REAL EXCHANGE RATE AND THE ENDOGENEITY OF INCOME ELASTICITIES: THEORETICAL ASPECTS AND EMPIRICAL EVIDENCE.

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ABSTRACT

The paper analyses the influence of the real exchange rate (RER) on the income elasticities of the demand for imports and exports in a balance of payments constrained growth framework (BPCG). Theoretically, we identify the transmission mechanisms through which the real exchange rate affects the elasticities and discuss its implications. Empirically, a novel two-stage test is carried out. First, we estimate the trade income elasticities for each country in different periods. Secondly, we evaluate the effect of the level of the RER over the elasticities. The results provide empirical evidence supporting the hypothesis of endogeneity of the income elasticities, especially for developing countries in Latin America.

Key Words: Real Exchange rate, structural change and endogeneity of the income elasticities.

1 - Introduction

There is a common literature that argues that structural change is essential for development. The dual model Arthur Lewis (1952), for example, assumes the existence of a traditional sector with low productivity and other modern, with high productivity. So, in terms of economic growth the key variable is the transition ability of skilled labor from the traditional sector to the modern sector. In same vein, the structuralist tradition in economics has long argued that a country's productive structure plays a key role in the path of economic development pattern to be followed (see Prebisch, 1949; Furtado, 1964). This is also the central tenet of many studies through subsequent decades, such as Kaldor (1966), Pasinetti (1981), Young (1995), McMillan e Rodrik (2011), among others.

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Structural change also plays a key role on growth at the standard balance-of-payments-constraint growth model (BPCG) introduced in the pioneer work of Thirlwall (1979). In this model, the only safe solution to raise the growth rate of a country, in line with the intertemporal equilibrium of balance-of-payments (BoP), is through structural changes that increase (reduce) the income elasticities of the demand for exports (imports). Thirlwall's model admits a direction of causality from income elasticities to economic growth. As the author points out, this is the basic premise of all the classic center-periphery models, such as those from Prebisch (1949), Myrdal (1957), Seers (1962), and Kaldor (1970).

The question becomes, therefore, to understand how differences in elasticities cause different growth rates and, above all, what are the factors to determine it. In this sense, researchers have expanded BPCG models by incorporating functions that try to capture the endogeneity of income elasticities of demand for exports and imports (Setterfield, 1997; Palley, 2002; McCombie and Roberts, 2002; Botta, 2009, among others).

Recently works also pose the hypothesis that the endogeneity these elasticities in relation to the level of the real exchange rate (RER) for developing countries[3] (Barbosa-Filho, 2006; Missio and Jayme Jr., 2012; Ferrari, Freitas and Barbosa-Filho, 2013; Oreiro, Missio and Jayme Jr., 2015, Bresser, Oreiro and Marconi, 2015; Marconi, Araújo and Oreiro, 2015, Gabriel, Jayme Jr. e Oreiro, 2016; among others). The core argument of this hypothesis is to assume that the maintenance of a competitive real exchange rate for a prolonged period of time can affect the productive structure (driving structural change) and thus change the magnitude of the income elasticities for exports and imports.

The paper's main objective is to investigate this hypothesis of a connection between the real exchange rate, structural change and change of the income elasticities. From a theoretical standpoint, its contribution is to systematize and advance the identification of transmission mechanisms as well as to discuss some of their implications. In doing

[3] Papers following a Kaldorian approach have shown different ways in which the level of the RER can affect economic growth. See, for example, Rapetti (2016) and Ibarra and Blecker (2016). See also Razmi (2016) or Boggio and Barbieri (2017) for alternative roles for the RER level in heterodox open economy growth models.

so, the paper contributed to the understanding of the arguments in support of the endogeneity hypothesis of income elasticities of international trade in relation to the level of the real exchange rate.

The second contribution of this paper is to present a test for the endogeneity hypothesis, which is new in the literature regarding RER and growth in a BPCG framework. To do so, a novel two-stage test is carried out. First, we estimate the trade income elasticities for each country in different periods. Secondly, we evaluate the effect or the level of the RER over the elasticities.

Although this issue has received renewed attention in recent years due to lower international growth rates as well as to the debate on 'currency wars'. The connection between real exchange rates and growth remains, however, an unsettled question in the academic literature. The endogeneity hypothesis of income elasticities is a path that provides elements that can elucidate this connection.

The paper is organized as follows: Section 2 presents a BPCG model with endogenous income elasticities. Section 3 presents the transmission mechanisms through which the real exchange rate can induce structural change and change the elasticities. Finally, the last section the empirical test is presented.

2 - Thirlwall's model and the the endogeneity of income elasticities

Thirlwall's 1979 benchmark model shows that, in the long run, output growth can be explained by two groups of factors. First, the growth of demand, chiefly exports. Secondly, by structural characteristics. Both work to determine a ceiling to output growth, provided that no country can consistently grow faster than the rate compatible with a stable balance-of-payments.

Structural characteristics encompass the income elasticity of imports and exports. These structural characteristics are also associated with technical progress and with each country's position in the international division of labor.

The central thesis of this line of investigation is that balance-of-payments disequilibria set in before short run productive capacity is fully utilized. Hence, aggregate demand

must be curtailed and full capacity utilization is never reached. The slower growth of output also set lower levels of investments and technical progress, which in turn affect the competitiveness of domestic goods in foreign markets, worsening the country's external restriction.

Formally, the model can be described by the following equations:

$$P_d.X = P_f.M.E \quad (1)$$

$$M = (P_f.E)^{\psi}.P_d{}^{\varphi}.Y^{\pi} \quad (2)$$

$$X = (P_d/E)^{\eta}.P_f^{\delta}.Y_E^{\varepsilon} \quad (3)$$

where, P_d and P_f stand for domestic and foreign prices, respectively; X are the exports ;; E is the exchange rate; M_t are the imports; Y is the domestic output; ψ is the price elasticity of imports ($\psi < 0$); φ is the cross price elasticity of imports ($\varphi > 0$); π is the income elasticity of imports ($\pi > 0$); η price elasticity of exports ($\eta < 0$); δ is the price elasticity of exports ($\delta > 0$); ε income elasticity of exports ($\varepsilon > 0$); e Y_E is the output of foreign markets.

Rewriting the equations in dynamic terms and considering that the price elasticities of imports and exports are equal to their respective cross price elasticities ($\psi = -\varphi$ e $\eta = -\delta$), and considering that the terms of trade measured in a common currency remain stable in the long run ($p_d = p_f + e$), it is possible to obtain the well know Thirlwall's Law:

$$y = \frac{\varepsilon}{\pi}.y_E = \frac{x}{\pi} \quad (4)$$

Equation for established that the output growth rate consistent with the long run equilibrium in the balance-of-payments equals the ratio between the growth rate of exports (x) and the income elasticity of imports.

Differences of magnitude in the income elasticities of trade can explain divergent trajectories of growth between developed and developing countries. As a rule, the dependence on large, traditional, low income elasticity of demand goods producing sectors represents a dynamic obstacle to economic development.

Following the literature mentioned above, it is possible to consider that the income elasticities of trade are not parameters, but an endogenous function of the real exchange rate:

$$\varepsilon = f(\theta, \Delta) \qquad \text{with } \frac{\partial \varepsilon}{\partial \theta} > 0; \tag{5}$$

$$\pi = f(\theta, \Delta) \qquad \text{with } \frac{\partial \pi}{\partial \theta} < 0; \tag{6}$$

in which θ is the level of the RER and Δ represents all other variables affecting the income elasticitie of trade.

Hence, it is possible to rewrite Thirlwall's Law as:

$$y_t = \frac{\varepsilon(\theta, \Delta)}{\pi(\theta, \Delta)} . y_E. \tag{7}$$

Equation (7) differs from equation (4) given that long term output growth compatible with the equilibrium in the BoP also depends on the level of the RER.

Differentiating equation (7) with respect to time renders:

$$\frac{\partial y}{\partial \theta} = \left\{ \frac{\left[\pi(\theta) . \overset{+}{\frac{\partial \varepsilon(\theta)}{\partial \theta}} - \varepsilon(\theta) . \overset{-}{\frac{\partial \pi(\theta)}{\partial \theta}} \right]}{[\pi(\theta)]^2} . y_E \right\} > 0 \tag{8}$$

Figure 1 shows the linear relationship between the RER and the long run output growth rate.[4]

[4] It is possible to have a quadratic relation between the level of the real exchange rate and elasticities. Hence, after a threshold, the devaluation can bring about more problems than virtues, so affecting the growth negatively. Since come countries need to import capital goods, the growing prices in foreign currency can affect imports negatively, and thus investment.

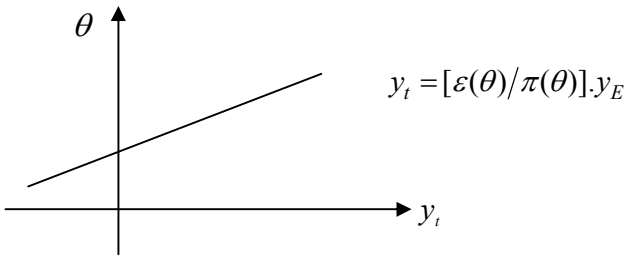

Figura 1: Real Exchange Rate and Domestic Income Elasticity.

Finally, to highlight the effects of inter-sectoral changes of output shares, Araujo and Lima (2007) modify Thirlwall's original model, introducing a pasinettian multisectoral macro-dynamic structure. The resulting equation shows that a country's output growth rate is associated with sectoral income elasticities of trade. These elasticities are weighted by each sector's share on total exports and imports. In this case, equation (4) becomes:

$$\sigma_i^U = \frac{\sum_{i=1}^{n-1} \xi \beta_i a_{i\hat{n}} a_{ni}}{\sum_{i=1}^{n-1} \phi_i a_{\hat{i}n} a_{ni} \left(\sum_{i=1}^{n-1} \beta_i \right)} \sum_{i=1}^{n-1} \frac{\dot{a}_{i\hat{n}}}{a_{i\hat{n}}} \qquad (9)$$

in which $a_{i\hat{n}}$ represents the coefficient of *per capita* foreign demand for the good *i*, with *i*=1, 2 ,..., n-1; $a_{\hat{i}n}$ is the coefficient of the per capita local demand for imports of the good *i* produced in the country A. The coefficient of production of consumption goods is given by a_{ni}, which stands for labor required in each sector. The Family sector in country A is given by $\hat{n}$ and the size of the population in each country is given by the coefficient ξ. β_i (ϕ_i) is the income elasticity of demand for exports (imports).

From a multi-sectoral assessment of the BOP constrained growth hypothesis, Araujo and Lima (2007) show that even if sectoral elasticities and world income growth are constant, a country can grow faster by either increasing the share in exports of sectors with a high-income elasticity for exports or decreasing the share of import of sectors with a high-income elasticity for imports. In such approach, the exchange rate did not play an important role because it is assumed that in the long run, the law of one price holds or a sectoral version of the purchasing power parity holds for each good.

It is also possible to add to this model the hypothesis of endogeneity of the elasticities. Missio, Araujo e Jayme Jr. (2013) expand the model developed by Araujo and Lima (2007) to derive a balance of payments equilibrium growth rate analogous to Thirlwall's Law based on a Pasinettiana multisectoral macro-dynamic structure in which income elasticities are endogenous real exchange. The model is constructed to relate growth, the RER and sector heterogeneity. From the point of view of cumulative causality, they demonstrate the effect of the level of real exchange rates on the generation of technological progress and how these rates also affect the growth of the whole economy through a balance of payments constraint approach. The conclusion shows that an undervalued real exchange rate has positive effects on economic growth in developing countries.

3 - Real Exchange Rate, Structural change and the Income Elasticities

The main argument behind the link between the RER and the income elasticities of demand for imports and exports is that the RER can induce progressive structural change. Hence, the RER can improve a country's foreign trade through time.

If this is the case, a better understating of what structural change is, as well as how changes on the level of the RER can induce structural change is needed. Hence, to further the understanding regarding the endogeneity of income elasticities of trade, three channels through which the RER can influence the productive structure can be identified:[5]

i) Change each sector's share on total exports and imports (composition effect)[6];
ii) Change the number of sectors associated with the international trade (specialization effect);
iii) Change the attractiveness of internationally traded (sophistication effect);

The following task is to identify the channels through which the RER generates these effects, which may not be independent of each other.

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[5] For simplicity we assume that each sector produces only one product.
[6] Araújo and Lima (2007) demonstrated the role of the composition effect based on the multisectoral Thrilwall law, ie considering that the sectoral elasticities are weighted by the coefficients that measure the share of each sector in the total volume of exports and imports. Even if they remain constant, the change in the growth rate can be caused by structural changes coming from the evolution of tastes or preferences according to Engel's law. Therefore, the main implication of the multisectoral model is that changes in the composition of demand, which are not reflected in changes in elasticities but result from changes in the participation of each sector in the export or aggregate import, also matters for economic growth.

a) Composition effect: the RER may foster growth through temporary, albeit sustained long enough to change the relative price of tradable and non-tradable goods. This is to say that RER affects aggregate demand when its level is kept at a competitive level to induce structural changes towards a larger share of technology-intensive tradable goods and services. Two important mechanisms are in place. The increase of exports stimulates the productions of these higher-tech goods, which also tend to have higher income elasticities of exports, generating positive dynamic externalities due to the learning process associated with competitive foreign markets. Secondly, in industrialized developing economies, a competitive RER favors the manufacturing and efficiency gains associated with the Kaldor-Verdoorn effect.

b) Specialization effect: these are the effects of changes of the RER over the number of sectors and goods that enter the mix of exported and imported goods. From the exports point of view, a more competitive RER induces export-oriented investments on the production of a larger number of goods. Secondly, considering that technical progress is largely brought forward by capital accumulation through new technologies embodied in new machinery and capital goods, new products may be exported. Finally, the RER changes the functional income distribution by influencing real wages and thus the productive structure. From the imports side, a competitive RER reduces the variety of imported goods, favoring the imports of essential ones. As the country develops, the dependence of imported goods tends to lessen.

c) Sophistication effect: the RER can influence technical progress by favoring the production of higher technology goods. A competitive RER increases firms' profits and their ability to fund new investments of R&D. In this case, it is assumed the competitive RER changes income distribution towards profits and that there is credit rationing due to imperfect markets[7]. Hence, there is a likelihood that the RER may create incentives to technical change and the production of more sophisticated, higher quality goods. The increase in R & D activities (sophistication effect) coupled with the appearance of new business units (composition effect) imply the appearance of new products, which reinforces the specialization effect. Moreover, the sector sophistication effect has impacts on other sectors of the productive structure, since it is expected a structural

[7] This effect is valid for developing countries. For developed ones, the relationship between RER and technical progress tends to be null or very small..

homogeneity, as well as the incorporation of the technical progress by sectors that are not linked to exports. As in the later sectors the innovative activity returns are larger, the discontinuities are expected to be quickly overcome

Henceforth, given that it can induce structural change, the RER may be a key variable influencing the income elasticities of commerce.

Another way to illustrate the effects of the RER over the income elasticities is through a Multi-sectoral Balance of Payments Constrained Growth Model. In this framework, the aggregate income elasticity of demand for exports, ε, is a weighted average of the sectoral elasticities. Formally:

$$\varepsilon = \sum_{i=1}^{k} \omega_{Xi} \varepsilon_i \quad (10)$$

Equation (10) shows that a country exports is composed by *k* goods, each with specific elasticity of demand for exports ε_i, whose contribution to ε, depends on its share of total exports ω_{Xi}.

Considering Equation (10) and if the transmission effects described above are independent of each other, the effects of the RER over aggregated demand can be described as follows:

(a) *composition effect:* the value of elasticities associated with each good/sector ε_i remains unchanged and the share of higher-tech goods/sectors increases. Given that these have higher elasticities the value of ε increases.

$$\varepsilon(\theta) = \sum_{i=1}^{k} \omega_{Xi}(\theta).\varepsilon_i \quad (11)$$

(b) *diversification effect*: refers to the effects of RER on the number of exported goods, Formally, it is represented by n terms of $K(\theta)$.

$$\varepsilon(\theta) = \sum_{i=1}^{k(\theta)} \omega_{Xi}.\varepsilon_i \quad (12)$$

(c) *sophistication effect*: this is the impact of RER on technical progress. In this case, the income elasticity associated with each good changes, although their share remain unchanged.

$$\varepsilon(\theta) = \sum_{i=1}^{k} \omega_{Xi}.\varepsilon_i(\theta) \quad (13)$$

In sum, the RER can impact technical progress from either a microeconomic, sectoral, or from a macroeconomic, aggregated, point of view. In either case, RER is linked with changes on the aggregate income elasticity of demand for exports, easing external constraints on growth. From this discussion, it iss possible to observe that a more competitive RER can change the elasticities of individual products and lead to

structural change, for example, in the form of higher weights on the industries or goods that have higher income elasticities of export demand.

However, two important issues arise from the connections between the level of RER and growth. The first, is that sectoral elasticities respond differently to changes on the level of the RER, given the peculiarities of the production of each good. It follows that each productive structure will have a different set of sectoral elasticities of demand for exports. (Gouvea and Lima, 2013). Hence, it can be expected that larger variations on the size of the elasticities will occur for technology intensive sectors/goods in which international competitiveness is based on dynamic comparative advantages. On the other hand, these changes will be smaller for goods/sectors dependent on natural comparative advantages.

Secondly, given that the development as well as technical progress of each sector varies across countries, the income elasticity of exports of each sector will respond differently given changes on the RER. In other words, the level of the RER can affect just specific income elasticities.

Also, the time required for this process to take place (elasticities change) is an empirical question (Eichengreen, 2007). However, it is possible to assume that in the short term, the impact of a competitive RER on growth will be predominantly through exports growth (effective demand channel). In the medium and long run, income distribution and technical progress channels should prevail.

Finally, it should be noted that for these effects to take place, i.e. for the competitive RER to have impact on the productive structure, a minimum time span is required. The exchange rate policy must be enforced beyond short run fluctuations, which are insufficient to promote structural change.

4. Empirical Evidence on the Endogeneity of Income Elasticities: A Preliminary Test

In this section we empirically test the endogeneity of elasticities. To the best of our knowledge, there are no such tests in the literature. We will follow a two-step procedure, the first of which consists in calculating elasticities according to the following equations:

$$m_{i,t} = c + \psi(rer_{i,t}) + \pi(y_{i,t}) + \mu_t + \eta_i + \varepsilon_{i,t} \tag{14}$$

$$x_{i,t} = c + \eta(rer_{i,t}) + \varepsilon(z_{i,t}) + \mu_t + \eta_i + e_{i,t} \tag{15}$$

where $m_{i,t}$ $(x_{i,t})$ is the growth rate of imports (exports); rer_{it} is the growth rate of the real exchange rate; $y_{i,t}$ is the growth rate of country i in the analysed period; z_t is the growth rate of the income of the rest of the world; ψ (η) is the price elasticity of the demand for imports (exports); π (ε) is the income elasticity of the demand for imports (exports); c is an exogenous constant; μ_t and η_i are the time-specific effects and unobserved country-level effects for each country i, invariant in time (they will not be displayed); e_{it} is the idiosyncratic error term; and the subscripts i and t refer to countries and to time periods, respectively.

The second step involves estimating the impact of the level of the real exchange rate on the elasticities estimated in equations (14) and (15). More specifically, we estimate the following equations:

$$\varepsilon_{i,t} = \beta_1 + \beta_2(\theta_{i,t}) + a_{i,t} \quad (16)$$

$$\pi_{i,t} = \alpha_1 + \alpha_2(\theta_{i,t}) + a_{i,t} \quad (17)$$

where $reec$ is the level of the real exchange rate (the average of the real exchange rate for the period the elasticities were calculated); β_1 and α_1 are constants; and e is the idiosyncratic error term. The coefficients we are interested in, β_2 and α_2, are expected to have respectively positive and negative signs.

4.1 **Methodology**

The sources used for the following data analysis are the statistical databases of New York University's Development Research Institute (DRI) (2008), as well as the real exchange rate data from the United States Department of Agriculture's Economic Research Service (Table 1). The estimation strategy involves defining two different samples of countries, based on data available for the 1978-2007 period. Specifically, we first build a *balanced panel* for a *broad sample* of 55 countries (*n*) over 30 year (*t*). Based on this sample, we perform the econometric procedures that show the behavior of the foreign trade elasticities under the hypotheses of endogenous to the level of the real exchange rate. The second sample (reduced sample) consists of 38 countries, over the same time span[8], for which there is an index of the real effective exchange rate available

[8] In the broad sample, data for each variable are missing in the less than 5% of the observations.

in the International Financial Statistics (IFS)[9]. This sample will be used to make the results obtained more robust.

The option for the reduced sample can be justified by the difficulty of defining - and, more precisely, using - a real exchange rate series "less" amenable to criticism, which better represents this variable. There are different ways of defining the real exchange rate. Nevertheless, this variable's series usually display a high proportion of missing data. Besides this, they are particularly marked by strong distortions, in large part owing to factors of the economic situation affecting certain countries (e.g., hyperinflations). Given these distortions, the following exercise is based on the series the two sources provide. On the one hand, this seeks to avoid problems with the data (limited number of observations, missing data, measurement errors); on the other, this intends to make the results more robust.

An expected econometric problem is the small significance of the parameters β_2 and α_2. This is because we theoretically expect these coefficients to be small, while it is empirically known that real exchange rate series have got high variance and, therefore, high standard-deviations. The expected values for the coefficients are low because, if it were otherwise, then small variations of the level of the real exchange rate would lead to great changes in the elasticities, in turn significantly altering the balance of payments constraint and the growth rate compatible with its equilibrium. As argued throughout this article, the effects of the real exchange rate on growth are usually indirect, and they mainly act through reducing productive heterogeneity, via a shift of the capital accumulation process towards more technology-intensive and/or higher value-added sectors. This means the impacts on the balance of payments constraint are moderate and – mostly – felt in the long-term.

Table 1 Here

The estimation strategy starts with obtaining each country's income elasticity for five-year periods, using OLS. This means every country will have six elasticity estimates for the 1978-2007 period. Knowing these elasticities, we estimate equations (28) and (29) employing panel-data techniques. The results follow.

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[9] That is, in this case the estimates using the index (real effective exchange rate) provided by the IFS instead of real exchange rate data from the United States Department of Agriculture's Economic.

4.2. Results

Table 2 presents the estimates for all countries. Regarding the income elasticity of the demand for imports, the coefficient obtained is significant and of the expected sign – i.e., a higher real exchange rate reduces the income elasticity of the demand for imports. On the other hand, the estimate of the coefficient associated to the income elasticity of the demand for exports displays the opposite sign (and is not significant). A possible explanation for this might be related to the composition of the sample, in which the effect for developed countries might be standing above and dominating that for the rest of countries. We performed the test separately for each group of countries, and the results corroborate this hypothesis.

Table 2 Here

Before presenting the results of the group-specific estimations, we repeat the previous exercise for the *reduced* sample. The results are of the expected signs and, once more, the coefficient associated to the income elasticity of the demand for imports is significant.

Table 3 Here

The results for the groups are reported in Tables 4 and 5. The impact of the real exchange rate on the elasticities differs between groups. Specifically, in the developing countries of Latin America there is a positive (non-significant) effect for the income elasticity of the demand for exports and a negative (significant) effect for that of imports. This suggests that the hypothesis of elasticities endogenous to the level of the real exchange rate is theoretically supported, above all, for this group of countries. Table 5 reports the results for the estimates using the IFS series. There thus is some empirical evidence for this group of countries supporting the hypothesis of endogenous elasticities. It can be seen, moreover, that the signs of the results for developed countries are the opposite of the expected. This indicates that maintaining a higher real exchange rate might affect their economies differently than it does in developing countries, viz., reducing growth.

Table 4 and 5 Here

5. Conclusions

From the theoretical point of view, this paper contributes in identification and systematization of mechanisms of transmission between the real exchange rate, the

structural change and the changes of the income elasticities. Thus, it contributed to the understanding of the arguments in supporting the hypothesis of endogeneity of income elasticities of international trade in relation to the level of the real exchange rate. In this case, three channels through which the RER can influence the productive structure can be identified: composition effect, specialization effect, sophistication effect.

We additionally presented empirical evidence on the relationship between RER level and growth. The main results show a negative and significant relationship between the RER and the income elasticity of the demand for imports by developing countries. This suggests that the hypothesis of elasticities endogenous to the level of the real exchange rate is theoretically supported, above all, for this group of countries.

The main conclusion is that keeping a competitive RER for developing countries can create important effects on the productive structure, confirming other empirical caveats like Rodrik (2008) Ramzi et all. (2012), and Porcile and Lima (2010). It changes their specialization pattern, relaxing the balance-of-payments constraint and, thus, allowing for a higher long-term growth rate.

Finally, for future research, we suggest to study more deeply those determinants of the income elasticities of trade. Precisely, advancing on the empirical tests about the endogeneity hypothesis of elasticities, identifying other variables that may affect them. This will show new transmission mechanisms as well as new spaces for economic policy measures. In addition, it would be important to test the hypothesis of endogeneity of sectoral income elasticities. That is, the RER is likely to affect different sectors differently. In this case, it would be possible to identify the most affected sectors and, with this, to design economic policy mechanisms that could potentiate the positive effects and/or mitigate possible negative counter-tendencies.

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Table 1: List of variables

Symbol	Comments	Source
m	Growth rate of imports	The authors, based on data from the DRI/NYU
x	Growth rate of exports	The authors, based on data from the DRI/NYU
y	Growth rate of GDP	DRI/NYU
y_{USA}	Growth rate of US GDP	DRI/NYU
rer	Growth rate of the real exchange rate	The authors, based on data from the Economic Research Service
θ	Level of the real exchange rate	*Economic Research Service*
$Ireec$	Index for the effective real exchange rate	IFS/IMF
π	Income elasticity of the demand for imports	The authors
ε	Income elasticity of the demand for exports	The authors

Notes: DRI – Development Research Institute; NYU – New York University; IFS – International Financial Statistics; and IMF – International Monetary Fund.
Source: The authors.

Table 2: Endogeneity of the elasticities – broad sample

Dependent variable	π	ε
θ	-0.002 (-1.77)*	-0.0012 (-0.71)
c	3.37 (9.51)***	0.401 (0.76)
n	318	312

Note: *** Significant at 1%; ** Significant at 5%; * Significant at 10%. The values of the t-statistic are in parenthesis. We used the growth rate of the United States as a proxy for z. The Hausman test indicated the need for fixed effects.

Table 3: Endogeneity of the elasticities – reduced sample

Dependent variable	π	ε
Ireec	-0.0058 (-1.69)*	0.00186 (0.54)
c	3.687 (7.03)***	-0.246 (-0.47)
n	228	222

Note: *** Significant at 1%; ** Significant at 5%; * Significant at 10%. The values of the t-statistic are in parenthesis. We used the growth rate of the United States as a proxy for z.

Table 4: Endogeneity of elasticities for groups of countries – broad sample

	Developed Countries (1978-2007)		Asia (1978-2007)		Latin America (1978-2007)	
Dependent variable	π	ε	π	ε	π	ε
θ	-0.152 (-1.43)	0.008 (0.11)	0.090 (0.89)	0.039 (0.39)	-0.0018 (-1.72)*	0.00041 (0.23)
c	4.36 (4.82)***	0.199 (0.32)	-0.577 (-0.14)*	-1.33 (-0.32)	3.84 (5.57)***	0.905 (0.74)
n	114	114	42	42	90	84

Note: *** Significant at 1%; ** Significant at 5%; * Significant at 10%. The values of the t-statistic are in parenthesis. We used the growth rate of the United States as a proxy for z. The Hausman test indicated the need for fixed effects.

Table 5: Endogeneity of elasticities for groups of countries – reduced sample

	Developed countries (1978-2007)		Developing countries (1978-2007)	
Dependent variable	π	ε	π	ε
Ireec	0.036 (0.74)	-0.011 (-0.31)	-0.006 (-1.51)	0.0019 (0.42)
c	-0.354 (-0.07)	1.430 (0.40)	3.63 (4.64)*	-0.685 (-0.75)
n	120	120	108	102

Note: *** Significant at 1%; ** Significant at 5%; * Significant at 10%. The values of the t-statistic are in parenthesis. We used the growth rate of the United States as a proxy for z.