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Exchange Rate Devaluation and Import Substitution in Latin America and the Caribbean

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Abstract

This paper assesses the LAC's import substitution response to the recent wave of currency devaluations. For this purpose, this document uses both descriptive data and a simple econometric model to establish the short-term relationship between exchange rate movements and import penetration (total and within manufacturing sector) in the region, with a special focus on those countries that had experienced the largest depreciations. The results suggest that there is a significant relationship between depreciation and the decrease in import penetration, indicating that a 1% increase in the local currency depreciation reduces the IP by 0.41% to 0.69% and varies in those sectors with a stronger presence of domestic production.

JEL Codes: C20, F14, F49.

Key words: depreciation, import substitution, Latin America.

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Abbreviations and acronyms

COMTRADE	United Nations Comtrade database
CNAE	Classificação Nacional de Atividades Econômicas
CPI	Consumer Price Index
GDP	Gross Domestic Product
IFS	International Financial Statistics
IP	Import penetration
IMF	International Monetary Fund
INT	Integration and Trade Department IADB
ISIC	International Standard Industrial Classification
LAC	Latin American and Caribbean
NAICS	North American Industry Classification System
REER	Real Effective Exchange Rate
RES	Research Department IADB

1. Introduction

Several Latin American and Caribbean (LAC) currencies have been experiencing a significant depreciation since 2012. This wave of depreciations has been driven by a slowdown in the region's main markets, particularly in China, which has led to a sharp fall in commodity prices. Since 2015, this slowdown has been compounded by the prospect of higher interest rates in the United States, which has recently started to materialize, putting additional downward pressure on the currencies in the region.

Depreciations are expected to have short and long term impacts on a country's trade flows. Export prices in dollar are likely to fall, leading to competitiveness gains, but at the same time imports become more expensive in local currency, opening opportunities for the local industry to substitute foreign suppliers. How far this substitution goes depends not only on the magnitude of the devaluation, but also on the physical capacity and technological capability of local firms to respond to these growth opportunities. The timing and duration of the devaluation also matter. If the devaluation happens in a moment where the local industry carries a significant spare capacity, a faster response is more likely to materialize, otherwise a reaction can only happen in the mid-to long term. But for that to happen, firms' expectations about the duration of the real devaluation—nominal changes can be quickly erased by inflation—are key to trigger the necessary investments.

In this note, we make a first attempt to assess LAC's import substitution response to this recent wave of currency devaluations. Resorting to both descriptive data and to a simple econometric exercise, we hope to shed some light on the short-term dynamics of this relationship between exchange rate movements and import penetration (total and within manufacturing sector) in the region, with a focus on countries which had experienced the largest depreciations.

2. General Trends

2.1 Depreciation

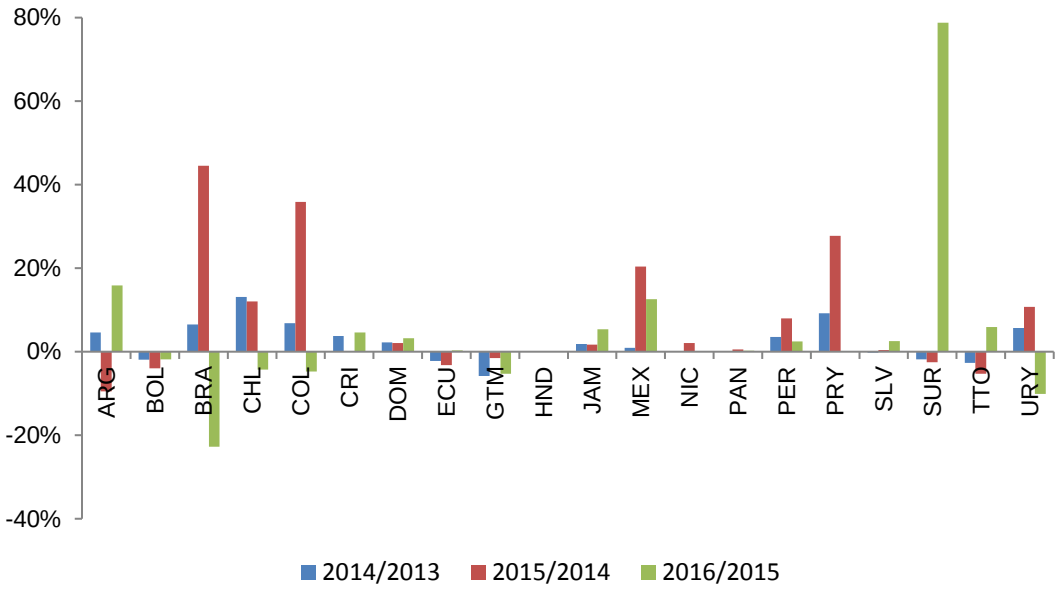
Looking at the annual real exchange rate variations for the period October 2013 – October 2016—Figure 1, we observe that several currencies have experienced strong depreciations in different years. [1]

Overall, the highest real depreciations have been observed in Brazil, Colombia, Mexico and Paraguay (on average, 9%, 13%, 11% and 18% respectively). However, the Chilean peso

[1] The real exchange rate used in this figure was calculated using a price ratio of each country's CPI to the US CPI. Then this ratio was multiplied for the nominal exchange rate in the same year.

consistently depreciated during the earlier part of the period (2013-2015) while the Argentine peso and the Surinamese dollar have strongly depreciated mostly during the 2016.

Figure 1 Annual Real Exchange Rate Variation, October 2013 – October 2016



Note: A positive variation means depreciation
Source: INT-IADB, using information from IMF-IFS and RES-IADB

2.2 Import Penetration

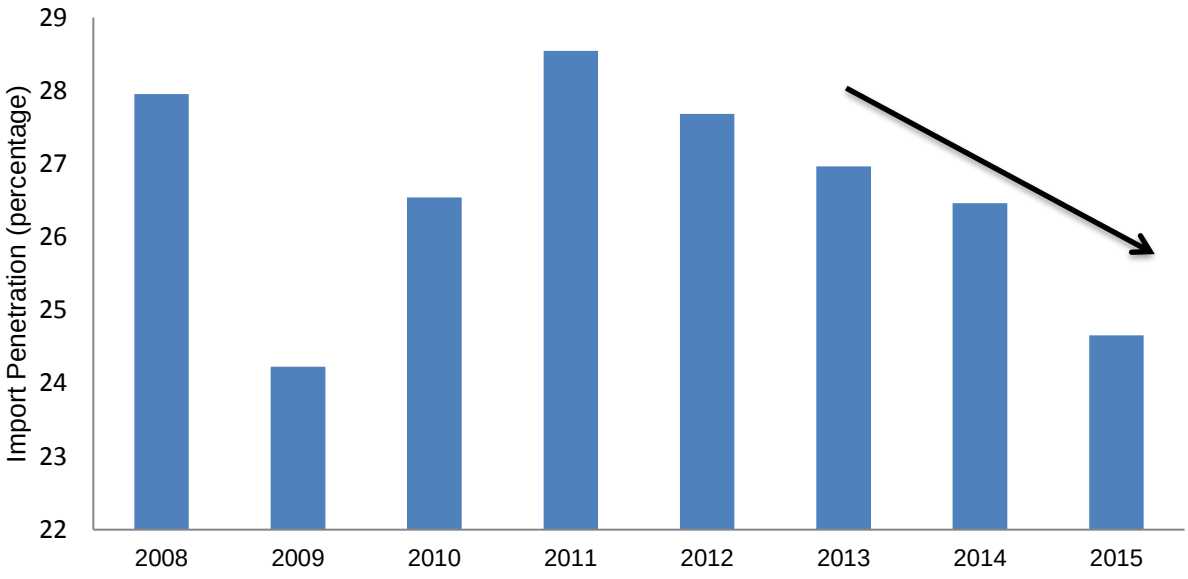
The import penetration (IP) index reflects each country's exposure to foreign goods as a share of total supply (domestic and foreign). It is built as the ratio of imports to the sum of domestic output and imports in each country, sector and year, all measured in local currency.

By construction, the IP index captures not only real changes in import substitution, but also the valuation effect brought about by currency fluctuations. For instance, a currency devaluation immediately increases the value of imports on local currency, and, therefore, contributes to an increase in the index even though there were not real changes in import penetration. To weed out this valuation effect, we replace the market exchange rate by a rate that that is consistent with a constant real exchange rate, set at its average level over the period of analysis.[1]

[1] For this purpose, an average real exchange rate (RER) index is calculated for the period 2008-2014. Then, the RER index series is rebased to the average computed and, finally, we use this rebased time series and the market exchange rate to solve for a nominal exchange rate that keeps the real exchange rate constant at the average level calculated for the overall period.

Using GDP as a measure of domestic product, Figure 2 shows the evolution of LAC's average (economy wide) IP index in 2008-2015 [2]. We note that the index has been decreasing since 2011 and in 2015 it was 28% below its recent peak.

Figure 2. LAC's average Import Penetration – Economy wide, 2008-2015 (%)



Note: Simple average across countries

Source: INT-IADB, using information from National Accounts and COMTRADE

2.3 Import Penetration by Sector

Using production data for manufacturing (at the 4-digit level of ISIC classification, rev 3), Table 1 shows the 10 sectors with the highest IP index for each country (period's average). [3] While there is a significant heterogeneity across countries, machinery and electronic products—in its different varieties—are recurrent in the list for most countries, followed by vehicles, chemicals and apparel.

[2] The countries included in the calculation of the average Import Penetration index are: Argentina, Bahamas, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Guyana, Mexico, Nicaragua, Peru, Paraguay, Uruguay and Venezuela.

[3] Due to data availability limitations on domestic production, for this exercise, we focus on the evidence from four countries: Brazil and Costa Rica for the period 2008-2013, and Colombia and Mexico for the period 2008-2014. Also, a sector is defined as a 4-digit code according to the International Standard Industrial Classification (Rev 3). Since the focus is on manufacturing, this definition includes only the 4-digit codes included within sections 15 and 36 of the ISIC.

Table 1. Sectors with the higher IP index, by country[4]

Country	Sector	Description sector	Average Import Penetration
BRA	2310	Coke oven products	88.69
BRA	3311	Medical and surgical equipment	86.79
BRA	2421	Pesticides and agro-chemical products	80.27
BRA	3210	Electronic valves, tubes and electronic components	74.52
BRA	3692	Musical instruments	69.78
BRA	2926	Machinery for textiles, apparel and leather production	69.25
BRA	1711	Spinning of textile fibers; weaving of textiles	62.99
BRA	2923	Machinery for metallurgy	59.59
BRA	2913	Bearings, gears, gearing and driving elements	57.32
BRA	1912	Luggage, handbags and the like, saddlery and harness	51.54
COL	3592	Bicycles and invalid carriages	94.32
COL	2922	Special purpose machinery	94.29
COL	2924	Machinery for mining, quarrying and construction	92.89
COL	2913	Bearings, gears, gearing and driving elements	87.86
COL	2912	Pumps, compressors, taps and valves	81.68
COL	2921	Agricultural and forestry machinery	72.30
COL	2511	Rubber and tubes	71.32
COL	3410	Motor vehicles	66.84
COL	1552	Manufacture of wines	62.72
COL	3110	Electric motors, generators and transformers	57.68
CRI	2413	Plastics in primary forms and of synthetic rubber	99.07
CRI	3410	Motor vehicles	96.83
CRI	1920	Footwear	94.53
CRI	2710	Basic iron and steel	83.62
CRI	1711	Spinning of textile fibers; weaving of textiles	74.48
CRI	1551	Rectifying and blending of spirits; ethyl alcohol production from fermented materials	72.47

[4] In 2013, Colombia changed the classification used to report its production; from the ISIC3-AC (adapted for Colombia) classification it started using the ISIC4-AC (adapted for Colombia). To make the analysis comparable across countries, we kept only the sectors that had a perfect and clean match between these two Colombian classifications and the ISIC rev3 International.

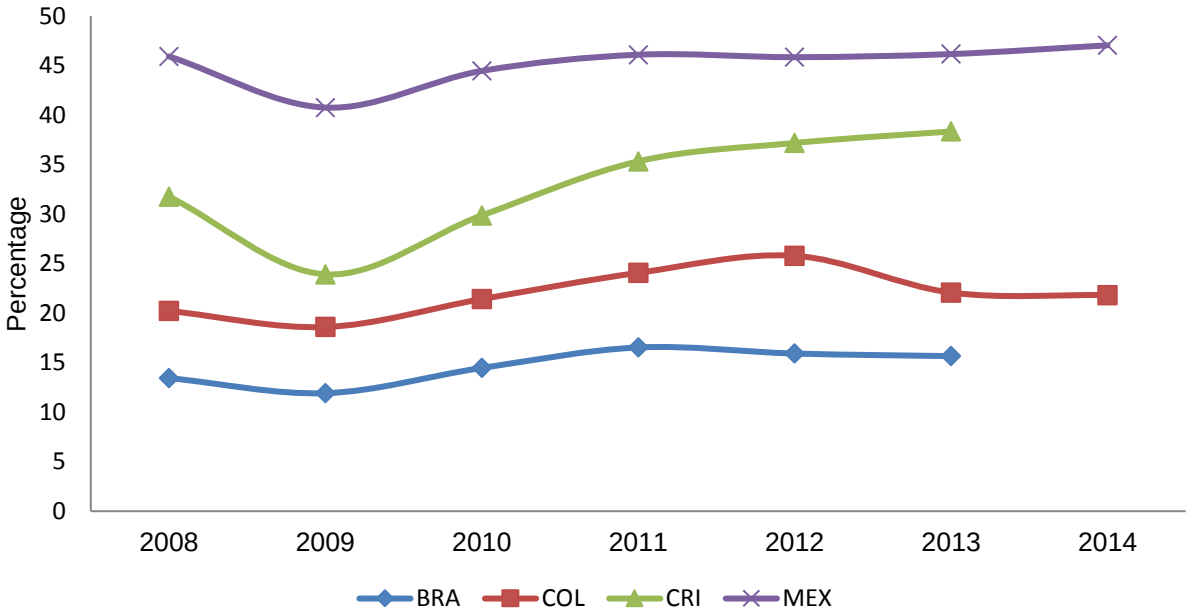
Country	Sector	Description sector	Average Import Penetration
CRI	1543	Cocoa, chocolate and sugar confectionery	72.16
CRI	2421	Pesticides and other agro-chemical products	68.37
CRI	2424	Soap and detergents, cleaning and polishing preparations	67.77
CRI	2101	Pulp, paper and paperboard	66.80
MEX	3230	Television and radio receivers	94.74
MEX	3000	Office, accounting and computing machinery	94.51
MEX	3220	Television and radio transmitters	93.31
MEX	2101	Pulp, paper and paperboard	92.51
MEX	2929	Other special purpose machinery	90.53
MEX	2520	Plastics products	90.15
MEX	2914	Ovens, furnaces and furnace burners	89.47
MEX	3210	Electronic valves and tubes and other electronic components	89.19
MEX	3694	Games and toys	88.97
MEX	3313	Industrial process control equipment	88.96

Source: INT-IADB using information from National Accounts, COMTRADE and IMF-IFS

Figure 3 shows the different evolution of the average IP index for the manufacturing sector by country, calculated using the share of each 4-digit sector in total manufacturing output.[5] We observe that there is a declining trend towards the last year in the time series available for Brazil and Colombia. Meanwhile, Costa Rica and Mexico show a persistent upward trend since 2009. As we will see in the following section, the difference in these trends across countries is consistent with the exchange rate movements that took place in each country's economy during the years observed in the figure.

[5] In contrast to Figure 2 where the IP index was calculated using an economy wide measure of product such as GDP, the IP index reflected in Figure 3 is calculated based on production data for the manufacturing only.

Figure 3. Average Import Penetration Index - Manufacturing Sector (ISIC rev3 15-36)



Note: Weighted average across countries

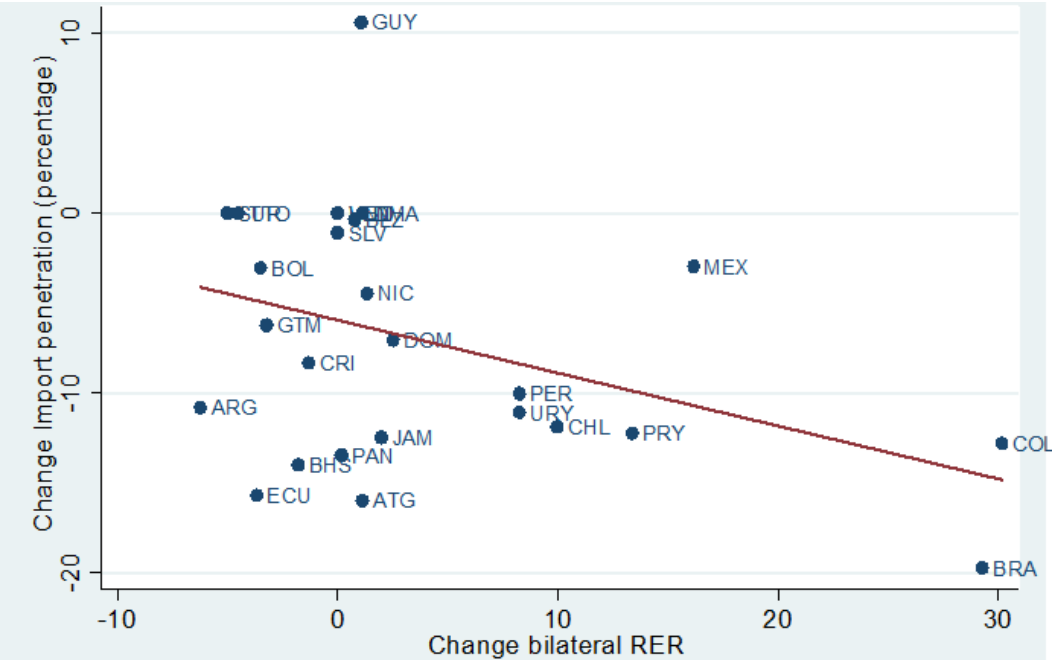
Source: INT-IADB using information from National Accounts, COMTRADE and IMF-IFS

2.4 Import Penetration vs. Real Exchange Rate Depreciation

Figure 4 shows preliminary evidence on the negative relationship between currency devaluation and the IP index. In 2015, the index went down in almost all countries and the decline was more severe in those experiencing the highest depreciations such as Brazil and Colombia. Even though this pattern suggests that local producers may have taken advantage of the devaluation to displace foreign competitors, this might be just reflecting a change in the composition of the countries' expenditures away from sector with a higher import share. For instance, as most of them are facing a downturn in economic activity, investment in machinery, which usually has high import content, might have fallen more than other expenditures, driving the average IP index down.[6]

[6] The evidence in Figure 4 is also confirmed when we use the sectoral data—as described in section 2.3. The negative relationship between an increase in the real exchange rate—a devaluation—and the decrease in the IP index holds for all sectors included in our analysis for manufacturing—sections 15 to 36 of the ISIC classification, rev 3.

Figure 4. Annual Change in Import Penetration Index vs. Depreciation in real terms (2015)



Source: INT-IADB, using information from National Accounts, COMTRADE and IMF-IFS

3. A more rigorous look at the currency impact

In this section, we analyze the relationship between the real exchange rate and the IP index at three different levels of aggregation: a) the overall economy; b) the manufacturing sector; and c) within the manufacturing sector.

In contrast to the analysis above, in this section we use the real effective exchange rate index to observe currency depreciations, as it could provide a better measure of how relative prices have changed with respect to all import suppliers and not just those that have their currencies pegged to the dollar.

The series primarily used for this analysis has been taken from the International Financial Statistics series from the IMF. [7] We focus on the estimation of the REER elasticity of the IP index for all LAC countries with available information for 2008-2014.[8]

[7] Real Effective Exchange Rate (REER) is the nominal effective exchange rate (a measure of the value of a currency against a weighted average of several foreign currencies) divided by a price deflator or index of costs (labor, consumer, among others). In this analysis, we consider the REER that uses the consumer price index.

[8] The sample considered in this estimation corresponds to the following 17 LAC countries: Argentina, Bahamas, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Guyana, Mexico, Nicaragua, Peru, Paraguay, Uruguay, Venezuela.

We explore the following specification:

$$(1) ln\left(M_{pen}\right)_{i,t} = \alpha + \beta_1 \ln\left(REER\right)_{i,t} + e_{i,t}$$

Where, i represents the country and t the year. Given the way in which the REER is defined—foreign currency per unit of local currency unit, we would expect a positive relationship with the IP index: a depreciation (a fall in the REER) would be expected to be associated with a decrease in the import penetration index.

3.1 Results at the country level, all imports

Table 2 presents the results covering the universe of imports for the LAC countries included in the sample, using different set of controls. They confirm the inverse relationship suggested above, with positive and significant estimates of REER elasticity in all specifications, confirming that a depreciation (a fall in the REER[9]) is correlated with a decrease in import penetration. On average—considering the last three columns including fixed effects, a depreciation of 1% is correlated with a decrease in the IP index of 0.5%.

Table 2. Real Effective Exchange Rate Elasticity of Import Penetration, All imports, All Latin American countries

VARIABLES	(1) Log M/P+M	(2) Log M/P+M	(3) Log M/P+M	(4) Log M/P+M
Log real exchange rate REER	0.531**	0.510**	0.486*	0.486*
	(0.244)	(0.237)	(0.243)	(0.243)
Constant	0.615	0.769	0.880	0.880
	(1.130)	(1.091)	(1.099)	(1.099)
Observations	117	117	117	117
Number of id	17	17	17	17
Year F.E.	No	Yes	Yes	Yes
Country F.E.	No	No	Yes	Yes
Cluster	No	No	No	by-country

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[9] For robustness, the model is estimated using the REER calculated using import shares from all countries as weights. This variable was computed by the RES-IADB department. The results obtained using this alternative series are consistent in statistical significance, sign and magnitude with those obtained using the series from the IMF (weighted average of several foreign currencies).

3.2 Results at the country level, manufacturing imports only

Table 3 presents the estimates of REER elasticities considering only the manufacturing sector, using different sets of controls. In this case, the IP index was constructed using the information from the World Development Indicators on manufacturing value added by country. The imports were converted to local currency using the bilateral real exchange rate as explained before.

Table 3. Real Effective Exchange Rate Elasticity of Import Penetration, Manufacturing Imports, All Latin American countries

VARIABLES	(1) Log M/P+M	(2) Log M/P+M	(3) Log M/P+M	(4) Log M/P+M
Log real exchange rate	0.609***	0.423***	0.412***	0.412***
	(0.111)	(0.130)	(0.133)	(0.133)
Constant	1.357***	2.130***	2.181***	2.181***
	(0.526)	(0.592)	(0.595)	(0.595)
Observations	151	151	151	151
Number of id	17	17	17	17
Year F.E.	No	Yes	Yes	Yes
Country F.E.	No	No	Yes	Yes
Cluster	No	No	No	by-country

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, *p<0.1

As in the case with the economy wide data, the estimates of the REER elasticity are positive and significant[10]. Depreciation is associated with a decrease in the IP index. On average, considering the most demanding specification (column 4), a depreciation of 1% is correlated with a decrease in the IP index of 0.42%.[11]

To the extent that these elasticities are slightly lower than those obtained for the economy wide sample, it suggests that manufacturing imports are less sensitive to changes in the real exchange rate. However, it is important to keep in mind that these discrepancies may be related to the differences in the data used to construct the IP index. In the overall economy sample, the domestic

[10] For robustness, we also estimated the model using the REER computed by the RES-IADB department. The results remain consistent—the sign of the coefficients, their magnitude and statistical significance do not vary significantly.

[11] In related work, Faleiros et al. (2016) explore the effect of the exchange rate movements and labor productivity on import penetration in the Brazilian manufacturing sector. Despite differences in the technique and specification used—they use GMM and also explore the relationship between IP and labor productivity, their results are consistent to ours: an exchange rate depreciation has a negative effect on import penetration, although they also find that labor productivity has the strongest negative impact on the IP index.

production was proxied by GDP, while for the manufacturing, the variable used was value added.[12]

3.3 Results at the country-sector level (ISIC 4-digit), manufacturing imports only

In this sub section, we estimate the REER elasticity using country-sector, ISIC (rev 3) at 4-digit data within manufacturing sector. Again, for this exercise, we focus the analysis on a group of countries where production data[13] at such level was available—Brazil, Colombia, Costa Rica and Mexico. Coincidentally, some of these countries also had currencies that experienced strong depreciations in the past years. The results are presented in Table 4.[14]

Consistent with the previous results, the estimates of the REER elasticity are positive and significant.[15] In this case, we employed the REER provided by the RES-IADB department to consider the weights accounting for import shares in manufacturing exclusively. The results suggest that 1% depreciation is correlated with a decrease in import penetration of 0.69% on average in the most demanding specification (column 4).

The difference with respect to the previous results could be related to several factors. Again, it is important to note the differences in the information used to construct the IP index. In this sample, we use production data whereas in previous results we used value added. In addition, the sample of countries in this last exercise includes only four countries and some whose currencies strongly depreciated (Brazil, Colombia and Mexico).

[12] Value added is obtained from net output after subtracting intermediate inputs. It could be that the intermediate inputs in the manufacturing sector are a component highly sensitive to the changes in the exchange rate. Therefore, by removing them, the measure of value added obtained is less sensitive to the exchange rate movement vis-a-vis other measures reflecting gross output such as GDP.

[13] The production data was available in national industrial classification for the case of Colombia (ISIC A.C. -adapted for Colombia), Mexico (NAICS) and Brazil (CNAE2), except for the case of Costa Rica (ISIC rev3). Thus, we had to bring the data from the national classification to ISIC rev 3 and making all the industry-level information comparable across the sample.

[14] The presentation of the results has been organized consistently with the two tables above, except that in this case, Column 4 includes a clustering of data by country-sector.

[15] Using interaction terms, we tested whether the relationship holds for each country separately. We find that the positive relationship holds for Brazil (0.96), Colombia (0.16) and Costa Rica (0.49). The elasticity becomes negative in the case of Mexico (-0.26), which might be related to the relatively high import content of Mexico manufacturing output, notably exports. See Blyde (2014).

Table 4. Real Effective Exchange Rate Elasticity of Import Penetration, Manufacturing Imports at ISIC 4-digit, selected country sample

	(1)	(2)	(3)	(4)
VARIABLES	Log M/P+M	Log M/P+M	Log M/P+M	Log M/P+M
Log real exchange rate	1.335***	0.721***	0.690***	0.690***
	(0.101)	(0.110)	(0.111)	(0.111)
Constant	-3.007***	-0.250	-0.0964	-0.0964
	(0.481)	(0.512)	(0.508)	(0.508)
Observations	2,264	2,264	2,264	2,264
Number of id	358	358	358	358
Year F.E.	No	Yes	Yes	Yes
Country-sector F.E.	No	No	Yes	Yes
Cluster	No	No	No	by-country-sector

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3.4 Differences in elasticities by group of sectors

So far, we have assumed that the import penetration response to currency fluctuations across countries and sectors would be well represented by an average effect. Yet, as shown in 2.3, import penetration can vary significantly across countries and sectors, reflecting differences in country size, geography, comparative advantages and moments of the economic cycle. We expect to see, for instance, higher elasticities in country/sectors where, driven by these determinants, domestic supply is stronger, accounting for a significant share of the country's goods consumption.

To try to capture this likely heterogeneity in response, we split the sample from the exercise above into two groups based on the country/sectors' strength of domestic supply. For each country, we calculate for each sector the domestic production's average share of total supply in the period. [16] We then use the bottom and upper third of each country's distribution to build two separate samples—the weak and the strong domestic supply groups- and use then to estimate two REER elasticities. The results are presented in Table 5.

[16] The share of domestic production is calculated as domestic production over the sum of domestic production plus imports.

Table 5. Real Effective Exchange Rate Elasticity of Import Penetration, Manufacturing Imports at ISIC 4-digit, selected country sample, by sector groups

a) Upper third of Sectors (ISIC 4-digit) with the most presence of domestic production

VARIABLES	(1) Log M/P+M	(2) Log M/P+M	(3) Log M/P+M	(4) Log M/P+M
Log REER, manufacturing import weights	1.992***	1.123***	0.995***	0.995***
	(0.253)	(0.298)	(0.305)	(0.305)
Constant	-7.601***	-3.696***	-3.073**	-3.073**
	(1.160)	(1.345)	(1.391)	(1.391)
Observations	688	688	688	688
Number of id	108	108	108	108
Year FX	No	Yes	Yes	Yes
Country-sector FX	No	No	Yes	Yes
Cluster	No	No	No	by-country-sector

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

b) Lower third of Sectors (ISIC 4-digit) with the least presence of domestic production

VARIABLES	(1) Log M/P+M	(2) Log M/P+M	(3) Log M/P+M	(4) Log M/P+M
Log REER, manufacturing import weights	0.551***	0.304***	0.218***	0.218***
	(0.0630)	(0.0708)	(0.0717)	(0.0717)
Constant	1.709***	2.812***	3.206***	3.206***
	(0.301)	(0.332)	(0.330)	(0.330)
Observations	689	689	689	689
Number of id	112	112	112	112
Year FX	No	Yes	Yes	Yes
Country-sector FX	No	No	Yes	Yes
Cluster	No	No	No	by-country-sector

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results show that indeed, there are important differences. The REER elasticity is higher for the group of sectors where there is a stronger presence of domestic production—on average 0.99 vis-a-vis 0.21 for the other group. This result suggests that the sectors with higher share of domestic production present almost a perfect responsiveness to the changes in the real effective exchange rate (unitary-elasticity), whereas the sectors with a smaller share of domestic

production are less sensitive to the changes in the real effective exchange rate. This higher degree of responsiveness may in part reflect an import substitution effect in those sectors in which the domestic production has a non-trivial role.

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