goods and services and the denominator is nominal GDP, both in current national currency. The sample is an unbalanced panel of 65 countries between 1959 and 2015 at the quarterly frequency - see Table 43 in the Online Appendix. $deva_{ct}$ is an indicator of whether a large devaluation, as defined in Section 2.2, took place in country c in year-quarter t or in the previous 20 quarters. Column two considers only the recent devaluations listed in Table 1 (marked in bold). $log(RER_{ct})$ is the log of the real effective exchange rate index of country c in quarter-year t (with lower values associated with a real depreciation) taken from IFS. $tariffs_{ct}$ denotes the import-value weighted average of effectively applied tariffs across all products of country c in year t taken from UNCTAD. Tariffs are measured in percentage points and the corresponding coefficient displayed in the table is multiplied by 100. $log(RGDP_{ct})$ is the log of real GDP of country c in year-quarter t. The series of imports and nominal GDP have been de-trended by taking out a country-specific loglinear time trend as well as quarter dummies. Robust standard errors in parenthesis with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels.

Country	Year	Country	Year
Argentina	1975	Mexico	1977
Brazil	1983,1999	Turkey	1980, 1994
Indonesia	1979	Spain	1983
Israel	1975	South Africa	1984

Table 18: Episodes of Currency Crises Without Banking Crises

Increase in e/w of 20 percent	Baseline		Model of Importing		Data	
	Before	After	Before	After	Before (1994)	After (1999)
Exports / Absorption	16.01	28.78	-	-	16.12	31.39
Imports / Absorption	16.15	19.01	21.8	12.09	16.95	23.08
Trade Balance / Absorption	-0.14	9.77	-21.8	-12.09	-0.83	8.32
Difference		9.91		9.71		9.15

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 a 20 percent increase in foreign prices in the model with global firms calibrated in Section 4.1.3. The third and fourth columns correspond to a similar devaluation in the model of importing calibrated in Table 10. The last two columns correspond to the Mexican data. All values are in percentage points.

Table 19: Trade Deficit: Models and Data

Parameter		Targeted Moment		
Description	Value	Description	Model	Data
Average importing fixed cost ($\mu_{\tilde{f}}$)	-0.30	Aggregate Import Share	0.36	0.36
Average exporting fixed cost ($\mu_{\tilde{f}_X}$)	155.21	Aggregate Export Share	0.16	0.16
Fixed cost import status $\left(\tilde{F}_M\right)$	0.0102	Fraction Importers-Only	0.25	0.25
Fixed cost export status $\left(\tilde{F}_X\right)$	0.0113	Fraction Exporters-Only	0.07	0.07
Fixed cost import-export $\left(\tilde{F}_{XM}\right)$	0.0116	Fraction Importer-Exporters	0.17	0.17
Dispersion in efficiency (σ_φ)	0.59	Dispersion in sales	1.71	1.71
Dispersion in importing fixed costs ($\sigma_{\tilde{f}}$)	3.20	Dispersion in imp. shares	0.27	0.27
Dispersion in exporting fixed costs ($\sigma_{\tilde{f}_X}$)	99.05	Dispersion in exp. shares	0.18	0.18
Corr. efficiency - importing fixed cost ($\rho_{\varphi\tilde{f}}$)	0.84	Corr. sales-imp. shares	0.27	0.27
Corr. efficiency - exporting fixed cost ($\rho_{\varphi\tilde{f}_X}$)	0.28	Corr. sales - exp. shares	0.15	0.15
Corr. importing - exporting fixed costs ($\rho_{\tilde{f}\tilde{f}_X}$)	**-0.10**	**Corr. imp. - exp. shares**	**0**	**0.18**

Notes: Firm sales, given by (53) in the Appendix, are computed in logs. The import share corresponds to $1 - s_D$ in the text. The aggregate import share is the ratio of total spending in foreign inputs to total spending in inputs. The aggregate export share is the ratio of total foreign sales to total sales. Dispersion refers to the standard deviation. The fractions of importers-only, exporters-only and importer-exporters are computed as the number of firms in each group divided by the total number of firms in the economy. 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 20: Calibration of Model with Uncorrelated Importing and Exporting

	Within	Between	Covariance	Net Entry	Total
Mexico 94-99	-2.79	9.99	4.27	6.24	17.70
Uncorrelated Model	-0.92	-10.65	0.14	0.26	-11.18

Notes: The Table contains the Baily et al. (1992) decomposition in (5) 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. The model corresponds to the model with global firms calibrated in Table 20. All entries are in percentage points.

Table 23: Decomposition of Import Share Growth: Uncorrelated Model

Change in ...	Uncorrelated Model	Mexico 94-99
Aggregate Import Share	-4.02	5.68
Aggregate Export Share	6.69	12.75
Corr. sales-imp. shares	-0.01	0.06
Corr. sales-exp. shares	0.06	0.08
Corr. imp.-exp. shares	0.04	0.06
Fraction Importers-Only	-0.75	-7.05
Fraction Exporters-Only	1.62	3.70
Fraction Importer-Exporters	7	9.74

Table 21: Effects of a Counterfactual Devaluation: Uncorrelated Model

Notes: The changes in the moments are computed as differences in levels (i.e., the value of the moment post devaluation minus its value pre devaluation). The change in the aggregate import share, the aggregate export share, and the fractions of importers-only, exporters-only and importer-exporters are all expressed in percentage points. The correlation entries correspond to the difference in the correlation coefficient post-pre devaluation. 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). The data rows depict changes between 1994 and the average of 1995-1999 in the Mexican manufacturing sector. The model column depict changes in the model-generated data resulting from a 20 percent increase in the price of foreign goods. The model corresponds to the model with global firms calibrated in Table 20.

	Percentiles					
	10th	25th	50th	75th	90th	95th
Import Shares, Importers, final - initial						
Data	-0.40	-0.46	-0.38	-0.47	-1.62	-1.02
Uncorrelated Model	-0.01	-0.34	-5.46	-7.01	-3.49	-1.54
Export Shares, Exporters, final - initial						
Data	0.42	1.26	3.73	4.78	2.42	-0.91
Uncorrelated Model	0.06	0.32	1.41	2.37	0.74	-0.07

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% increase in the price of foreign goods. The uncorrelated model refers to the model with global firms calibrated in Table 20. All entries are in percentage points. Source: EIA.

Table 22: Changes in Distribution of Import and Export Shares: Uncorrelated Model

Increase in e/w of 20%	Baseline		Uncorrelated Model	
	Before	After	Before	After
Exports / Absorption	16.01	28.78	15.90	24.68
Imports / Absorption	16.15	19.01	16.11	15.64
Trade Balance / Absorption	-0.14	9.77	-0.21	9.04
Difference		9.91		9.25

Notes: The Table depicts the changes in exports, imports and the trade deficit as a percentage of domestic absorption resulting from a 20 percent increase in the price of foreign goods. 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 third and fourth columns correspond to the model with global firms calibrated in Table 20. All values are in percentage points.

Table 24: Trade Deficit: Uncorrelated Model

6.2 Sample Construction and Selection

The sample of 41 currency crises from LV which are present in the input-output tables of the WIOD, OECD or Johnson and Noguera (2017) is listed in Table 13.[83] Because currency crises are defined by LV in terms of the nominal exchange rate, the next step is to verify that the episodes feature a real depreciation. The next section details the measure of the real exchange rate that is used for each episode in the sample. Then, the process for selecting episodes with large enough real depreciations is detailed. The findings of Section 2.2 are robust to this selection process because they hold on the full sample of 41 events of Table 13, as shown, e.g., in Figure 18.

Real Exchange Rate Measure. As preferred measure, I rely on the bilateral real exchange rate with the US, defined as

$$e_{i,US} \equiv \frac{P_i}{NER_{i,US} \times P_{US}}, \tag{34}$$

where $NER_{i,US}$ is the nominal exchange rate between country i and the US expressed in units of country-i national currency per US dollar and P_i is the price index in country i. All results are robust to instead using a measure of the real effective exchange rate provided by the IFS.[84] A decrease in e corresponds to a real depreciation. Given the emphasis of the paper in changes in the relative price of imported to domestic inputs, the preferred measure of P_i is the producer price index (PPI). Such index targets the prices charged by domestic producers and hence tends to exclude imports. When the PPI is not available in the IFS data, I rely instead on the wholesale price index (WPI) or, in its absence, on the consumer price index (CPI). In instances where no price index of any kind is available, I rely on a measure of the real effective exchange rate based on the consumer price index provided by the IFS, when available.[85] Finally, for Chile (pre-1980) and Vietnam there is no price index data whatsoever in the IFS, nor any other measure of the real effective exchange rate.[86] Table 25 details the type of price index used to construct the real exchange rate measure for each episode in the sample of large devaluations.

[83] For post-1995 events, when multiple sources are available, I rely on the WIOD and, if WIOD is unavailable, on the OECD input-output tables. For all events prior to 1995, the JN data is used.

[84] This measure captures the real value of a country's currency relative to a weighted average of the main trading partners' currencies. More precisely, the real effective exchange rate is given by the nominal effective exchange rate adjusted for relative movements in prices (or labor costs) in the home and the main trading partners. 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. To avoid any endogeneity concerns of the devaluation affecting the trade weights, I rely mainly on bilateral real exchange rates with the US, defined in (34).

[85] The following episodes fall into this category: Brazil 1999, Chile 1982, Greece 1983, New Zealand 1984, Portugal 1983 and Russia 1998.

[86] Gregorio (1999) provides a real exchange rate measure for Chile in the 1970s. No reliable source of data for the real exchange rate was found for Vietnam for the 1970s or 1980s and hence the three corresponding episodes are dropped from the sample.

PPI	WPI	CPI	No Data
Finland 1993	Brazil 1976	Argentina 1975	Chile 1973
Iceland 2008	Brazil 1983	Argentina 1981	Vietnam 1972
Italy 1981	Brazil 1987	Argentina 1987	Vietnam 1981
Korea 1998	Brazil 1991	Argentina 2002	Vietnam 1987
Malaysia 1997	Israel 1975	Brazil 1999	
Mexico 1995	Israel 1980	Chile 1982	
Romania 1996	Israel 1985	Greece 1983	
South Africa 1984	Mexico 1982	Indonesia 1979	
Spain 1983		Indonesia 1997	
Sweden 1993		Mexico 1977	
Thailand 1998		New Zealand 1984	
Turkey 1984		Portugal 1983	
Turkey 1991		Russia 1998	
Turkey 1996		Turkey 1978	
Turkey 2001			

Table 25: RER Measure By Episode

Notes: The Table contains the type of price index used to construct the real exchange rate measure for each episode in the sample of large devaluations. The first column lists the episodes for which producer price index data (PPI) is available in the IFS database. The second column lists episodes for which the PPI is not available but the wholesale price index (WPI) is. The third column lists episodes with no PPI nor WPI data, but which have CPI data. The fourth column lists episodes for which the IFS has no price index data of any kind, nor any index of the real effective exchange rate. Source: IFS.

Selecting Large Real Depreciations and Year Adjustments. Some of the nominal currency crises identified by LV do not display large reductions in the real exchange rate. For example, the nominal exchange rate decreased by about 65% in Brazil in 1987 but the real exchange rate actually appreciated. For this reason, I restrict to episodes where the real exchange rate declined by at least 8% on impact. The results of the paper do not depend on the value of this threshold - e.g., the main fact of Section 2.2 holds for the full sample of 41 episodes for which input output data is available as shown in Figure 18. In a handful of cases, it is possible to identify a large real depreciation happening close to the date suggested by LV. In these cases, which are detailed in the next paragraph, I adjust the year of the devaluation accordingly.

In Brazil, the real exchange rate series shows a large drop in 1983 while in 1982, the year identified in LV, it shows only a very mild depreciation. I set the year of the devaluation to 1983. For similar reasons, the 1992 episode in Brazil is set to 1991, the 1985 episode in Israel is set to 1984, the 1978 episode in Turkey is set to 1980 and the 1991 episode in Turkey is set to 1994. Turkey 1984 exhibits a real depreciation of about 10% but the 3 previous years exhibit depreciations of similar magnitude. The first year showing a significant depreciation is 1980, which is classified as a separate episode in the original sample. This suggests that the 1984 event is capturing the tail of an event that started in 1980 and is therefore considered part of the 1980 event. Gregorio (1999) shows that Chile experienced a real depreciation of more than 50% starting in 1973 and hence this episode is kept in the sample.[87]

These adjustments, together with the requirement that the real devaluation be large enough, result in a final sample of 26 devaluation episodes listed in Table 1.[88]

Overlapping events. In constructing Figure 2, a window of 12 years around each devaluation is considered. For countries that feature multiple events that are less than 13 years apart, the windows around the

[87] This episode is listed as taking place in 1972 by LV. I set the year of the real devaluation to 1973 following Gregorio (1999).

[88] The following events display a real depreciation which is no larger than 8%: Greece 1983, Portugal 1983, New Zealand 1984, Israel 1984, Romania 1996, Turkey 1996, Argentina 1987, Italy 1981, Israel 1980, Brazil 1976 and Brazil 1987. The three episodes in Vietnam are dropped for lack of data on the real exchange rate.

Episode	Start year	End year
Mexico 1977	-	1979
Mexico 1982	1980	-
Chile 1973	-	1979
Chile 1982	1980	-
Argentina 1975	-	1978
Argentina 1981	1979	-
Brazil 1983	-	1988
Brazil 1991	1989	1996
Brazil 1999	1997	-
Turkey 1994	-	1998
Turkey 2001	1999	-

Table 26: Overlapping Events: Window Length Adjustments

Notes: The Table lists the devaluation episodes that are less than 13 years apart in a given country. The entries correspond to adjustment made in the initial year of the pre-devaluation period (column 2) and the final year of the post-devaluation period (column 3). For ease of readability, no value is reported when no adjustment is made to the initial or final year of the window.

devaluations are adjusted to ensure that each data point is used for at most one event. The criterion adopted is to ensure 2 years of pre-devaluation period. Table 26 lists the episodes with overlap and the adjustments.

6.3 Import Values, Import Volume and Output

This section documents the behavior of import values, import quantities and output in the sample of 26 large devaluations considered in Section 2.2. All series are detrended by removing a country-specific log linear trend. Figure 27 depicts the behavior of the current dollar value of imports (upper left panel) and of an index of import volume (upper right panel) around a large devaluation, for the average event in the sample.[89] The dollar value of imports falls by about 25-30% and remains substantially depressed relative to trend for several years following the devaluation.[90] The volume of imports falls by about 20% within two-years and remains 10% depressed relative to trend 8 years after the devaluation.[91] Real output shows a persistent decline of about 5% relative to trend - see bottom panel in Figure 27. Qualitatively, these findings are consistent with those in Meza and Quintin (2007), Korinek and Mendoza (2014) and Gopinath and Neiman (2014).

6.4 Additional Material for Decompositions

Derivation of Equation (5). Let m_{Dit} and m_{Iit} denote spending in domestic and foreign materials, respectively, by firm i in period t. Let total material spending by the firm be $mat_{it} = m_{Dit} + m_{Iit}$. Then the aggregate imported input share is given by

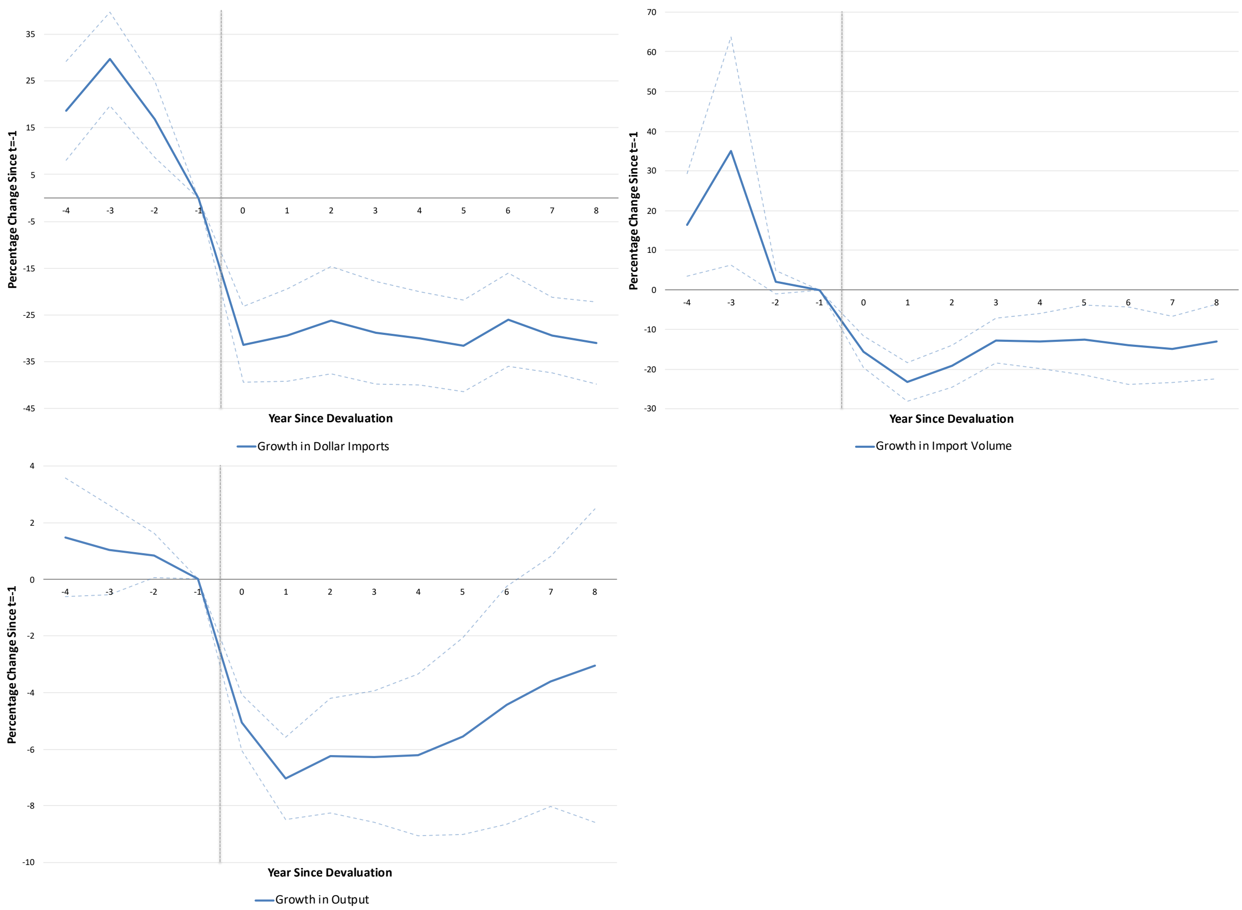
$$s_{I,AGGt} = \frac{\sum_{i \in I_t} m_{Iit}}{\sum_{i \in I_t} mat_{it}},$$

where I_t denotes the set of firms active in period t. Letting m_{it} be the firm's share in total industry materials

[89] Import volume indices are obtained from the IFS, except for Chile, Indonesia, Mexico and Argentina which are taken from World Development Indicators. No data on import volumes is available for the following 6 episodes: Argentina 1975, Chile 1973, Indonesia 1979, Mexico 1977, Russia 1998 and Turkey 1980.

[90] Gopinath and Neiman (2014), Alessandria et al. (2010) also find large drops import values over a 1-2 year horizon for the recent large devaluations of Argentina, Brazil, Korea, Mexico, Thailand and Russia. In contrast to them, this section focuses on detrended series over a longer horizon.

[91] The fall in import value and volume precedes the devaluation. This is expected as these events tend to be preceded by economic recessions, as seen in Figure 27, and imports are pro-cyclical.



Notes: The upper left figure depicts the rate of growth in the current dollar value of aggregate imports while the upper right figure depicts the rate of growth in an index of import volume. The bottom figure depicts the rate of growth in real GDP. 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. The figures depict averages of the experiences of the 26 episodes listed in Table 1, computed according to (3) in footnote 16. The index of import volume is not available for the events of Argentina 1975, Chile 1973, Indonesia 1979, Mexico 1977, Russia 1998 and Turkey 1980. The dashed lines give the standard deviation divided by the square root of the sample size. Source: IFS, WDI.

Figure 27: Import Value, Volume and Output After Large Devaluations

$$m_{it} \equiv \frac{mat_{it}}{\sum_{i \in I_t} mat_{it}},$$

and s_{it} be the firm's imported input share

$$s_{it} \equiv \frac{m_{Iit}}{mat_{it}},$$

the aggregate imported input share can be written as

$$s_{I,AGGt} = \sum_{i \in I_t} \frac{m_{Iit}}{mat_{it}} \frac{mat_{it}}{\sum_{i \in I_t} mat_{it}} = \sum_{i \in I_t} m_{it} s_{it}.$$

We now focus on the periods before and after the devaluation, denoted by 1 and 2, respectively. The change in the aggregate import share between these periods is given by

$$\Delta s_{I,AGG} \equiv s_{I,AGG2} - s_{I,AGG1} = \sum_{i \in I_2} m_{i2} s_{i2} - \sum_{i \in I_1} m_{i1} s_{i1}. \tag{35}$$

Consider now the following partitions of the sets of active firms in each period:

$$\begin{aligned} I_2 &= S \cup En \qquad (36) \\ I_1 &= S \cup X \\ S &= NI \cup OI \cup CI \cup NN, \qquad (37) \end{aligned}$$

where En is the set of entering firms (present in period 2 but not in 1), X is the set of exiting firms (present in period1 but not in 2) and S the set of continuing firms (present in both periods). In turn, NI, OI, CI and NN are the sets of new importers (non-importers in period 1, importers in period 2), old importers (importers in period 1, non-importers in period 2), continuing importers (importers in both periods) and never importers (non-importers in both periods).

$$\begin{aligned} \Delta s_{I,AGG} &= \sum_S m_{i2}s_{i2} - \sum_S m_{i1}s_{i1} + \sum_{En} m_{i2}s_{i2} - \sum_X m_{i1}s_{i1} \\ &= \sum_S \{m_{i1}(s_{i2}-s_{i1}) + (m_{i2}-m_{i1})s_{i2}\} + \sum_{En} m_{i2}s_{i2} - \sum_X m_{i1}s_{i1} \end{aligned}$$

This is the Baily et al. (1992) decomposition. We next split the set continuing firms S by import status according to (37):

$$\frac{\Delta s_{I,AGG}}{s_{I,AGG1}} = \frac{1}{s_{AGG1}} \left\{ \sum_{CI} \{m_{i1}(s_{i2}-s_{i1}) + (m_{i2}-m_{i1})s_{i2}\} + \sum_{NI} m_{i2}s_{i2} - \sum_{OI} m_{i1}s_{i1} + \sum_{En} m_{i2}s_{i2} - \sum_X m_{i1}s_{i1} \right\},$$

where the fact that $s_{i1} = 0$ for new importers and $s_{i2} = 0$ for old importers was used. The sets of new importers and old importers can be lumped with En and X, respectively:

$$\frac{\Delta s_{I,AGG}}{s_{I,AGG1}} = \frac{1}{s_{I,AGG1}} \left\{ \sum_{CI} \{m_{i1}(s_{i2}-s_{i1}) + (m_{i2}-m_{i1})s_{i2}\} + \sum_{\tilde{NI}} m_{i2}s_{i2} - \sum_{\tilde{OI}} m_{i1}s_{i1} \right\}$$

where $\tilde{NI} \equiv En \cup NI$ and $\tilde{OI} \equiv X \cup OI$. Finally, note that the term $(m_{i2} - m_{i1})\, s_{i2}$ can be split into a between and a covariance term, the desired expression is obtained:

$$\frac{\Delta s_{I,AGG}}{s_{I,AGG1}} = \frac{1}{s_{I,AGG1}} \left\{ \sum_{CI} \{m_{i1}(s_{i2}-s_{i1}) + (m_{i2}-m_{i1})s_{i1} + (m_{i2}-m_{i1})(s_{i2}-s_{i1})\} + \sum_{\tilde{NI}} m_{i2}s_{i2} - \sum_{\tilde{OI}} m_{i1}s_{i1} \right\}.$$

With a slight abuse of notation, the sets $\tilde{NI}$ and $\tilde{OI}$ are referred to as NI and OI in expression (5) in the main text.

Derivation of (6). This equation simply follows from (35) and the fact that

$$\Delta s_{I,AGG} = \sum_{i \in I_2} m_{i2}s_{i2} - \sum_{i \in I_1} m_{i1}s_{i1}.$$

Panel A: Mexico

Year	$\Delta\bar{s}_S$	$\Delta cov(m_{iS}, s_i)$	Entry	Exit	All
1995	-2.58	11.49	-0.04	-0.07	8.95
1996	-3.79	15.96	2.83	-0.27	15.27
1997	-1.16	14.07	2.57	-3.92	19.41
1998	-2.53	16.76	2.66	-1.02	17.91
1999	-0.61	14.41	2.27	-1.62	17.70

Panel B: Indonesia

Year	$\Delta\bar{s}_S$	$\Delta cov(m_{iS}, s_i)$	Entry	Exit	All
1998	-1.75	2.83	1.01	0.78	1.30
1999	-1.24	2.42	3.81	0.67	4.32
2000	-2.11	13.50	0.40	-0.12	11.92

Notes: The Table contains the decomposition of the aggregate import share given in (38) for the devaluations of Mexico in 1995 (Panel A) and Indonesia in 1998 (Panel B). Each row performs the decomposition between the pre-devaluation year (1994 for Mexico and 1997 for Indonesia) and several subsequent 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 27: Dynamic Olley Pakes Decomposition

Let E be the set of active exporters in period 2. Consider the following partitions of the sets of active firms in each period:

$$I_2 = E \cup$$

More precisely, the decomposition in (6) partitions the firms of period 2 (I_2) into exporters (E_2) and non-exporters (NE_2), and the firms of period 1 (I_1) into those that export in period 2 ($I_1 \cap E_2$) and the rest, which includes surviving firms that are non-exporters in period 2 and exiting firms($\{I_1 \cap NE_2\} \cup X$). COMPLETE

6.4.1 Dynamic Olley Pakes Decomposition

This decomposition is given by

$$\frac{\Delta s_{AGG}}{s_{AGG1}} = \{\underbrace{\Delta\bar{s}_S + \Delta cov(m_{iS}, s_i)}_{Survivors} + \underbrace{m_{En2}\left(s_{AGG,En2} - s_{AGG,S2}\right)}_{Entry} - \underbrace{m_{X1}\left(s_{AGG,X1} - s_{AGG,S1}\right)}_{Exit}\}\frac{1}{s_{AGG1}}, \quad (38)$$

where $\Delta\bar{s}_S$ is the change in the average import share among continuing firms, $\Delta cov(m_{iS}, s_i)$ is the change in the covariance between market shares and import shares among continuing firms, and m_{Gt} and s_{Gt} denote the material share and the aggregate import share of group $G \in \{En, X\}$ in period t where En are the firms that enter the sample and X the firms that exit.

Table 27 contains the results of applying this decomposition to the Mexican and Indonesian devaluations of 1995 and 1998. The decomposition is performed over different time horizons keeping the pre-devaluation year fixed.

Derivation of (38). The derivations follow Melitz and Polanec (2015). Consider again the groups of entering firms En, exiting firms X and continuing firms S defined above in (36). Let $G \in \{S, X, En\}$ be an index for these groups. Let

$$m_{Gt} \equiv \frac{\Sigma_{i\in G} mat_{it}}{\Sigma_i mat_{it}} = \Sigma_{i\in G} m_{it}$$

be the share of materials accounted by group G. Likewise, let

$$s_{AGG,Gt} \equiv \frac{\Sigma_{i\in G} imp_{it}}{\Sigma_{i\in G} mat_{it}} = \Sigma_{i\in G} \frac{mat_{it}}{\Sigma_i mat_{it}} \frac{\Sigma_i mat_{it}}{\Sigma_{i\in G} mat_{it}} \frac{imp_{it}}{mat_{it}} = \Sigma_{i\in G} \frac{m_{it}}{m_{Gt}} s_{it}$$

be the aggregate import share of group G. It follows that $m_{Gt} \times s_{AGG,Gt} = \Sigma_{i\in G} m_{it} s_{it}$ and the period-1 aggregate import share can be written as

$$\begin{aligned} s_{AGG1} &= \Sigma_{i\in S} m_{i1} s_{i1} + \Sigma_{i\in X} m_{i1} s_{i1} \\ &= m_{S1} s_{AGG,S1} + m_{X1} s_{AGG,X1} \\ &= s_{AGG,S1} + m_{X1} \left(s_{AGG,X1} - s_{AGG,S1} \right), \end{aligned}$$

where $m_{S1} + m_{X1} = 1$ was used. The period-2 aggregate import share can be written as

$$\begin{aligned} s_{AGG2} &= \Sigma_{i\in S} m_{i2} s_{i2} + \Sigma_{i\in En} m_{i2} s_{i2} \\ &= m_{S2} s_{AGG,S2} + m_{En2} s_{AGG,En2} \\ &= s_{AGG,S2} + m_{En2} \left(s_{AGG,En2} - s_{AGG,S2} \right). \end{aligned}$$

Therefore, the change in the import share is:

$$\Delta s_{AGG} \equiv s_{AGG2} - s_{AGG1} = s_{AGG,S2} - s_{AGG,S1} + m_{En2} \left(s_{AGG,En2} - s_{AGG,S2} \right) - m_{X1} \left(s_{AGG,X1} - s_{AGG,S1} \right).$$

We now apply a static Olley Pakes decomposition to each aggregate import share of continuing firms. More precisely, letting n_S be the number of continuing firms,

$$\begin{aligned} s_{AGG,S2} = \Sigma_{i\in S} \frac{m_{i2}}{m_{S2}} s_{i2} &= \frac{1}{n_S} \Sigma_{i\in S} s_{i2} + \Sigma_{i\in S} \frac{m_{i2}}{m_{S2}} s_{i2} - \frac{1}{n_S} \Sigma_{i\in S} s_{i2} \\ &= \bar{s}_{S2} + \Sigma_{i\in S} \left(\frac{m_{i2}}{m_{S2}} - \frac{1}{n_S} \right) s_{i2} \\ &= \bar{s}_{S2} + \Sigma_{i\in S} \left(\frac{m_{i2}}{m_{S2}} - \frac{1}{n_S} \right) \left(s_{i2} - \bar{s}_{S2} \right) = \bar{s}_{S2} + cov(m_{iS2}, s_{i2}), \end{aligned}$$

where $\bar{s}_{S2}$ denotes the simple average of the period-2 import shares for the set of continuing firms. Likewise,

$$s_{AGG,S1} \equiv \bar{s}_{S1} + \Sigma_{i\in S} \left(\frac{m_{i1}}{m_{S1}} - \frac{1}{n_S} \right) \left(s_{i1} - \bar{s}_{S1} \right) = \bar{s}_{S1} + cov(m_{iS1}, s_{i1}).$$

Putting all together, we obtain the desired result:

$$\Delta s_{AGG} = \bar{s}_{S2} - \bar{s}_{S1} + cov(m_{iS2}, s_{i2}) - cov(m_{iS1}, s_{i1}) + m_{E2} \left(s_{AGG,E2} - s_{AGG,S2} \right) - m_{X1} \left(s_{AGG,X1} - s_{AGG,S1} \right).$$

6.4.2 Within vs Between Sectors Decomposition

How much of the increase in the aggregate import share documented in Section 2.2 is due to changes within sectors vs changes across sectors? We now decompose the growth in the aggregate import share into a component associated with increases in the sector-level import shares and a component associated with changes in the size of sectors of different import intensity. More precisely, we consider the following decomposition:

$$\frac{\Delta s_{I,AGG}}{s_{I,AGG1}} = \{\underbrace{\sum_{j\in J} m_{j1}\left(s_{I,AGGj2} - s_{I,AGGj1}\right)}_{Within} + \underbrace{\sum_{j\in J} \left(m_{j2} - m_{j1}\right) s_{I,AGGj2}}_{Between}\} \frac{1}{s_{I,AGG1}}, \tag{39}$$

where m_{jt} denotes the share of total materials accounted by sector j in period t , $s_{I,AGGjt}$ denotes the aggregate import share of sector j in period t, and J is the total number of sectors in Manufacturing.[92] Sectors are defined at the two-digit level. The decomposition is performed over several horizons, keeping the pre-devaluation year fixed at 1994 for Mexico and 1997 for Indonesia. For Indonesia, no information about the firms' sector of operation is available for 1999 or 2000, and hence the decomposition is performed over 1997-1998 only. Table 28 contains the results. For both countries and over all horizons, the Within component is positive and accounts for a significant share of the overall increase in the aggregate import share. For Mexico (Panel A), on average, almost 3/4 of the increase in the import share is accounted by within-sector increases in import intensity. For Indonesia (Panel B), the Within component is almost 4 times larger than the actual increase in the aggregate import share.

Panel A: Mexico			
Year	Within	Between	All
1995	9.65	-0.71	8.95
1996	11.91	3.36	15.27
1997	12.23	7.27	19.41
1998	10.29	7.62	17.91
1999	8.90	8.80	17.70
Panel B: Indonesia			
Year	Within	Between	All
1998	4.85	-3.54	1.30

Table 28: Change in Aggregate Import Share: Sector-Level Decomposition

Notes: The table performs the decomposition of the growth in the aggregate import share given in (39) for the devaluations of Mexico in 1995 (Panel A) and Indonesia in 1998 (Panel B). Each row performs the decomposition over a different time horizon keeping the pre-devaluation year fixed (at 1994 for Mexico and 1997 for Indonesia). For Indonesia, no information on firms' sector of operation is available for 1999 or 2000. 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. Sources: Encuesta Industrial Anual (Mexico) and Survei Industri (Indonesia).

Table 29 provides the contribution of each two-digit sector to the Within and Between components documented in Table 28. The first column shows that, for almost all industries, the import share increased following the devaluation.[93] We also see that, in the case of Mexico, the positive contribution of the Between seen in Table 28 for 1999 is explained by Metal Products, Machinery and Equipment, which displays a large expansion and is very import-intensive in 1999. We conclude that industry-level increases in import shares played a significant role in explaining the growth in the manufacturing-level import share documented in Section 2.2. Sectoral reallocations played a role in the Mexican devaluation but not in the Indonesian one.

[92] Formally, the sector-level import share and material share are given by

$$s_{I,AGGjt} = \frac{\sum_{i\in I_{jt}} m_{It}}{\sum_{i\in I_{jt}} mat_{it}} \text{ and } m_{jt}=\frac{\sum_{i\in I_{jt}} mat_{it}}{\sum_{i\in I_{t}} mat_{it}}$$

where I_{jt} is the set of active firms in sector j in period t and, as before, I_t is the set of active firms in period t.

[93] For Mexico, an exception is Wood and Wood products which shows a large decline in its import intensity. For Indonesia, the exception is Food, Beverages and Tobacco.

Panel A: Mexico 1994-1999

Industry	Within: $\Delta s_{AGGj}/s_{AGG94}$	Within: m_{j94}	Between: $\Delta m_j/s_{AGG94}$	Between: s_{AGGj99}
31 - Food, Beverages, Tobacco	2.36	0.24	-13.20	0.18
32 - Textiles, Apparel, Leather	18.44	0.06	-3.86	0.28
33 - Wood and Wood Products	-22.13	0.01	-0.76	0.11
34 - Paper, Paper Products, Printing	2.19	0.05	-1.65	0.34
35 - Chemicals, Plastics Products	21.27	0.16	-4.07	0.45
36 - Mineral Products (Non-Metallic)	20.31	0.02	-1.48	0.22
37 - Basic Metal Industries	1.89	0.10	-0.12	0.17
38 - Metal Products, Machinery, Equipment	9.40	0.37	25.32	0.60
39 - Other Manufacturing Industries	5.60	0.00	-0.19	0.45

Panel B: Indonesia 1997-1998

Industry	Within: $\Delta s_{AGGj}/s_{AGG97}$	Within: m_{j97}	Between: $\Delta m_j/s_{AGG97}$	Between: s_{AGGj98}
31 - Food, Beverages, Tobacco	-9.52	0.22	4.27	0.09
32 - Textiles, Apparel, Leather	8.06	0.22	8.37	0.40
33 - Wood and Wood Products	4.58	0.11	-1.36	0.05
34 - Paper, Paper Products, Printing	29.91	0.05	1.83	0.39
35 - Chemicals, Plastics Products	1.45	0.19	2.97	0.36
36 - Mineral Products (Non-Metallic)	39.75	0.02	-3.12	0.39
37 - Basic Metal Industries	8.61	0.04	-3.23	0.58
38 - Metal Products, Machinery, Equipment	11.62	0.15	-9.57	0.60
39 - Other Manufacturing Industries	11.73	0.01	-0.15	0.38

Table 29: Sector Level Decomposition, Within and Between Component

Notes: The table provides details on the decomposition of the growth in the aggregate import share given in (39) for the devaluations of Mexico in 1995 (Panel A) and Indonesia in 1998 (Panel B). For Mexico, the decomposition is performed between 1994 and 1999. For Indonesia, the decomposition is performed between 1997 and 1998. The first column provides the change in the import share at the two-digit industry level (normalized by the initial manufacturing-level import share) observed following the devaluation. The second column provides the share of each industry in total manufacturing materials in the pre-devaluation year. The third column provides the industry-level change in the material share (normalized by the initial manufacturing-level import share). The fourth column provides the industry-level import share in the post-devaluation year. All values are in percentage points. Sources: Encuesta Industrial Anual (Mexico) and Survei Industri (Indonesia).

Panel A: Mexico

	Import Share Growth		Between + Covariance		Net Entry	
Year	Total	Exp. Exporters	Total	Exp. Exporters	Total	Exp. Exporters
1995	8.95	7.08	7.03	5.43	-0.99	-0.23
1996	15.27	16.37	8.24	7.94	5.48	6.82
1997	19.41	22.89	13.82	13.50	6.56	7.98
1998	17.91	23.31	13.89	14.75	5.93	8.48
1999	17.70	22.85	14.26	15.53	6.24	9.29

Panel B: Indonesia

	Import Share Growth		Between + Covariance		Net Entry	
Year	Total	Exp. Exporters	Total	Exp. Exporters	Total	Exp. Exporters
1998	1.30	2.64	4.04	2.26	-0.65	1.06
1999	4.32	8.18	1.69	2.02	5.37	6.89
2000	11.92	7.06	10.11	-0.28	3.80	6.39

Notes: The table contains the contribution of expanding exporters to the growth in the aggregate import share, and various of its components, observed after the devaluations of Mexico in 1995 (Panel A) and Indonesia in 1998 (Panel B). The first two columns report the contribution of expanding exporters to the growth in the aggregate import share according to (40). The third and fourth columns report the contribution of exporters to the sum of the Between and Covariance components as outlined in (41). The last two columns provide a similar decomposition of the Net Entry component. Each row performs the corresponding decomposition over a different time horizon keeping the pre-devaluation year fixed (at 1994 for Mexico and 1997 for Indonesia). All values are in percentage points. Sources: Encuesta Industrial Anual (Mexico) and Survei Industri (Indonesia).

Table 30: The Change in the Aggregate Import Intensity and Expanding Exporters

6.4.3 Expanding Exporters and the Aggregate Import Share

In this Section, I consider an alternative version of the decompositions (6) and (7) considered in the main text, where firms are split according to whether they expanded their export share following the devaluation. In particular, I consider the following decomposition of the aggregate import share growth:

$$\frac{\Delta s_{I,AGG}}{s_{I,AGG1}} = \underbrace{\frac{1}{s_{I,AGG1}}\left\{\sum_{I_2\cap EE} m_{i2}s_{i2} - \sum_{I_1\cap EE} m_{i1}s_{i1}\right\}}_{\text{Expanding Exporters}} + \underbrace{\frac{1}{s_{I,AGG1}}\left\{\sum_{I_2\cap R} m_{i2}s_{i2} - \sum_{I_1\cap R} m_{i1}s_{i1}\right\}}_{\text{Rest}}, \tag{40}$$

where I_t denotes the set of active firms in period t and EE is the set of expanding exporters, defined as firms whose export share increased following the devaluation, i.e., $s_{Xi2} > s_{Xi1}$. The rest of the firms, which either contracted their export shares or kept them constant, are grouped into the set R.[94] Likewise, I compute the sum of the Between and Covariance components over the set of expanding exporters:

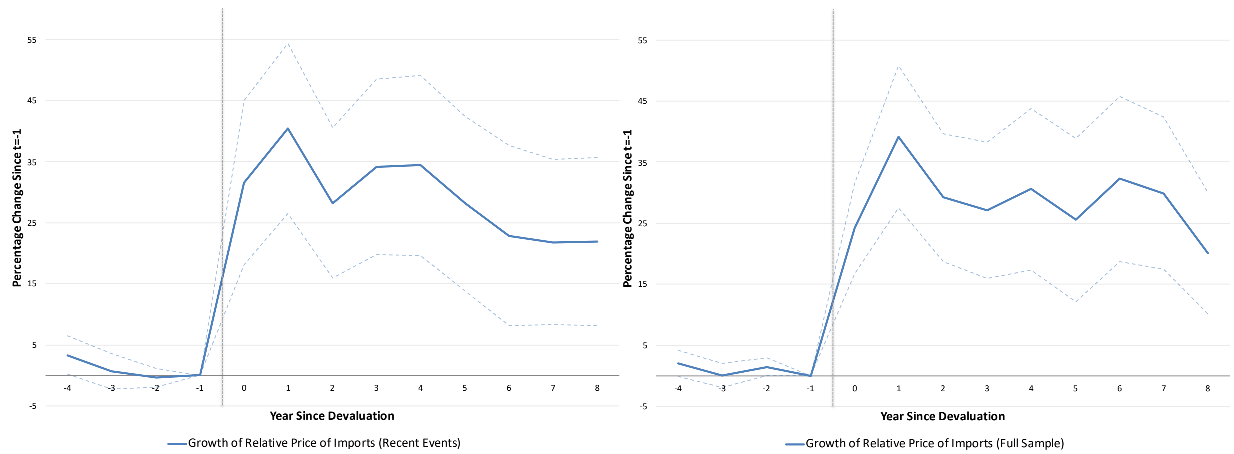
$$\underbrace{\frac{1}{s_{I,AGG1}}\sum_{CI}\left(m_{i2}-m_{i1}\right)s_{i2}}_{\text{Between+Covariance}} = \frac{1}{s_{I,AGG1}}\{\underbrace{\sum_{CI\cap EE}\left(m_{i2}-m_{i1}\right)s_{i2}}_{\text{Exporters}} + \underbrace{\sum_{CI\cap R}\left(m_{i2}-m_{i1}\right)s_{i2}}_{\text{Non-Exporters}}\}, \tag{41}$$

The results of applying the decompositions in (40) and (41)are contained in Table 30.

[94] Firms that enter the sample after the devaluation and have a positive export share ($s_{Xi2} > 0$) are classified as expanding exporters. Likewise, firms with a positive export share before the devaluation ($s_{Xi1} > 0$) that exited the sample are classified in the group R.

6.5 Relative Price of Imports

This section reports the behavior of the relative price of imports to domestic goods during the large devaluations listed in Table 1. The price of domestic goods is measured with the PPI. When producer prices are not available, wholesale (WPI) or consumer prices (CPI) are used instead.[95] The price of imported goods is measured with unit value indices of imports, computed as the ratio of import value to volume, taken from UNCTAD's trade database. For a few countries, the IFS provides import price indices that are survey-based (instead of unit value based). In these cases, priority is given to the survey-based import price indices.[96] Unit value indices are subject to the potential concern of changing product composition. However, as noted in Burstein et al. (2005), after large devaluations the quality of imports is likely to go down, not up. This implies a downward bias in the growth of the unit-value-based import price index following the devaluation. Import price indices are available for 19 out of the 26 episodes in Table 1.[97] Figure 28 contains the results for both the set of recent episodes (left panel) and the full sample (right panel). Consistent with the behavior of the RER, the figure shows a persistent increase in the relative price of imported goods.[98]



Notes: The figure depicts the rate of growth in the relative price of imports to the PPI. When producer prices are not available, wholesale (WPI) or consumer prices (CPI) are used. Import prices are measured with unit value indices, except for the episodes in Chile, Finland, Korea, Mexico and Sweden where survey-based import price indices are used. The left panel depicts the average experience of the recent episodes, marked in bold in Table 1. The right panel depicts the experience of the full sample of events. Source: IFS, UNCTAD.

Figure 28: Relative Price of Imports to Domestic Prices

6.6 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

$$s_D \equiv \frac{p_D z_D}{p_D z_D + m_I} = \frac{\beta^{\varepsilon} \left(p_D/q_D\right)^{1-\varepsilon}}{\beta^{\varepsilon} \left(p_D/q_D\right)^{1-\varepsilon} + \left(1-\beta\right)^{\varepsilon} e^{1-\varepsilon} A\left(\Sigma\right)^{1-\varepsilon}} = Q\left(\Sigma; e\right)^{\varepsilon-1} \beta^{\varepsilon} \left(p_D/q_D\right)^{1-\varepsilon}, \tag{42}$$

[95] The WPI is used for Brazil and Israel. The CPI is used for Indonesia, Chile and Argentina. Because the CPI includes imported goods, it will tend to increase by more than the PPI after the devaluation, creating a downward bias in the growth in the relative price of imports.

[96] This is the case for Chile, Finland, Korea, Mexico and Sweden.

[97] No data is available for the following 8 episodes: Argentina 1975, Chile 1973, Indonesia 1979, Israel 1975, Mexico 1977, Russia 1998, Spain 1983 and Turkey 1980.

[98] Alessandria et al. (2010) find large increases in the relative price of imports to the domestic PPI for the recent events of Argentina, Brazil, Korea, Mexico, Thailand and Russia.

where $Q(\cdot)$ is the price index of materials defined in (15) above.[99] Equation (42) implies a relationship between $Q(\cdot)$ and s_D which, when plugged into (14), delivers the expression for the unit cost given by (17) above. In addition, using the expression for $A(\cdot)$ as a function of n given by (16), equation (42) implies the following relationship between s_D and n:

$$s_D = \left(1+\left(\frac{1-\beta}{\beta}\right)^{\varepsilon} e^{1-\varepsilon}\left(p_D/q_D\right)^{\varepsilon-1} z^{1-\varepsilon} n^{\eta(\varepsilon-1)}\right)^{-1}. \tag{43}$$

Firm profits. This section derives the expression in (23). Consider the strategy of importing-exporting. Combining the expressions in (19) and, (22), firm profits can be expressed as:

$$\begin{aligned}\Pi_{XM} &= \pi_D+\pi_X-wf_in-wF_{XM}\\ &= \sigma^{-\sigma}(\sigma-1)^{\sigma-1}u_i^{1-\sigma}P^{\sigma-1}S+\frac{1}{\theta-1}\underline{b}^{\theta}e^{\theta\sigma}\sigma^{-\theta\sigma}(\sigma-1)^{\theta(\sigma-1)}(1+\tau)^{-\theta(\sigma-1)}u_i^{-\theta(\sigma-1)}f_{Xi}^{1-\theta}-wf_in-wF_{XM}\end{aligned}$$

Since the unit cost u_i and the mass of imported countries n are both linked to the domestic share via (17) and (43), this expression can be written as

$$\begin{aligned}\frac{\Pi_{XM}}{w} &= \sigma^{-\sigma}(\sigma-1)^{\sigma-1}\left(\frac{1}{1-\gamma}\right)^{-(\sigma-1)(1-\gamma)}\left(\frac{p_D/w}{\gamma\beta^{\frac{\varepsilon}{\varepsilon-1}}q_D}\right)^{-(\sigma-1)\gamma}\varphi_i^{\sigma-1}s_{Di}^{-(\sigma-1)\frac{\gamma}{\varepsilon-1}}(P/w)^{\sigma-1}(S/w) \qquad (44)\\ &+\frac{1}{\theta-1}(e/w)^{\sigma\theta}\underline{b}^{\theta}\sigma^{-\sigma\theta}\left(\frac{\sigma-1}{1+\tau}\right)^{\theta(\sigma-1)}\left(\frac{1}{(1-\gamma)^{1-\gamma}}\frac{(p_D/w)^{\gamma}}{\gamma^{\gamma}\beta^{\gamma\frac{\varepsilon}{\varepsilon-1}}q_D^{\gamma}}\right)^{-\theta(\sigma-1)}\varphi_i^{\theta(\sigma-1)}s_{Di}^{-\theta(\sigma-1)\frac{\gamma}{\varepsilon-1}}f_{Xi}^{1-\theta}\\ &-\left(\frac{\beta}{1-\beta}\right)^{\frac{\varepsilon}{\eta(\varepsilon-1)}}\left(\frac{ze/w}{p_D/w}\right)^{\frac{1}{\eta}}q_D^{\frac{1}{\eta}}\left(s_D^{-1}-1\right)^{\frac{1}{\eta(\varepsilon-1)}}f_i-F_{XM}.\end{aligned}$$

Note that profits have been expressed in terms of labor and all relevant prices and general equilibrium variables have been normalized by the wage: P/w, S/w and ze/w.[100] This implies that the wage can be normalized to unity, i.e., $w=1$.

By appropriately re-scaling profits and fixed costs by prices and general equilibrium variables, and noting that $p_D=P$, this expression can be written as

$$\begin{aligned}\tilde{\Pi}_{XM} &\equiv \frac{\Pi_{XM}}{w}\frac{1}{\kappa_{norm}(P/w)^{(\sigma-1)(1-\gamma)}(S/w)} \qquad (45)\\ &= \beta^{\frac{\varepsilon}{\varepsilon-1}(\sigma-1)\gamma}\varphi_i^{\sigma-1}s_{Di}^{-(\sigma-1)\frac{\gamma}{\varepsilon-1}}+\\ &+\tilde{f}_{Xi}^{1-\theta}\frac{1}{\theta}\beta^{\gamma\frac{\varepsilon}{\varepsilon-1}\theta(\sigma-1)}\varphi_i^{\theta(\sigma-1)}s_{Di}^{-\theta(\sigma-1)\frac{\gamma}{\varepsilon-1}}-\tilde{f}_i\gamma\eta(\sigma-1)\left(\frac{\beta}{1-\beta}\right)^{\frac{\varepsilon}{\eta(\varepsilon-1)}}\left(s_D^{-1}-1\right)^{\frac{1}{\eta(\varepsilon-1)}}-\tilde{F}_{XM},\end{aligned}$$

where $\tilde{f}_i, \tilde{f}_{Xi}$ and $\tilde{F}_{XM}$ are given by

$$\tilde{f}_i\equiv\frac{1}{\gamma\eta}\left(\frac{1}{1-\gamma}\right)^{(\sigma-1)(1-\gamma)}\left(\frac{1}{\gamma q_D}\right)^{(\sigma-1)\gamma}\frac{\sigma^{\sigma}}{(\sigma-1)^{\sigma}}q_D^{\frac{1}{\eta}}(ze/w)^{\frac{1}{\eta}}\left(\frac{P}{w}\right)^{-(\sigma-1)(1-\gamma)-\frac{1}{\eta}}\left(\frac{S}{w}\right)^{-1}f_i \tag{46}$$

[99] All of the theoretical expressions in the Appendix correspond to the following version of the material input bundle in (9):

$$x=\left(\beta(q_Dz_D)^{\frac{\varepsilon-1}{\varepsilon}}+(1-\beta)x_I^{\frac{\varepsilon-1}{\varepsilon}}\right)^{\frac{\varepsilon}{\varepsilon-1}},$$

where $\beta\in(0,1)$ is a location parameter that was omitted in the main text for ease of exposition. In the quantitative exercises of Section 4, this parameter was normalized to $\beta=1/2$.

[100] Note that the price of foreign inputs $p_c=ep^*\propto ez$, where z is an auxiliary parameter defined in footnote 43 in the main text.

$$\tilde{f}_{Xi}^{1-\theta} \equiv \left(\frac{P}{w}\right)^{1-\sigma+(1-\theta)(\sigma-1)\gamma} \left(\frac{S}{w}\right)^{-1} \frac{\theta}{\theta-1} \underline{b}^{\theta} (e/w)^{\sigma\theta} \sigma^{-\sigma(\theta-1)} (\sigma-1)^{(\theta-1)(\sigma-1)} \times \tag{47}$$
$$\times \left(\frac{1}{1-\gamma}\right)^{(\sigma-1)(1-\gamma)(1-\theta)} \left(\frac{1}{\gamma q_D}\right)^{(1-\theta)(\sigma-1)\gamma} (1+\tau)^{-\theta(\sigma-1)} f_{Xi}^{1-\theta}$$

$$\tilde{F}_{XM} \equiv \frac{1}{\kappa_{norm} (P/w)^{(\sigma-1)(1-\gamma)} (S/w)} F_{XM}, \tag{48}$$

and k_{norm} is a function of parameters given by

$$\kappa_{norm} \equiv \sigma^{-\sigma} (\sigma-1)^{\sigma-1} \left(\frac{1}{1-\gamma}\right)^{-(\sigma-1)(1-\gamma)} (\gamma q_D)^{(\sigma-1)\gamma}.$$

Because re-scaled profits $\tilde{\Pi}_{XM}$ are a monotone increasing transformation of profits Π_{XM}, the domestic share s_D that maximizes re-scaled profits also maximizes profits. Profits for the importer-only, exporter-only and purely domestic status can be similarly obtained as special cases of (45) (i.e., $\tilde{f}_X \to \infty$, $s_D = 1$, or both), replacing $\tilde{F}_{XM}$ by the corresponding status fixed cost. The expressions for $\tilde{F}_M$ and $\tilde{F}_X$ are similar to (48).

Export share - domestic share relationship. Domestic revenue is given by

$$R_{Di} = \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} u_i^{1-\sigma} P^{\sigma-1} S. \tag{49}$$

Following steps similar to those leading to (22), export revenue is given by

$$R_{Xi} = e^{\sigma\theta} \underline{b}^{\theta} \frac{\theta}{\theta-1} \sigma^{1-\sigma\theta} (\sigma-1)^{\theta(\sigma-1)} (1+\tau)^{-\theta(\sigma-1)} u_i^{-\theta(\sigma-1)} w^{1-\theta} f_{Xi}^{1-\theta}. \tag{50}$$

The export share is defined as:

$$s_{Xi} \equiv \frac{R_{Xi}}{R_{Di} + R_{Xi}}.$$

Using the relationship between the unit cost and domestic share in (17), it follows that

$$\frac{1}{s_{Xi}} - 1 = \kappa_4 \varphi_i^{(\sigma-1)(1-\theta)} s_{Di}^{(\theta-1)(\sigma-1)\frac{\gamma}{\varepsilon-1}} f_{Xi}^{\theta-1} \left(\frac{e}{w}\right)^{-\sigma\theta} \underline{b}^{-\theta} \left(\frac{P}{w}\right)^{(\sigma-1)(1-\gamma)+\gamma\theta(\sigma-1)} \frac{S}{w}, \tag{51}$$

where κ_4 is determined by model parameters:

$$\kappa_4 \equiv (1+\tau)^{\theta(\sigma-1)} (\sigma-1)^{(1-\theta)(\sigma-1)} (1-\gamma)^{(1-\theta)(1-\gamma)(\sigma-1)} \sigma^{\sigma(\theta-1)} (\gamma q_D)^{(\sigma-1)\gamma(1-\theta)} \frac{\theta-1}{\theta} \underline{b}^{-\theta}.$$

Relying on the rescaled fixed costs of importing and exporting defined in (46)-(47), this relationship between the export share and the import share becomes:

$$\frac{1}{s_{Xi}} - 1 = \varphi_i^{(\sigma-1)(1-\theta)} s_{Di}^{(\theta-1)(\sigma-1)\frac{\gamma}{\varepsilon-1}} \tilde{f}_{Xi}^{\theta-1}. \tag{52}$$

6.7 Calibration Strategy

I follow Blaum et al. (2018) 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 φ_i and the re-scaled fixed costs $\tilde{f}_i, \tilde{f}_{Xi}, \tilde{F}_{XM}, \tilde{F}_M, \tilde{F}_X$ defined in (46)-(48), the firms' problem can be solved without knowledge of the general equilibrium variables, S and P. This follows from expressions (23) and (24). 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

$$s_{I,AGG} \equiv \int_i \frac{mat_i}{\int mat_i di} \times (1 - s_{Di})\, di = \int_i \omega_i \times (1 - s_{Di})\, di,$$

where mat_i are materials of firm i and ω_i is the firm's share in total materials. We can use revenue to compute ω_i as materials are proportional to revenue.[101] Domestic and foreign revenue is given by

$$\begin{aligned} R_{Di} &= \kappa_1 \varphi_i^{\sigma-1} s_{Di}^{-(\sigma-1)\frac{\gamma}{\varepsilon-1}} P^{(\sigma-1)(1-\gamma)} S \\ R_{Xi} &= \kappa_1 \varphi_i^{\sigma-1} \frac{s_{Xi}}{1 - s_{Xi}} s_{Di}^{-(\sigma-1)\frac{\gamma}{\varepsilon-1}} P^{(\sigma-1)(1-\gamma)} S \end{aligned}$$

where κ_1 is a composite of parameters defined in (59) below. Total firm revenue is therefore

$$R_i = \kappa_1 \varphi_i^{\sigma-1} s_{Di}^{-(\sigma-1)\frac{\gamma}{\varepsilon-1}} \left(\frac{1}{1 - s_{Xi}} \right) P^{(\sigma-1)(1-\gamma)} S. \tag{53}$$

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

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

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.[102] The fractions of importers-only, exporters-only and importers-exporters, as well as the dispersion in import and export shares and their correlation, follow directly from (s_{Di}, s_{Xi}). Finally, note that while the level of sales R_i depends on S, P - as seen in (53)- 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.

[101] More precisely,

$$mat_i = \gamma u_i y_i = \gamma \frac{\sigma - 1}{\sigma} R_i.$$

[102] In particular, the aggregate export shares is given by

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

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 $\left(\varphi_i, \tilde{f}_i, \tilde{f}_{Xi}, \tilde{F}_{XM}, \tilde{F}_M, \tilde{F}_X\right)$. 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 φ_i and s_{Di} using (28) in Proposition 1. Aggregate spending S is computed with the distribution of φ_i, s_{Di}, s_{Xi} as well as all re-scaled fixed costs from (29) - see Section 6.8 below for derivations.

6.8 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.[103] 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.[104]

This two-step characterization is particularly convenient given the calibration strategy outlined in Section 6.7. 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 (17), the pricing rule in (18), and the definition of the price index $P^{1-\sigma} = \int_i p_i^{1-\sigma} di$, yields:

$$\begin{aligned}
\left(\frac{P}{w}\right)^{1-\sigma} &= \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} \int u_i^{1-\sigma} di \\
&= \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} \left(\frac{1}{1-\gamma}\right)^{-(\sigma-1)(1-\gamma)} \left(\frac{p_D/w}{\gamma \beta^{\frac{\varepsilon}{\varepsilon-1}} q_D}\right)^{-(\sigma-1)\gamma} \int \varphi_i^{\sigma-1} s_{Di}^{-\frac{\gamma}{\varepsilon-1}(\sigma-1)} di
\end{aligned}$$

[103] We consider the case where $\underline{b}/w$ 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.

[104] In this step, we rely on the fact that the data (s_{Di}, s_{Xi}) together with φ_i imply values of normalized fixed costs $\left(\tilde{f}_i, \tilde{f}_{Xi}, \tilde{F}_X, \tilde{F}_M, \tilde{F}_{XM}\right)$. For an importer-exporter, the FOC and the export share equations pin down the norm fixed costs

$$\begin{aligned}
& (1-\beta)^{\frac{1}{\eta}\frac{\varepsilon}{\varepsilon-1}} \beta^{\frac{1}{\eta}\frac{\varepsilon}{\varepsilon-1}(\eta\gamma(\sigma-1)-1)} \varphi^{\sigma-1} s_D^{\frac{1}{\eta}\frac{1}{\varepsilon-1}(1-\eta\gamma(\sigma-1))} (1-s_D)^{1-\frac{1}{\eta(\varepsilon-1)}} \\
& + (1-\beta)^{\frac{1}{\eta}\frac{\varepsilon}{\varepsilon-1}} \beta^{\frac{1}{\eta}\frac{\varepsilon}{\varepsilon-1}(\theta\eta\gamma(\sigma-1)-1)} \varphi^{\theta(\sigma-1)} s_D^{\frac{1}{\eta(\varepsilon-1)}(1-\theta\eta\gamma(\sigma-1))} (1-s_D)^{1-\frac{1}{\eta(\varepsilon-1)}} \tilde{f}_X^{1-\theta} \\
= \; & \tilde{f}
\end{aligned}$$

$$s_X^{-1} - 1 = \varphi^{-(\sigma-1)(\theta-1)} s_{Di}^{\frac{\gamma}{\varepsilon-1}(\sigma-1)(\theta-1)} \beta^{-\gamma\frac{\varepsilon}{\varepsilon-1}(\sigma-1)(\theta-1)} \tilde{f}_X^{\theta-1}$$

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 $\tilde{f}_{Xi}$ is only required when $s_{Xi} > 0$ and $\tilde{f}_i$ is required only when $s_{Di} < 1$. Finally, we choose $\tilde{F}_X, \tilde{F}_M, \tilde{F}_{XM}$ so that the numbers of importers, exporters and importer-exporters match the ones implied by the data (s_{Di}, s_{Xi}).

Solving this equation delivers the expression for P in (28) in the Proposition where

$$\kappa_0 \equiv \left(\frac{\sigma}{\sigma-1}\right)^{\frac{1}{1-\gamma}} (1-\gamma)^{-1} \left(\gamma\beta^{\frac{\varepsilon}{\varepsilon-1}} q_D\right)^{-\frac{\gamma}{1-\gamma}}. \tag{54}$$

We next turn to finding aggregate domestic spending S, which is defined as

$$\frac{S}{w} = \frac{I}{w} + \frac{S_X}{w}, \tag{55}$$

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 (25):

$$\frac{I}{w} = L + T + \int_i \pi_i/w di. \tag{56}$$

Firm profits are given by

$$\frac{\pi_i}{w} = \frac{R_i}{w}/\sigma - l_{Fi},$$

where R_i is total revenue and l_{Fi} 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

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

Letting $R_X \equiv \int R_{Xi} di$ be total export revenue, the definition of consumer income (56) together with (55) imply:

$$\frac{S}{w} = L - L_F + T + \frac{S}{w}\frac{1}{\sigma} + \frac{R_X}{w}\frac{1}{\sigma} + \frac{S_X}{w}. \tag{57}$$

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

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

$$\frac{R_{Xi}}{w} = \kappa_1 \varphi_i^{\sigma-1} \frac{s_{Xi}}{1-s_{Xi}} s_{Di}^{\frac{\gamma}{\varepsilon-1}(1-\sigma)} \left(\frac{P}{w}\right)^{(1-\gamma)(\sigma-1)} \frac{S}{w} \tag{58}$$

where

$$\kappa_1 \equiv \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} (1-\gamma)^{(1-\gamma)(\sigma-1)} \left(\gamma\beta^{\frac{\varepsilon}{\varepsilon-1}} q_D\right)^{\gamma(\sigma-1)}. \tag{59}$$

Aggregate exports are therefore

$$\frac{R_X}{w} = \kappa_1 \left(\int_i \varphi_i^{\sigma-1} \frac{s_{Xi}}{1-s_{Xi}} s_{Di}^{\frac{\gamma}{\varepsilon-1}(1-\sigma)} di\right) \left(\frac{P}{w}\right)^{(1-\gamma)(\sigma-1)} \frac{S}{w} \equiv \kappa_1 \Upsilon \left(\frac{P}{w}\right)^{(1-\gamma)(\sigma-1)} \frac{S}{w}. \tag{60}$$

where

$$\Upsilon \equiv \int_i \varphi_i^{\sigma-1} \frac{s_{Xi}}{1-s_{Xi}} s_{Di}^{\frac{\gamma}{\varepsilon-1}(1-\sigma)} di$$

Domestic material spending. Letting m_i be total material spending by firm i, we have that

$$\begin{aligned}\frac{S_X}{w} &= \int_i s_{Di}\frac{m_i}{w}di = \int_i s_{Di}\gamma\frac{\sigma-1}{\sigma}\frac{R_i}{w}di \\ &= \gamma\frac{\sigma-1}{\sigma}\left(\frac{S}{w}\int_i s_{Di}\left(\frac{p_i}{P}\right)^{1-\sigma}di + \int_i s_{Di}\frac{R_{Xi}}{w}di\right),\end{aligned} \tag{61}$$

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

$$\int_i s_{Di}\left(\frac{p_i}{P}\right)^{1-\sigma}di = \kappa_1 P^{(1-\gamma)(\sigma-1)}\int_i \varphi_i^{\sigma-1}s_{Di}^{1+\frac{\gamma}{\varepsilon-1}(1-\sigma)}di, \tag{62}$$

where κ_1 is defined in 59 above. Note next that

$$\int_i s_{Di}\frac{R_{Xi}}{w}di = \kappa_1 P^{(1-\gamma)(\sigma-1)}\frac{S}{w}\int_i \varphi_i^{\sigma-1}\frac{s_{Xi}}{1-s_{Xi}}s_{Di}^{1+\frac{\gamma}{\varepsilon-1}(1-\sigma)}di \tag{63}$$

Plugging (62) and (63) into (61), we obtain

$$\frac{S_X}{w} = \gamma\frac{\sigma-1}{\sigma}\frac{S}{w}\kappa_1\left(\frac{P}{w}\right)^{(1-\gamma)(\sigma-1)}\Gamma, \tag{64}$$

where

$$\Gamma \equiv \int_i \varphi_i^{\sigma-1}s_{Di}^{1+\frac{\gamma}{\varepsilon-1}(1-\sigma)}\frac{1}{1-s_{Xi}}di$$

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

$$L_F = \int_i \left(f_i n_i + f_{Xi}n_{Xi} + \mathbb{I}_{Mi}F_M + \mathbb{I}_{Xi}F_X + \mathbb{I}_{XMi}F_{XM}\right)di, \tag{65}$$

where n_i is the mass of countries sourced, n_{Xi} is the mass of countries to which the firm exports to, and $\mathbb{I}_{Mi}, \mathbb{I}_{Xi}$ and $\mathbb{I}_{XMi}$ are indicators of whether the firm is an importer-only, exporter-only or importer-exporter, respectively.[105] Note that

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

$$n_i f_i = \left(\frac{\beta}{1-\beta}\right)^{\frac{\varepsilon}{\eta(\varepsilon-1)}}q_D^{\frac{1}{\eta}}\left(ze/P\right)^{\frac{1}{\eta}}\left(s_{Di}^{-1}-1\right)^{\frac{1}{\eta(\varepsilon-1)}}f_i.$$

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 (46), the importing fixed cost bill can be written as

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

where

$$\kappa_2 \equiv \left(\frac{\beta}{1-\beta}\right)^{\frac{\varepsilon}{\eta(\varepsilon-1)}}\frac{(\sigma-1)^{\sigma}}{\sigma^{\sigma}}q_D^{(\sigma-1)\gamma}\gamma^{1+(\sigma-1)\gamma}(1-\gamma)^{(\sigma-1)(1-\gamma)}\eta. \tag{66}$$

[105] Note that these status indicators are functions of (s_{Di}, s_{Xi}). More precisely, $\mathbb{I}_{Mi} = \mathbb{I}(s_{Di}<1)\times\mathbb{I}(s_{Xi}=0)$, $\mathbb{I}_{Xi} = \mathbb{I}(s_{Di}=1)\times\mathbb{I}(s_{Xi}>0)$ and $\mathbb{I}_{XMi} = \mathbb{I}(s_{Di}<1)\times\mathbb{I}(s_{Xi}>0)$.

Similarly, relying on (47), the exporting fixed cost bill can be written as

$$n_{Xi} f_{Xi} = \left(\frac{\theta - 1}{\theta}\right) \kappa_3 \left(\frac{P}{w}\right)^{(\sigma-1)(1-\gamma)} \left(\frac{S}{w}\right) \left(s_{Xi}^{-1} - 1\right)^{-\frac{\theta}{\theta-1}} \tilde{f}_{Xi}.$$

where

$$\kappa_3 \equiv \sigma^{-\sigma} (\sigma - 1)^{(\sigma-1)} (1-\gamma)^{(\sigma-1)(1-\gamma)} (\gamma q_D)^{(\sigma-1)\gamma}. \tag{67}$$

Finally, using (48), the fixed costs to the overall global status are

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

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

$$L_F \equiv \left(\frac{P}{w}\right)^{(\sigma-1)(1-\gamma)} \left(\frac{S}{w}\right) \Psi \tag{68}$$

where

$$\Psi \equiv \int \left(\kappa_2 \left(s_{Di}^{-1} - 1\right)^{\frac{1}{\eta(\varepsilon-1)}} \tilde{f}_i + \kappa_3 \left(\frac{\theta-1}{\theta}\right) \left(\frac{s_{Xi}}{1 - s_{Xi}}\right)^{\frac{\theta}{\theta-1}} \tilde{f}_{Xi} + \kappa_3 \left(\mathbb{I}_{Mi} \tilde{F}_M + \mathbb{I}_{Xi} \tilde{F}_X + \mathbb{I}_{XMi} \tilde{F}_{XM}\right) \right) di.$$

Equation (68) gives an expression for the total labor used for fixed costs as a function of the data (s_{Di}, s_{Xi}) and the re-scaled fixed costs. We next show that, in turn, these re-scaled fixed costs can be obtained from (s_{Di}, s_{Xi}).

Re-scaled fixed costs from (s_{Di}, s_{Xi}). We now show that there is a one-to-one mapping between the firm behavior data (s_{Di}, s_{Xi}) and the re-scaled fixed costs $\left(\tilde{f}_i, \tilde{f}_{Xi}, \tilde{F}_s\right)$ 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_D associated with the profit function in (23):

$$\begin{aligned} &(1-\beta)^{\frac{1}{\eta}\frac{\varepsilon}{\varepsilon-1}} \beta^{\frac{1}{\eta}\frac{\varepsilon}{\varepsilon-1}(\eta\gamma(\sigma-1)-1)} \varphi_i^{\sigma-1} s_{Di}^{\frac{1}{\eta}\frac{1}{\varepsilon-1}(1-\eta\gamma(\sigma-1))} (1-s_{Di})^{1-\frac{1}{\eta(\varepsilon-1)}} \\ &+ (1-\beta)^{\frac{1}{\eta}\frac{\varepsilon}{\varepsilon-1}} \beta^{\frac{1}{\eta}\frac{\varepsilon}{\varepsilon-1}(\theta\eta\gamma(\sigma-1)-1)} \varphi_i^{\theta(\sigma-1)} s_{Di}^{\frac{1}{\eta(\varepsilon-1)}(1-\theta\eta\gamma(\sigma-1))} (1-s_{Di})^{1-\frac{1}{\eta(\varepsilon-1)}} \tilde{f}_{Xi}^{1-\theta} \\ &= \tilde{f}_{Mi}. \end{aligned} \tag{69}$$

In addition, the definition of the export share, together with expressions for R_{Di} and R_{Xi}, and the definition of $\tilde{f}_{Xi}$, yields:

$$\frac{1}{s_{Xi}} - 1 = \beta^{\frac{\varepsilon}{\varepsilon-1}(\sigma-1)\gamma(1-\theta)} \varphi_i^{(\sigma-1)(1-\theta)} s_{Di}^{(\theta-1)(\sigma-1)\frac{\gamma}{\varepsilon-1}} \tilde{f}_{Xi}^{\theta-1}. \tag{70}$$

Note that this expression is the analog of (51) derived in Section 6.6, but relying on the rescaled fixed costs. Equations (69)-(70) imply a mapping from (s_{Di}, s_{Xi}) to $\left(\tilde{f}_i, \tilde{f}_{Xi}\right)$. Finally, to obtain the re-scaled fixed costs to the global strategy, $\left[\tilde{F}_s\right]$, note that the firm behavior data (s_{Di}, s_{Xi}) imply the following fractions of firms in each status:

$$frac_M = \int \mathbb{I}_{Mi} di, \; frac_X = \int \mathbb{I}_{Xi} di \text{ and } frac_{XM} = \int \mathbb{I}_{XMi} di,$$

where $\mathbb{I}_{Mi}, \mathbb{I}_{Xi}$ and $\mathbb{I}_{XMi}$ are indicators of importer-only, exporter-only and importer-exporter statuses, defined in footnote 105. The re-scaled status fixed costs $\tilde{F}_M, \tilde{F}_X$ and $\tilde{F}_{XM}$ can be jointly chosen to generate fractions of firms $frac_M, frac_X$ and $frac_{XM}$ in each status, using the expressions for profits in (23)-(24).

Putting it all together. Plugging (60), (64) and (68) into the fixed point condition (57) delivers

$$\begin{aligned}\frac{S}{w} = {} & L + T - \left(\frac{P}{w}\right)^{(\sigma-1)(1-\gamma)}\left(\frac{S}{w}\right)\Psi + \frac{S}{w}\frac{1}{\sigma} + \kappa_1 \Upsilon \left(\frac{P}{w}\right)^{(1-\gamma)(\sigma-1)}\frac{S}{w}\frac{1}{\sigma} \\ & + \gamma\frac{\sigma-1}{\sigma}\frac{S}{w}\kappa_1\left(\frac{P}{w}\right)^{(1-\gamma)(\sigma-1)}\Gamma,\end{aligned} \tag{71}$$

Solving for S, this condition delivers (29) in Proposition 1. Welfare is given by I/P where

$$\frac{I}{w} = \frac{S}{w}\left[1 - \gamma\frac{\sigma-1}{\sigma}\kappa_1\Gamma\left(\frac{P}{w}\right)^{(1-\gamma)(\sigma-1)}\frac{S}{w}\right].$$

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 (28) and (71).

6.9 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

$$L = \int_i \left(l_{pi} + f_i n_i + f_{Xi} n_{Xi} + \mathbb{I}_{Mi} F_M + \mathbb{I}_{Xi} F_X + \mathbb{I}_{XMi} F_{XM}\right) di, \tag{72}$$

where L is the (perfectly inelastic) labor supply, l_{pi} is firm i's demand for variable labor and $n_i, n_{Xi}, \mathbb{I}_{Mi}, \mathbb{I}_{Xi}$ and $\mathbb{I}_{XMi}$ are defined below equation (65) in Section 6.8. 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 (27) 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, $\underline{b}$, is endogenous. In this case, all equilibrium outcomes depend on three endogenous, general equilibrium variables: S, P and $\underline{b}$. While the price of foreign goods is still exogenously given (controlled by e), the average level of foreign demand, $e^{\sigma-1}\underline{b}$, 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 $(S, P, \underline{b})$. 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 (28) and (29) 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 6.8. We now provide a third equilibrium condition, derived from the labor market clearing condition in (72), which together with equations (28)-(29) fully characterizes the equilibrium triplet $(S, P, \underline{b})$.

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

$$\begin{aligned}
L_p &= \frac{\sigma-1}{\sigma}(1-\gamma)\int\left(\frac{R_{Di}}{w}+\frac{R_{Xi}}{w}\right)di \\
&= \frac{\sigma-1}{\sigma}(1-\gamma)\left(\kappa_1\Upsilon\left(\frac{P}{w}\right)^{(1-\gamma)(\sigma-1)}+1\right)\frac{S}{w}
\end{aligned}$$

where the second line follow from (60). The total labor demand, denoted by L_d, is given by

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

where L_F is the total amount of labor used for fixed costs given by (68). 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 :

$$\frac{S}{w} = \frac{L}{\frac{\sigma-1}{\sigma}(1-\gamma)\left(\kappa_1\Upsilon\left(\frac{P}{w}\right)^{(1-\gamma)(\sigma-1)}+1\right)+\left(\frac{P}{w}\right)^{(\sigma-1)(1-\gamma)}\Psi}. \tag{73}$$

Equations (28), (29) and (73) jointly characterize the equilibrium triplet $(S, P, \underline{b})$.

Calibration And Solution Strategy. The calibration strategy adopted for the partial equilibrium case, described in Section 6.7, 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

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

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.[106] 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 $\left(\tilde{f}_i, \tilde{f}_{Xi}, \tilde{F}_X, \tilde{F}_M, \tilde{F}_{XM}\right)$, as outlined in Section 6.7, we can compute Ψ, Υ and Γ and hence obtain S and P from the labor market clearing and price index equations, (28) and (73), respectively. Importantly, nothing guarantees that the trade balance condition (29) is satisfied, i.e., that the trade deficit equals the exogenously given transfers T.[107]

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 6.7. The targets are the moments of the

[106] The following relationships were used

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

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

[107] Another way to see this is that

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

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}), $\left(\tilde{f}_i, \tilde{f}_{Xi}, \tilde{F}_X, \tilde{F}_M, \tilde{F}_{XM}\right)$ and the S, P obtained via the GE conditions (28) and (73) above. Their difference need not be equal to exogenous T.

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 $\left(\varphi_i, \tilde{f}_i, \tilde{f}_{Xi}, \tilde{F}_{XM}, \tilde{F}_M, \tilde{F}_X\right)$. In contrast to the previous approach, the level of transfers T is now treated as an additional parameter and chosen to make equation (29) 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 (46)-(48), can be used to back out the actual fixed costs $\left(f_i, \underline{b}^{\frac{\theta}{1-\theta}} f_{Xi}, F_X, F_M, F_{XM}\right)$. More precisely, the following conditions are used

$$\tilde{f}_i \equiv \frac{1}{\gamma\eta}\left(\frac{1}{1-\gamma}\right)^{(\sigma-1)(1-\gamma)}\left(\frac{1}{\gamma q_D}\right)^{(\sigma-1)\gamma}\frac{\sigma^\sigma}{(\sigma-1)^\sigma} q_D^{\frac{1}{\eta}}(ze/w)^{\frac{1}{\eta}}\left(\frac{P}{w}\right)^{-(\sigma-1)(1-\gamma)-\frac{1}{\eta}}\left(\frac{S}{w}\right)^{-1} f_i \tag{74}$$

$$\begin{aligned}\tilde{f}_{Xi} \equiv & \left(\left(\frac{P}{w}\right)^{1-\sigma+(1-\theta)(\sigma-1)\gamma}\left(\frac{S}{w}\right)^{-1}\frac{\theta}{\theta-1}(e/w)^{\sigma\theta}\sigma^{-\sigma(\theta-1)}(\sigma-1)^{(\theta-1)(\sigma-1)}\times\right.\\ & \left.\times\left(\frac{1}{1-\gamma}\right)^{(\sigma-1)(1-\gamma)(1-\theta)}\left(\frac{1}{\gamma q_D}\right)^{(1-\theta)(\sigma-1)\gamma}(1+\tau)^{-\theta(\sigma-1)}\right)^{\frac{1}{1-\theta}}\underline{b}^{\frac{\theta}{1-\theta}} f_{Xi}\end{aligned} \tag{75}$$

Note that $\underline{b}$ and f_{Xi} cannot be identified separately in this step, but only the combo $\underline{b}^{\frac{\theta}{1-\theta}} f_{Xi}$ is obtained. The pre-devaluation level of $\underline{b}$ is not required to compute any of the relevant model outcomes. Finally, the value of θ is kept at the level calibrated in Section 4.1.1.[108]

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

$$x \equiv \left(\frac{\underline{b}'}{\underline{b}}\right)^{\frac{\theta}{1-\theta}}$$

is the factor by which $\underline{b}^{\frac{\theta}{1-\theta}} f_{Xi}$ grows. Given this guess, compute the corresponding re-scaled fixed costs using equations (74)-(75), where the right hand side of (75) 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 (28) to compute P', (73) to compute S' and (29) to compute T'. Compute the mean squared error as $(P'-P)^2 + (S'-S)^2 + (T'-T_d)$, 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.[109] 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 percent, as observed in Mexico between 1994 and the average of 1995-99.

Tables 31-33 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 Table 20. The data figures correspond to changes between 1994 and the average of the 1995-99 period. The results confirm the main findings of

[108]In addition, the values of σ,γ, ε and η are kept at the same values used in Section 4.1.1, i.e., values taken from Blaum et al. (2018).

[109]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 (73).

Change in...	Model (Uncorrelated)	Model (Baseline)	Data
Fraction Importers-Only	-4.59	-9.25	-7.05
Fraction Exporters-Only	1.85	3.97	3.70
Fraction Importer-Exporters	4.60	6.37	9.74
Corr. sales-imp. shares	-0.02	0.04	0.06
Corr. sales-exp. shares	0.08	0.12	0.08
Corr. imp.-exp. shares	0.02	0.07	0.06

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 percent increase in e/w. 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 33: Changes in Other Non-Targeted Moments (GE)

Section 4.2.1. In the baseline model, a 20 percent increase in the price of foreign goods 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.

	Model		Mexico 94-99
Rate of growth in ...	Uncorrelated	Baseline	
Aggregate Import Share	-23.97	10.34	15.85
Aggregate Export Share	81.98	120.21	78.32
Price Index	11.75	11.20	-

Table 31: Effects of a Counterfactual Devaluation (GE)

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 Table 20 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.

	Percentiles					
	10th	25th	50th	75th	90th	95th
Import Shares, Importers, final - initial						
Data	-0.40	-0.46	-0.38	-0.47	-1.62	-1.02
Model (Baseline)	-1.62	-2.04	-5.24	-6.34	-2.36	-0.91
Model (Uncorrelated)	-0.01	-0.45	-5.53	-6.57	-3.08	-1.27
Export Shares, Exporters, final - initial						
Data	0.42	1.26	3.73	4.78	2.42	-0.91
Model (Baseline)	1.45	4.07	9.83	13.65	9.63	6.55
Model (Uncorrelated)	0.21	0.88	3.91	7.50	5.42	3.18

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 percent increase in e/w. All entries are in percentage points. Source: EIA.

Table 32: Changes in Distribution of Import and Export Shares (GE)

	Within	Between	Covariance	Net Entry	Total
Model, Uncorrelated	-2.30	-21.93	0.48	-0.22	-23.97
Model, 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 (5) performed on model-generated data resulting from a 20 percent counterfactual increase in e/w as well as on data from the Mexican manufacturing sector between 1994 and 1999. All entries are in percentage points.

Table 34: 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 Baily et al. (1992). Table 34 applies the decomposition in equation (5) 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 model with partial equilibrium in the labor market in the main text.

6.10 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 $F_X = f_{Xi} = 0 \; \forall i$ 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.[110] 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.[111] To do so, it is assumed that the level of foreign demand $\underline{b}$ 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 4.2.2. Table 35 contains the results. As before, the model is able to perfectly match all moments. Tables 36 and 37 consider a 20 percent increase in the price of foreign goods. We see that the aggregate import share falls by about 15 percent - 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.

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

$$\frac{R_{Di}}{R_{Xi}} = P^{\sigma-1} S e^{1-\sigma} (1+\tau)^{\sigma-1} \frac{\theta-1}{\theta} \frac{1}{\underline{b}},$$

which is constant across firms.

[111] This is the same as imposing labor market clearing, as the consumer budget constraint in (25) and the goods market clearing conditions in (26), together imply that

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

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.

In contrast, the aggregate 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 percent, which is higher than what the baseline predicts.

Parameter		Targeted Moment		
Description	Value	Description	Model	Data
Average importing fixed cost ($\mu_{\tilde{f}}$)	1.42	Aggregate Import Share	0.36	0.35
Fixed cost import status ($\tilde{F}_M$)	0.06	Fraction Importers	0.42	0.42
Dispersion in efficiency (σ_{φ})	0.63	Dispersion sales	1.71	1.71
Dispersion in importing fixed costs ($\sigma_{\tilde{f}}$)	3.24	Dispersion imp. shares	0.27	0.27
Corr. efficiency - importing fixed cost ($\rho_{\varphi\tilde{f}}$)	0.87	Corr. sales-imp. shares	0.27	0.27

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 35: Model with Importing (GE): Calibration to Mexican Data

Rate of growth in ...	Model of Importing	Mexico 94-99
Aggregate Import Share	-15.98	15.85
Price Index	8.40	-

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 36: Effects of a Counterfactual Devaluation: Model of Importing (GE)

Change in...	Model of Importing	Mexico 94-99
Fraction Importers	-1.18	2.70
Corr. sales-imp. shares	-0.03	0.05

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

	Within	Between	Covariance	Net Entry	Total
Model of Importing	-2.95	-12.99	0.07	-0.00	-15.98
Mexico 94-99	-2.79	9.99	4.27	6.24	17.70

Notes: The Table contains the Baily et al. (1992) decomposition in (5) performed on model-generated data of counterfactual devaluations. All entries are in percentage points.

Table 38: Model of Importing (GE): Decomposition of Increase in Import Share

7 Online Appendix

7.1 Additional Materials for Empirics

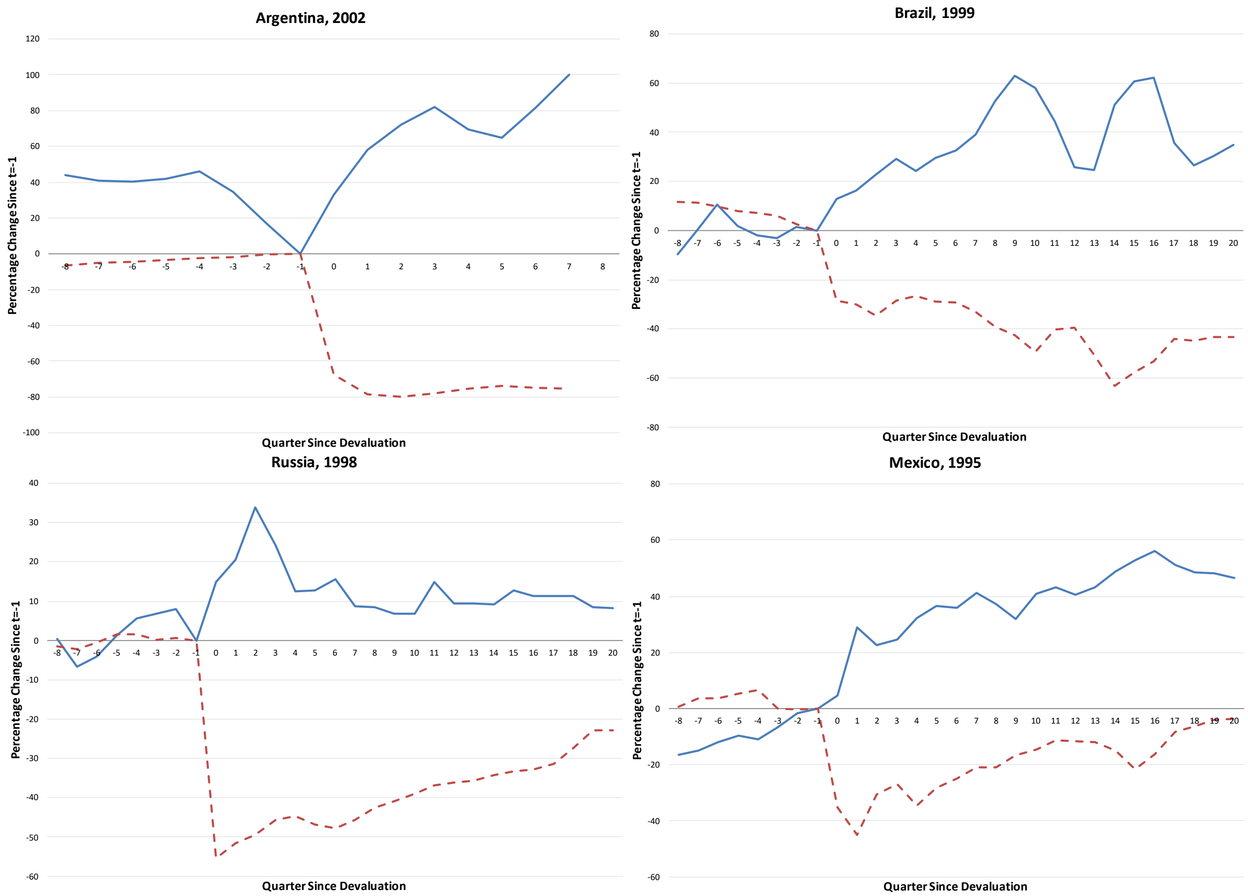


Figure 29: Imports to GDP Ratio After Large Devaluations, By Country

Notes: The blue (solid) 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 (dashed) line depicts the rate of growth in the bilateral real exchange rate with the US defined in Section 2.2 - see (1). The quarter of the devaluation was Q1 of 2002 for Argentina, Q1 of 1999 for Brazil, Q3 of 1998 for Russia and Q4 of 1994 for Mexico. The data was seasonally adjusted using the X-12-ARIMA software of the US Census. Source: IFS.

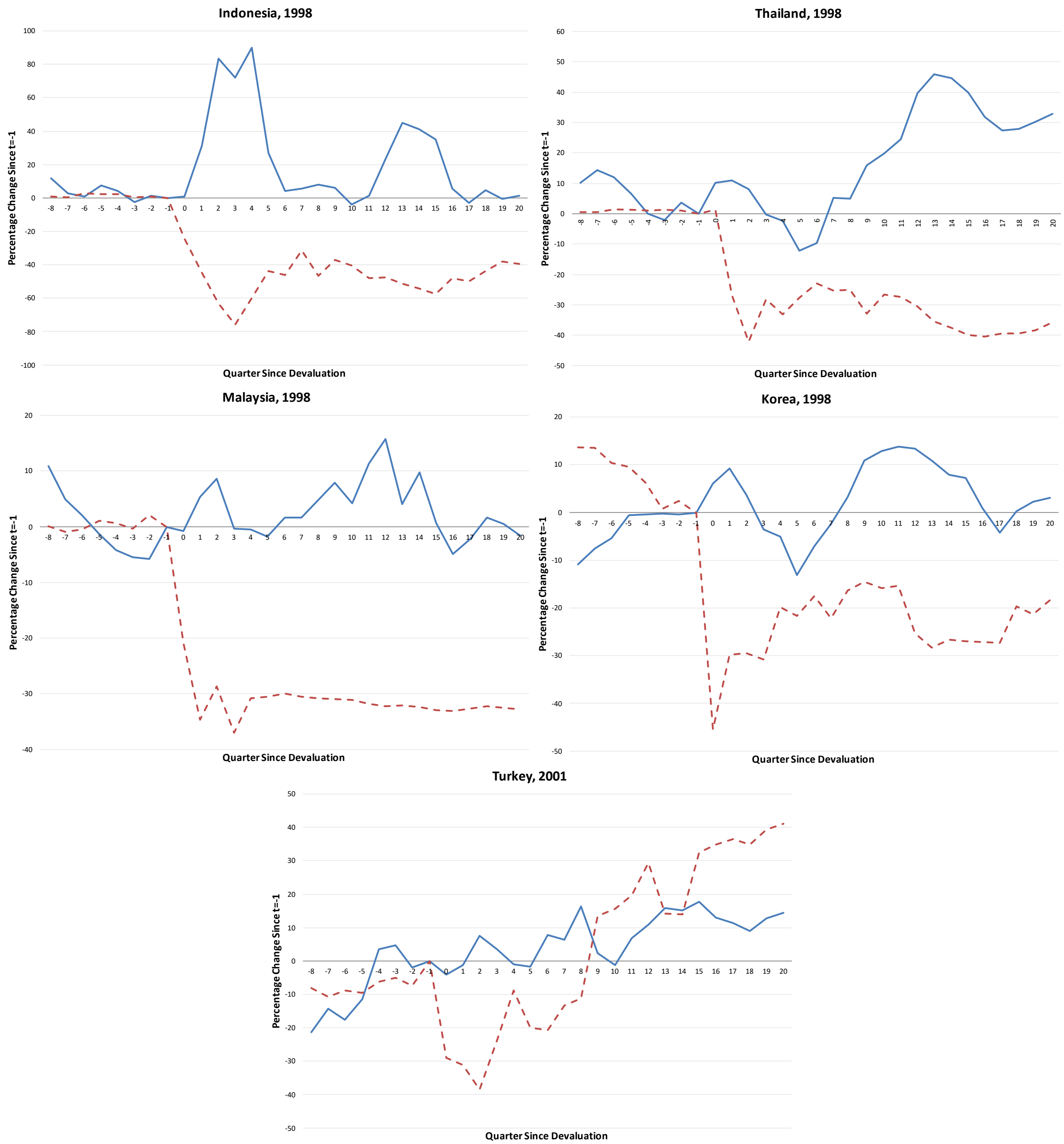


Figure 30: Imports to GDP Ratio After Large Devaluations, By Country

Notes: The blue (solid) 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 (dashed) line depicts the rate of growth in the bilateral real exchange rate with the US defined in Section 2.2 - see (1). The quarter of the devaluation was Q3 of 1997 for Indonesia, Q3 of 1997 for Thailand, Q3 of 1997 for Malaysia, Q4 of 1997 for Korea and Q1 of 2001 for Turkey. The data was seasonally adjusted using the X-12-ARIMA software of the US Census. Source: IFS.

OECD		Non-OECD	
Australia	Japan	Argentina	Philippines
Austria	Korea	Bulgaria	Romania
Belgium	Luxembourg	Brazil	Russian Federation
Canada	Mexico	Brunei	Saudi Arabia
Chile	Netherlands	China	Singapore
Czech Republic	New Zealand	Colombia	Thailand
Denmark	Norway	Costa Rica	Tunisia
Estonia	Poland	Cyprus	Chinese Taipei
Finland	Portugal	Hong Kong	Vietnam
France	Slovak Republic	Croatia	South Africa
Germany	Slovenia	Indonesia	
Greece	Spain	India	
Hungary	Sweden	Cambodia	
Iceland	Switzerland	Lithuania	
Ireland	Turkey	Latvia	
Israel	United Kingdom	Malta	
Italy	United States	Malaysia	

Table 39: Countries in OECD Input Output Tables

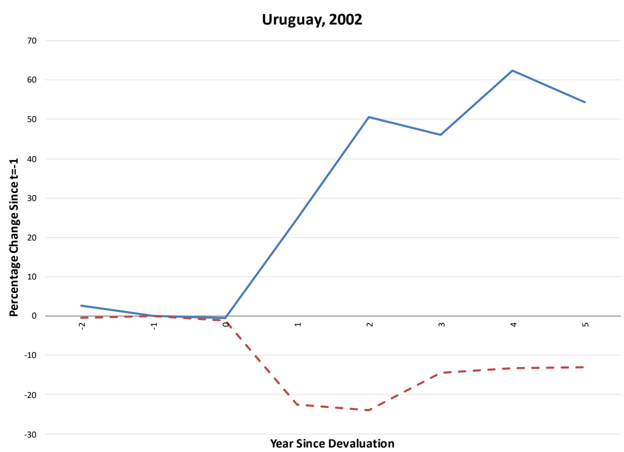


Figure 31: Imports to GDP Ratio, Uruguay

Notes: The blue (solid) line is the rate of growth in the ratio of total imports to GDP between a given year and the year before the devaluation (labeled -1). The year of the devaluation is labeled 0. The red (dashed) line depicts the rate of growth in the real effective exchange rate. The year of the devaluation was 2002. Source: IFS.

Australia	Estonia	Japan	Romania
Austria	Finland	South	Russia
Belgium	France	Latvia	Slovak
Brazil	Germany	Lithuania	Slovenia
Bulgaria	Greece	Luxembourg	Spain
Canada	Hungary	Malta	Sweden
China	India	Mexico	Taiwan
Cyprus	Indonesia	The	Turkey
Czech	Ireland	Poland	UK
Denmark	Italy	Portugal	USA

Table 40: Countries in WIOD

Industry Code	Description
C01T05	Agriculture, hunting, forestry and fishing
C10T14	Mining and quarrying
C15T16	Food products, beverages and tobacco
C17T19	Textiles, textile products, leather and footwear
C20	Wood and products of wood and cork
C21T22	Pulp, paper, paper products, printing and publishing
C23	Coke, refined petroleum products and nuclear fuel
C24	Chemicals and chemical products
C25	Rubber and plastics products
C26	Other non-metallic mineral products
C27	Basic metals
C28	Fabricated metal products
C29	Machinery and equipment, nec
C30T33X	Computer, Electronic and optical equipment
C31	Electrical machinery and apparatus, nec
C34	Motor vehicles, trailers and semi-trailers
C35	Other transport equipment
C36T37	Manufacturing nec; recycling
C40T41	Electricity, gas and water supply
C45	Construction
C50T52	Wholesale and retail trade; repairs
C55	Hotels and restaurants
C60T63	Transport and storage
C64	Post and telecommunications
C65T67	Financial intermediation
C70	Real estate activities
C71	Renting of machinery and equipment
C72	Computer and related activities
C73T74	R&D and other business activities
C75	Public admin. and defense; compulsory social security
C80	Education
C85	Health and social work
C90T93	Other community, social and personal services
C95	Private households with employed persons

Table 41: Sectors in the OECD Input Output Tables

Argentina	Denmark	Iceland	Portugal
Australia	Spain	Israel	Romania
Austria	Estonia	Italy	Russia
Belgium	Finland	Japan	Slovak Republic
Brazil	France	Korea	Slovenia
Canada	United Kingdom	Malaysia	Sweden
Switzerland	Greece	Mexico	Thailand
Chile	Hungary	Netherlands	Turkey
China	Indonesia	Norway	United States
Czech Republic	India	New Zealand	Vietnam
Germany	Ireland	Poland	South Africa

Table 42: Countries Included in the Sample of Robustness Regressions

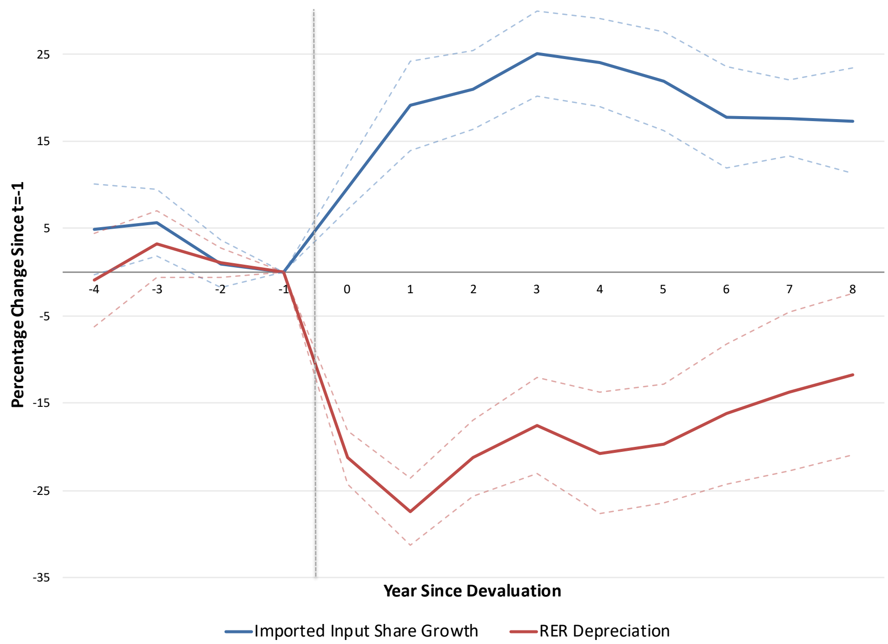
Albania	Cambodia	Georgia	Latvia	Poland
Argentina	Chile	Greece	Lithuania	Qatar
Armenia	Hong Kong	Guatemala	Luxembourg	Romania
Australia	Macao	Hungary	Macedonia	Russia
Austria	Colombia	Iceland	Malaysia	Rwanda
Azerbaijan	Costa Rica	India	Malta	Saudi Arabia
Belarus	Croatia	Indonesia	Mauritius	Serbia
Belgium	Cyprus	Iran	Mexico	Slovak Republic
Bolivia	Czech Republic	Ireland	Nigeria	Slovenia
Botswana	Denmark	Israel	Norway	Sweden
Brazil	Egypt	Kazakhstan	Paraguay	Thailand
Brunei	Estonia	Korea	Peru	Turkey
Bulgaria	Finland	Kyrgyz Republic	Philippines	Ukraine

Table 43: Countries in the Imports-to-GDP Regression Sample

7.2 Removing Overlapping Devaluations

Given the length of the window around the devaluation considered, several episodes display an overall in their sample period. For countries with two events less than 13 years apart, the windows around the devaluations are adjusted to ensure that each data point is used for at most one event - see Table 26 in Section 6.2 of the Appendix for details. Here, an alternative approach is considered. For any country with multiple events, I keep the most recent one.[112] This results in the following ten episodes being dropped: Argentina 1975 and 1981, Brazil 1983 and 1991, Chile 1973, Mexico 1977 and 1982, Turkey 1980 and 1994.

[112] Naturally, there are several other ways to remove overlapping events. Results for alternative procedures are available upon request.



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 after removing overlapping events: for countries with multiple events, only the most recent one is kept. 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: WIOD, OECD, JN, IFS.

Figure 32: Imported Input Share After Large Devaluation, Removing Overlapping Events

7.3 Strength of Devaluation

This section considers a 10% and 30% increase in the price of foreign goods in terms of domestic labor (e). Results are provided both for the baseline model with global firms (calibrated in Section 4.1.3) and the model of importing (calibrated in Table 10).

	Model, 10% Devaluation		Model, 30% Devaluation	
Change in ...	Baseline	Importing	Baseline	Importing
Aggregate Import Share	0.95	-2.74	4.32	-7.56
Aggregate Export Share	5.02	-	14.99	-
Corr. sales-imp. shares	0.01	-0.02	0.04	-0.04
Corr. sales-exp. shares	0.04	-	0.11	-
Corr. imp.-exp. shares	0.03	-	0.08	-
Fraction Importers-Only	-1.49	-0.2	-4.31	-0.72
Fraction Exporters-Only	1.34	-	3.72	-
Fraction Importer-Exporters	4.03	-	12.5	-

Table 44: Effects of a 10% and 30% Counterfactual Devaluation

Notes: The changes in the moments are computed as differences in levels (i.e., the value of the moment post devaluation minus its value pre devaluation). The change in the aggregate import share, the aggregate export share, and the fractions of importers-only, exporters-only and importer-exporters are all expressed in percentage points. The correlation entries correspond to the difference in the correlation coefficient post-pre devaluation. 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). The model columns depict changes in the model-generated data resulting from a 10% (first two columns) and a 30% (last two columns) increase in the price of foreign goods. The "Baseline" column corresponds to the model of global firms calibrated in Section 4.2.1. The "Importing" column corresponds to the model of importing calibrated in Section 4.2.2.

	Within	Between	Covariance	Net Entry	Total
Baseline Model, 10% Devaluation	-0.88	3.28	0.12	0.13	2.65
Model of Importing, 10% Devaluation	-1.38	-6.25	0.02	-0.03	-7.64
Baseline Model, 30% Devaluation	-2.35	13.1	0.85	0.39	11.99
Model of Importing, 30% Devaluation	-3.94	-17.2	0.15	-0.09	-21.08

Notes: The Table contains the Baily et al. (1992) decomposition in (5) performed on model-generated data resulting from a 10% and 30% counterfactual real depreciation. The "Baseline Model" corresponds to the model of global firms calibrated in Section 4.2.1. The "Model of Importing" column corresponds to the model of importing calibrated in Section 4.2.2. All entries are in percentage points.

Table 46: Decomposition of Import Share Growth: 10% and 30% Devaluations

Rate of growth in...	Price Index	Unit Cost (Avg.)	Aggregate Productivity	Welfare
Baseline Model, 10% Devaluation	2.72	1.84	3.99	2.15
Model of Importing, 10% Devaluation	4.01	3.17	-1.16	-2.3
Baseline Model, 30% Devaluation	6.62	4.33	16.37	11.11
Model of Importing, 30% Devaluation	11.07	8.81	-2.97	-5.7

Notes: The Table contains the rates of growth in the consumer price index, aggregate productivity and consumer welfare, as well as the average growth rate in the unit cost, resulting from a 10% and a 30% counterfactual devaluations in the model. The "Baseline Model" corresponds to the baseline calibration of Section 4.2.1. The "Model of Importing" corresponds to calibration in Table 10.The consumer price index P is computed according to (28). The unit cost is computed according to (17). The growth rate in the unit cost is computed for each firm; the Table reports the average growth rate across all firms (including importers and non-importers). Aggregate productivity is computed according to (33). Consumer welfare is I/P where I is given by (30).

Table 47: Normative Consequences of the Devaluation: 10% and 30% Devaluation

	Percentiles					
	10th	25th	50th	75th	90th	95th
Import Shares, Importers, final - initial						
Baseline Model, 10% Devaluation	-1.56	-0.65	-2.03	-3.5	-1.67	-0.62
Model of Importing, 10% Devaluation	-0.12	-0.44	-1.72	-1.96	-1.06	-0.48
Baseline Model, 30% Devaluation	-1.64	-2.14	-7.4	-9.46	-4.74	-2.09
Model of Importing, 30% Devaluation	-1.48	-1.9	-3.8	-5.76	-3.13	-1.59
Export Shares, Exporters, final - initial						
Baseline Model, 10% Devaluation	0.09	0.29	0.62	1.14	0.97	0.96
Baseline Model, 30% Devaluation	0.18	0.57	1.64	2.87	2.83	2.53

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% increase in the price of foreign goods. The model columns depict changes in the model-generated data resulting from a 10% and a 30% increase in the price of foreign goods. The "Baseline" column corresponds to the model of global firms calibrated in Section 4.2.1. The "Importing" column corresponds to the model of importing calibrated in Section 4.2.2. All entries are in percentage points. Source: EIA.

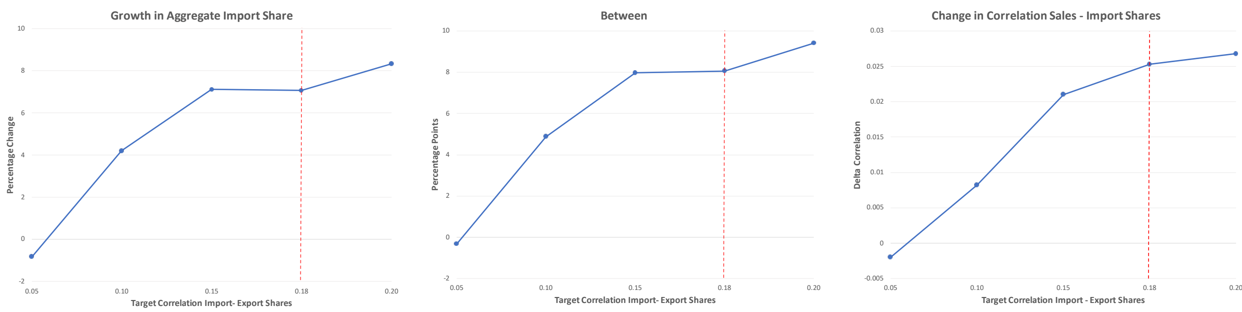
Table 45: Changes in Distribution of Import and Export Shares

7.4 The Importing-Exporting Correlation

To further explore the role of the ex-ante correlation between importing and exporting, I consider additional re-calibrations that target values for this correlation in a window around the value observed in the Mexican data (and used in the baseline case).[113] In these exercises, all parameters considered in Section 4.1.1 are re-calibrated, including the export elasticity θ. Figure 33 depicts the effects of a 20 percent increase in foreign prices on various model outcomes. A lower ex-ante correlation between importing and exporting is associated

[113] In the data and baseline model, this value is 0.18. The recalibration exercises consider values for the correlation in the range 0.05-0.20. The window is asymmetric for computational reasons.

with (i) lower growth in the aggregate import share, which eventually becomes negative, (ii) a lower Between component, which eventually becomes negative, and (iii) a lower change in the correlation between firm size and import intensity.



Notes: The Figures depict the effects of a 20 percent 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 left panel shows the growth in the aggregate import share. The middle panel shows the between component (measured in percentage points) resulting from the decomposition of the aggregate import share growth given in (5). The right 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). All growth rates are expressed in percentage points.

Figure 33: Targeting Different Pre-Devaluation Correlations of Import and Export Shares