PSL Quarterly Review

vol. 78 n. 312 (March 2025)

Special issue on premature deindustrialization and climate change: global North and South perspectives

Endogenous income elasticities

FABRICIO J. MISSIO*

Federal University of Minas Gerais (CEDEPLAR/UFMG), Belo Horizonte, Brazil, email: fjmissio@cedeplar.ufmg.br

Abstract:
This paper deepens the analysis of the income elasticities of import and export demand in relation to the real exchange rate (RER) within a balance of payments constrained growth framework. It identifies how the RER can affect these elasticities and explores the resulting implications. A key highlight is the RER's ability to induce structural changes toward more complex and technology-intensive sectors. To illustrate this, a formal multisectoral model is presented, demonstrating the conditions under which a higher RER can alleviate external constraints. Finally, several related considerations are addressed.

How to cite this article:
Missio F.J. (2025), "Endogenous income elasticities", *PSL Quarterly Review*, 78 (312), pp. 51-66.

DOI: https://doi.org/10.13133/2037-3643/18918

JEL codes:
O11, E12, F43

Keywords:
balance-of-payments constraint, multi-sectoral Thirlwall's Law, income elasticities

Journal homepage:
https://rosa.uniroma1.it/rosa04/psl_quarterly_review

The pioneering work of Thirlwall (1979) introduced the standard balance of payments constraint growth model (BPCG). In this model, the only safe way to boost a country's growth rate while maintaining the intertemporal balance of payments equilibrium is through structural changes that increase (reduce) the income elasticities of the demand for exports (imports).

The question, therefore, becomes how differences in elasticities cause different growth rates and, above all, what factors determine this. To answer this, researchers have incorporated, into this set of models, functions that try to capture the endogeneity of the income elasticities of international trade (among others: McCombie and Roberts, 2002; Palley, 2003; Botta, 2009).

My co-authors[1] and I have argued that the real exchange rate (RER) can affect the productive structure, promoting structural change and altering income elasticities. More specifically, we argue that maintaining a competitive RER incentivizes research and innovation by enhancing self-financing conditions and access to credit. This, in turn, facilitates the modernization and diversification of productive capacities, ultimately expanding export capacity and reducing

* I would like to express my gratitude to the participants of the CNPq project entitled "New Green Developmentalism: Institutions and Public Policies for Reindustrialization with Social Equity" (n. 404978/2023-1) for their valuable contributions and the FAPEMIG (a research-supporting foundation of Minas Gerais state) (APQ-01964-18).

[1] I especially mention Frederico G. Jayme Jr, Hugo Carcanholo Iasco Pereira, Luciano Gabriel, José Luis Oreiro, and Ricardo Araújo.

imports in the long run. Furthermore, this environment supports sectors characterized by higher complexity, technological advancement, and productivity, which tends to ease external constraints and foster economic growth in developing countries.

However, I believe it is essential to clarify the transmission mechanisms that underlie the hypothesis of income elasticity endogeneity. This is precisely the objective of this article. More specifically, I propose to develop the transmission mechanisms between the RER and income elasticities of international trade further, showing how the RER can affect nonprice competitiveness through structural change and, thus, relax external constraints.

Following this, I present a simplified and didactic extension of the multisectoral BPCG framework, integrating the three main transmission mechanisms discussed throughout the article. I then explore the conditions under which the RER can relax external constraints.

In summary, the primary theoretical contribution of this paper is to support the hypothesis that the income elasticities of import and export demand are endogenous to RER within a BPCG framework.

This work is not intended to be an exhaustive review of the entire literature, as the topic of the effects of the RER on the economy is vast and multifaceted. Readers are encouraged to engage more deeply with the existing literature, including the works of Razmi et al. (2012), Blecker (2016), Rapetti (2020), Demir and Razmi (2022), Palazzo and Rapetti (2023); these offer valuable insights. Additionally, this study can be seen as a complement to previous works developed by myself and co-authors. Naturally, I have benefited greatly from these discussions, and I am grateful to my colleagues for their consistently fruitful contributions.

1. Theoretical aspects

In post-Keynesian literature, the RER has been somewhat neglected. In the context of the so-called BPCG models, the long-term equilibrium growth rate depends on the ratio between the income elasticities of exports and imports. Changes in the RER are considered irrelevant for long-term growth, either because of empirical evidence that price elasticities of exports and imports are low (so that the impact of an RER depreciation on the growth rate of exports and imports is limited) or because terms of trade do not show a systematic trend toward appreciation or depreciation in the long run (McCombie and Roberts, 2002, p. 92).

According to Thirlwall (2002, p. 69), achieving a higher growth rate over the long term while adhering to the intertemporal balance of payments equilibrium requires structural changes that boost the income elasticity of exports and reduce it for imports. In Thirlwall's model, the direction of causation flows from elasticities, which reflect the production structure, to growth. As the author points out, this is the basic assumption of all classic core-periphery models, such as those of Prebisch (1950), Myrdal (1957), Seers (1962), and Kaldor (1970).

Pasinetti's (1981, 1993) work on structural economic dynamics advances this discussion. The author demonstrates that changes in the production structure lead to alterations in growth, given the different rates of sectoral demand expansion. In other words, each sector has a particular capacity (a different elasticity) to benefit from increases in output. This idea, along with the operation of an external constraint on growth, was incorporated by Araújo and Lima (2007) into a formal model, analogous to Thirlwall's, which retains Pasinetti's multisectoral dynamics. The final result, expressed in the equation known as the Multisectoral Thirlwall's Law, shows that a country's per capita income growth rate is directly proportional to the growth rate of its exports (given by the sectoral income elasticity of demand multiplied by the world economy's growth

rate) and inversely related to the income elasticity of the sectoral import demand, with both elasticities weighted by the relative shares of the sectors in the trade composition.

However, analyses of how variations in exchange rate policy can drive structural changes[2] in economies are still in their early stages. For example, within the BPCG framework, this dimension is often underexplored or insufficiently addressed. In these models, the income elasticities associated with foreign trade serve a dual purpose: they not only determine aggregate demand but also reflect a range of supply-side factors that influence the economy's structural competitiveness. Then, the external constraint determined by income elasticities can be influenced only by changes in RER levels if the economy undergoes permanent RER depreciation or appreciation. This is valid because the direct effects of exchange rate policy variations on growth are considered, while the potential effects on technological progress, capital accumulation, and productive heterogeneity – and consequently on the elasticities themselves – are overlooked. Therefore, further analysis is needed to deepen the understanding of the connection between the RER and income elasticity.

In other words, existing analyses assume that the channels affecting the productive structure operate through the stimuli exerted by RER variations on demand and/or the wage structure. However, while these are important, it is acknowledged that they do not capture the full range of effects. For example, a competitive RER can influence the supply side of the economy by inducing an increase in the industry's share of the product (see Ottonello et al., 2024). Since this sector exhibits a higher average productivity compared to others, this change tends to enhance the efficiency of the entire economy. Therefore, the starting point for addressing this gap is the understanding that the RER level can influence productivity and the economy's productive structure, driving changes in patterns of specialization and competitiveness through other mechanisms as well.

The hypothesis of endogenous income elasticities of foreign trade expands the analysis by allowing for the examination of additional effects of the exchange rate on growth. Furthermore, it enhances our understanding of the factors that determine these elasticities.[3]

Some studies have incorporated functions into BPCG models to capture the endogeneity of elasticities. McCombie and Roberts (2002) integrate structural change into Thirlwall's Law by introducing hysteresis in the parameters that determine the economy's long-term growth rate. In this scenario, the ratio of the income elasticities of demand for exports and imports is specified as a nonlinear function of past growth rates. Palley (2003) suggests that the income elasticity of import demand is a negative function of excess capacity. The rationale behind this approach is that imports are related to economic "bottlenecks". As excess capacity and unemployment decrease, these bottlenecks become more significant, thereby increasing the share of imports in income growth. Botta (2009) argues that, in developing countries, the income elasticities of export (import) demand are a positive (negative) function of the share of manufacturing in domestic output.

It is also acknowledged that the income elasticities of import and export demand are endogenous to the RER level (Barbosa-Filho, 2006; Missio and Jayme Jr., 2012; Ferrari et al., 2013; Oreiro et al., 2015; Missio et al., 2017).

According to Missio and Jayme Jr. (2012), the starting point is to observe that there are other mechanisms (not explored by the literature) through which the RER level influences productivity

[2] Structural change is understood as the reorganization of the productive structure, reflected in a country's trade specialization pattern.

[3] In summary, it is assumed that changes in the productive structure, which reflect modifications in elasticities, alter the external constraints and, therefore, that policies that promote such structural changes have effects on growth.

and the productive structure of the economy, thereby altering the pattern of specialization and competitiveness.

These "new" mechanisms are associated with the possibility that maintaining a competitive RER[4] can establish incentives for, for example, technological progress. More specifically, currency depreciation – increasing firms' profits and their capacity for self-financing – affects the funds that are available to these firms to undertake investment projects related to research and innovation.[5]

RER appreciation promotes a redistribution of income from profits to wages, which implies a reduction in firms' ability to self-finance. This leads to decreased availability of internal funds for acquiring new technologies. Additionally, firms face increased difficulties in accessing external financing due to information asymmetries in financial markets, resulting in credit rationing. Consequently, even with the potential to acquire inexpensive technology from abroad, various productive sectors may remain unable to invest in modernizing their productive capacity.

On the other hand, with a competitive RER, it is expected that firms will undertake innovative activities, leading to greater productive heterogeneity (for example, a larger variety of goods produced) and structural homogenization, as technological progress is now attained by sectors not traditionally linked to external markets. In the more backward sectors, where the returns on innovative activities are higher, it is expected that discontinuities will be swiftly overcome.[6]

An increase in productive heterogeneity, especially in tradable sectors, underscores the Kaldorian insights from "Verdoorn's Law", which highlights a positive link between industrial output growth and productivity. This growth leads to transformative changes in productive structures and demand composition, which, in turn, promote new processes and product innovations in the industrial sector. Such growth supports the expansion of business operations and the adoption of modern technology, enhancing productivity. This shift not only drives internal sectoral innovation but also lays the groundwork for increased external economic interactions.

Additionally, a competitive RER boosts external demand, fostering output growth and cumulative productivity gains, particularly through dynamic economies of scale, where technological changes become irreversible. This cycle of growth and increasing returns accelerates productivity and technological advancement, enhancing competitiveness in external markets through mechanisms such as learning by doing, using, interacting, and exporting.[7]

In short, sustaining a competitive RER fosters greater productive heterogeneity, advances technological progress, enhances the capacity to finance investments, and increases overall labour productivity. This ensures, over time, a higher income elasticity of demand for exports. Similarly, the income elasticity of demand for imports decreases as domestic manufacturing diversifies and

[4] Discussing a competitive RER requires considering its level. Achieving a competitive rate requires implementing policies over a certain period that lead to a significant and sustained devaluation. The impact of the RER on the productive structure is partly due to this change in its level. Therefore, the terms competitive RER, RER devaluation, and RER undervaluation are often used interchangeably.

[5] The empirical literature shows that the main determinants of R&D spending and physical capital investment are cash flow and sales volume (Hall, 1992; Himmelberg and Petersen, 1994; Bond et al., 1999). These are two variables that are positively affected by depreciations in the RER level. See also Dao et al. (2021).

[6] It is implicitly assumed that technology is one of the essential elements in long-term growth, as improvements in production techniques lead to increases in productivity and an acceleration of the growth rate, allowing for the incorporation of excess labour and a reduction in structural heterogeneity. Moreover, it is acknowledged that structural change can be promoted by the very accumulation of capital, which leads to a reduction in the technological gap, as new technologies are typically embodied in new machinery and equipment (Fagerberg, 1994). Thus, since both capital accumulation and technological innovation are influenced by the level of the RER, it is evident that the RER also has effects on growth from the supply side of the economy.

[7] The increase in productive heterogeneity in a "dual" economy *à la* Lewis allows for an increase in labour productivity through the reallocation of labour from lagging nontradable sectors to advanced tradable sectors.

the technology incorporated in these products advances. Therefore, a depreciated RER enhances productive diversity and the technological sophistication of domestic goods, reducing reliance on imports and subsequently lowering the income elasticity of demand for imports.

2. RER, structural change, and the endogenous income elasticities

The main argument in support of the hypothesis of endogenous income elasticities of foreign trade, relative to the RER level, is that the exchange rate can induce structural change and, consequently, modify a region's or country's economic structure, thereby improving its performance in international trade in a sustained manner over time (Missio and Jayme Jr., 2012; Bresser-Pereira et al., 2015; Marconi et al., 2021).

Thus, to clarify these points, it is assumed that structural change occurs because the RER level influences the productive structure in three dimensions:

i) the share of each sector/product in total imports and exports (composition effect);
ii) the number of sectors (products) existing (produced) in the economy (specialization effect); and
iii) the attractiveness of products and/or the intensity of technological progress embodied in the products (sophistication effect).

The key question now is to identify the mechanisms through which the RER can generate composition, specialization, and sophistication effects (which are not necessarily independent of one another). In general, these mechanisms can be identified as follows:

a) *Composition effect*: the RER is a crucial tool for promoting growth through temporary, yet sufficiently prolonged, changes in the relative prices of tradable and nontradable goods. Sustaining a stable and competitive RER can realign the productive structure towards technologically advanced tradable goods, enabling short-term impacts on aggregate demand from international trade to facilitate long-term economic growth. The facilitation of access to international markets stimulates production in export sectors, generating positive dynamic externalities across the economy, such as learning from competition in external markets and attracting foreign direct investment. This enhances the productivity and competitiveness of domestic products. For developing countries that have progressed in their industrialization, maintaining a competitive RER particularly benefits the industrial sector by facilitating the acceptance of the Kaldorian implications of Verdoorn's Law, which links industrial output growth to productivity growth. As industrial production expands, new processes are adopted, new businesses emerge, and existing firms grow, enabling the adoption of modern equipment and thus increasing overall economic productivity. Some studies in the literature that address these links are Barbosa-Filho (2006), Cimoli et al. (2013), Ferrari et al. (2013), Missio et al. (2017), Libman et al. (2019) and Palazzo (2024a, 2024b).
b) *Diversification effect*: this refers to the changes produced by RER on the variety of goods (sectors) that make up the export and import baskets. From the perspective of exports, the argument has two main points. i) A competitive RER encourages export-oriented investments by facilitating domestic firms' access to external markets. This suggests that economic development is shaped by the investment rate, which is, in turn, influenced by the exchange rate, especially concerning export-driven investments. These investments result in diversification of production. ii) Given that technological progress largely stems from capital accumulation – where new technologies are typically embedded in new machinery and

equipment – it is reasonable to expect the addition of new products to the export basket (Missio and Jayme Jr., 2012; Oreiro et al., 2015). Furthermore, a variant of this effect can be observed in how the RER influences the functional distribution of income. Specifically, changes in income distribution, which are impacted by variations in the RER, affect the productive structure, ultimately determining the degree of specialization in production (Dosi et al., 1990; Missio and Jayme Jr., 2012). Regarding imports, the competitive RER reduces the variety of imported goods, concentrating imports on essential goods necessary for the functioning of the economy. As the level of economic development increases, the reliance on these goods diminishes, as domestic production begins to meet local market demand.

c) *Sophistication effect*: the RER can substantially impact technological progress embedded in products. Specifically, currency devaluation boosts corporate profits and enhances firms' capacity for self-financing, thereby increasing available funds for investment in research and innovation projects. This leads to a greater availability of internal funds for acquiring new technologies, and it reduces firms' reliance on external financing, particularly since credit markets often face rationing due to information asymmetries. Consequently, under a competitive exchange rate, companies are more likely to engage in innovative activities that incorporate higher levels of technology into their products, enhancing their quality and appeal in international markets.[8] See Missio and Jayme Jr. (2012), Caglayan and Demir (2019) and Marconi et al. (2020).

Identifying these mechanisms is crucial; however, that alone does not clearly demonstrate their effects on income elasticities. To progress in this area, applying sectoral models can be an effective approach. To illustrate this, we note that the aggregate income elasticities of exports can be viewed as a weighted average of sectoral elasticities. Formally, this can be expressed as:

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

where ε is the aggregate income elasticity, ω_{Xi} represents the share of sector i in the export basket, ε_i is the income elasticity of sector i, and k is the number of products/sectors exported.

This weighted formula captures the influence of sectoral elasticities on the aggregate elasticity, reflecting the different contributions of each sector. Equation (1) formalizes the idea that a country's export profile is composed of k goods, each with a specific income elasticity ε_i, whose contribution to the determination of ε depends on its share in that profile, ω_{Xi}.

By using equation (1) and simplifying it under the assumption that the effects are independent, we can demonstrate the effect of the RER on the aggregate elasticity of the exports by considering each of the three main effects discussed above.

i) Considering the composition effect, we have:

$$\varepsilon(\theta) = \sum_{i=1}^{k} \omega_{Xi}(\theta).\, \varepsilon_i \qquad (1.1)$$

[8] The increase in R&D activities (sophistication effect), combined with the emergence of new business units (composition effect), leads to the introduction of new products, reinforcing the specialization effect. Furthermore, it is important to emphasize that the sectoral sophistication effect has implications for other sectors of the productive structure, as structural homogenization is expected, since technological progress is now also incorporated in sectors that are not linked to the external market. Given that the returns on innovative activities are higher in the lagging sectors, it is expected that the discontinuities will be quickly overcome.

where θ is the RER level. A competitive RER promotes a change in the productive structure in favour of high-tech tradable goods, which have a higher income elasticity of demand. It is important to note that, while the values of the elasticities remain unchanged, the share of the sectors associated with higher elasticities does change. This implies that the aggregate value of ε will increase.

ii) Considering the diversification effect, we argue that modifications in the long-term RER level impact the quantity of goods (sectors) that make up the export import profile. In formal terms, k is a function of the RER level.

$$\varepsilon(\theta) = \sum_{i=1}^{k(\theta)} \omega_{Xi}.\varepsilon_i \tag{1.2}$$

iii) In the case of the sophistication effect, since there is a change in the degree of technology incorporated into the products, the income elasticity associated with each product changes:

$$\varepsilon(\theta) = \sum_{i=1}^{k} \omega_{Xi}.\varepsilon_i\,(\theta) \tag{1.3}$$

It is assumed that the first two effects influence the aggregate elasticity of imports in opposite directions. Specifically, a competitive RER tends to decrease the share of goods with a higher degree of technological intensity in the import portfolio and to reduce the number of imported products. The sophistication effect does not apply.

3. Endogeneity in the multisectoral model

This section aims to present a formal argument that integrates the key issues discussed. Specifically, the proposed formalization seeks to account for the effects of variations in the RER on the productive structure (structural change) in the three dimensions outlined in the previous section, while also considering the hypothesis of the endogeneity of elasticities.

In formal terms, this implies adopting a modified version of Thirlwall's multisectoral law, that is:

$$y_d = \left(\sum_{i=1}^{k(\theta)} \rho_i(\theta)\varepsilon_i(\theta)\right) / \left(\sum_{i=1}^{n(\theta)} \varphi_i(\theta)\pi_i\right) y_E \tag{2}$$

where y_d is the domestic income; y_E is the external income, ρ_i (φ_i) represents the share of sector i in exports (imports), ε_i (π_i) is the income elasticity of demand for exports (imports), k (n) is the number of sectors/products that make up the exports (imports), and θ is the RER level.

Equation (2) specifically incorporates the idea that structural change is endogenous to the RER.[9] Even if the number of sectors remains constant and the elasticities do not change, variations in the RER can still affect the participation of each sector in the productive structure and, consequently, can influence the growth rate (composition effect). Additionally, equation (2)

[9] Equation (2) supports the findings of the multisectoral model discussed by Araújo and Lima (2007), indicating that, even when elasticities remain constant, structural changes can impact the overall growth rate. These changes often result from shifts in demand composition – due not to changes in elasticities but rather to the varying participation of each sector in aggregate exports or imports – driven by evolving tastes or preferences, as suggested by Engel's law. Additionally, it aligns with the results of Missio et al. (2017), demonstrating how RERs affect technological progress through the mechanism of cumulative causation, known as the sophistication effect.

incorporates the idea that the RER can influence the number of sectors in the economy (diversification effect), particularly those linked to the international market (where sophistication effect is most prominent).

From equation (2), we can demonstrate that (see appendix):

$$dy_d/d\theta = \left[\left(\sum_{i=1}^{k(\theta)}\left(\rho_i'(\theta)\varepsilon_i(\theta) + \rho_i(\theta)\varepsilon_i'(\theta)\right)\right)\left(\sum_{i=1}^{n(\theta)}\varphi_i(\theta)\pi_i\right) - \left(\sum_{i=1}^{k(\theta)}\rho_i(\theta)\varepsilon_i(\theta)\right)\left(\sum_{i=1}^{n(\theta)}\varphi_i'(\theta)\pi_i\right)\right] / \left[\left(\sum_{i=1}^{n(\theta)}\varphi_i(\theta)\pi_i\right)^2\right] y_E \quad (3)$$

To advance the analysis of the sign of this derivative, we note that:

i) $\frac{d\,k}{d\,\theta} > 0$ – Currency devaluations increase the number of export sectors connected to international trade. According to Bresser-Pereira (2012), the RER acts as a kind of switch that either "turns on" or "turns off" firms that are technologically and administratively competent in relation to global demand.

ii) $\frac{d\,n}{d\,\theta} < 0$ – A competitive RER tends to decrease the diversity of imported products and the involvement of foreign sectors in the national economy. This happens for two main reasons: first, it enables the domestic economy to focus on producing goods with higher technological intensity (the sophistication effect); second, the price effect redirects demand towards imports. As a result, domestically manufactured goods progressively cater to the demand for technologically advanced products, whereas imports become concentrated on less technologically intensive, more cost-effective goods.

iii) $\frac{d\,k}{d\,\theta} > \frac{d\,n}{d\,\theta}$ – Tastes, preferences and habits, along with investments in advertising, marketing, and the establishment of distribution channels, create a certain rigidity in the declining demand for imported goods. As a result, the presence of international sectors in the domestic economy contracts more slowly than the expansion of domestic firms into international markets.

Additionally, we can consider that $\rho_i(\theta)$, $\varepsilon_i(\theta)$, and $\varphi_i(\theta)$ are linear in θ, that is:

i) $\rho_i(\theta) = a_i(\theta) + b_i$ (4)

ii) $\varphi_i(\theta) = -e_i(\theta) + f_i$ (5)

iii) $\varepsilon_i(\theta) = c_i(\theta) + d_i$ (6)

Equation (4) illustrates the "composition effect" on exports. A competitive RER fosters exports, investment, and industrialization, thus enhancing the participation of more technology-intensive sectors. These sectors tend to exhibit higher income elasticities. The constant term (b_i)

reflects the notion that not all sectors are sensitive to exchange rate fluctuations, with this being particularly the case for sectors for which the country holds a strong comparative advantage.

Equation (5) captures the composition effect on imports. The premise is that a competitive exchange rate diminishes the share of technology-intensive imported goods, as these tend to rise in cost. Nevertheless, the constant term reflects the notion that not all products are substitutable, rendering this effect insignificant for certain sectors.

Equation (6) illustrates the "sophistication effect" on exports. The currency devaluation increases firms' profits, leading them to invest more in technology, thereby raising the technological intensity of export products. This, in turn, enhances the income elasticities of these products. The constant term reflects the fact that not all sectors benefit from this technological progress; for some sectors, elasticity remains unchanged.

Under these conditions, it can be demonstrated that the derivative of y_d with respect to θ is positive.

4. Issues and challenges

4.1. Speed and time

The model is limited by the assumption that income elasticities are uniformly responsive to changes in the RER level across all sectors. However, we do not expect uniformity in sectoral elasticities. Each productive and technological setup will determine a unique set of elasticities. For instance, the impact of the RER on income elasticity of exports for products like bananas is likely minimal. While some sectors may show significant effects of the RER on their income elasticities, others may exhibit little to no impact.

It is expected that the greatest variations in income elasticities will occur in technology-intensive sectors competing internationally through dynamic competitive advantages. Conversely, these changes (in elasticities) should be reduced for sectors/products whose competitiveness is based on natural comparative advantages. Therefore, when the RER level is maintained at a stable and competitive level for a sufficient period, it is expected that the income elasticities of exports (imports) will increase (decrease), although it is likely that for some sectors this modification will be significant while for others it will not.

The development of sectors and technological progress, influenced by financial institutional arrangements, varies across countries, leading to sector-specific responses in income elasticity to shifts in the RER. The pace and effectiveness of these elasticity changes are dependent on how the RER level impacts the evolution of the productive structure and technological advancement.

The second point is whether a more competitive RER genuinely alters the elasticities of individual products, or if it instead leads to structural change, such as increasing the weights of industries or goods with higher income elasticities of export demand. In other words, does the RER change the elasticities at the industry level, the weights across different industries, or both? The answer requires a recognition that the RER level influences trade elasticities through the three main channels previously discussed. Therefore, it is expected that the RER affects elasticities both by its direct impact on each of them and by its effects on the productive structure.

The time required for changes in elasticities is an empirical question (Eichengreen, 2007). However, it is reasonable to assume a 'division of labour' among the different channels. In the short term, the effects of RER variations on output are mainly driven by the effective demand channel. A more competitive RER, by boosting exports, is expected to increase aggregate demand

and domestic production through a multiplier effect. This should initiate the composition effect in the export/import pattern. In contrast, over the medium to long term, the income redistribution and technological progress channels become dominant (Missio and Jayme Jr., 2012). This shift leads to structural changes, which, in turn, influence the long-term growth rate. The diversification and sophistication effects become more pronounced.

Moreover, it is likely that these effects vary across countries because of differences in their productive structures. There are also empirical reasons to assume that this effect begins in the short to medium term. One specific way to justify this is by noting that, according to the part of the literature on the determinants of technological progress, cash flow and sales volume, lagged by one period, are the primary determinants of investment in research and development. These variables are directly influenced by the RER level. Additionally, it is important to consider that these investments have several characteristics – such as path dependence and cumulative effects – that characterize the process of technological evolution. Consequently, in the short to medium term, variations in the RER are likely to stimulate investment and induce changes in the income elasticities of foreign trade.

4.2. Empirical test

The empirical testing of elasticity endogeneity is still quite limited. I understand that the tests should encompass the three mechanisms discussed earlier. Nonetheless, the majority of existing studies concentrates on analysing the ratio between the income elasticities of exports and imports. This approach, however, falls short in providing clear insights into the specific transmission channels. We also acknowledge several limitations in our ability to test these relationships empirically, including methodological constraints, data availability, and challenges in isolating the effects of individual variables.

To address this issue, my primary suggestion is to explore the varied responses of individual products or sectors to changes in the RER level. In a straightforward manner, at the product or sector level, it is possible to analyse – through a counterfactual analysis comparing before and after a devaluation, for example – whether the RER has altered: i) the basket of imported/exported products; ii) the participation of sectors that remained active in international trade; and iii) the degree of technological progress incorporated into these products. To the best of my knowledge, current data limitations make the execution of this latter exercise more challenging.

For instance, Palazzo and Rapetti (2023) conducted a study using trade data from Argentina, applying the Mean Group Method to estimate macro trade elasticities at a detailed four-digit product level. Their findings highlight a wide range of responses by exports and imports to RER movements at the individual product level.

Considering these complexities, our strategy is constrained to indirect testing. That is, we conceptualize the effects of the RER on income elasticities as structural changes that occur in the anticipated direction. For example, Gabriel and Missio (2018) demonstrate how the RER affects various economic sectors and the economic complexity index. Their goal was to assess whether exchange rate fluctuations could drive pro-growth structural changes in the economy. Using panel data from 118 countries over the period 1990 to 2011, their estimations support this notion. Iasco-Perreira and Missio (2022) examine the relationship between exchange rate movements and structural change in Latin American countries from 1975 to 2017. The model includes an RER misalignment variable to directly assess the impact of exchange rate fluctuations on the structural composition of these economies.

Empirical validation could draw from additional works like Palazzo (2024b, 2024c). In the first study, the author analyses the development of export sectors in Argentina for the period 2003-2008, following the 2002 crisis and subsequent large devaluation. The period is shown to have the highest number of export surge episodes between 1980 and 2015. Additionally, the author finds that: (i) the probability of export surge episodes increased by 2.5% for each standard deviation of higher labour intensity during the period of significant and sustained devaluation, as nontradable costs dominated these sectors' production functions; (ii) export surges were more likely in sectors related to already competitive industries, particularly upstream sectors; and (iii) the new export volumes in these sectors exhibited persistent dynamics even after the period of currency competitiveness ended, indicating trade hysteresis.

5. Political economy of a competitive RER

There are others significant challenges in the strategy of maintaining a competitive RER. Although these challenges may not be directly linked to the concept of structural change presented here, I believe it is important to acknowledge them.

The political economy of a competitive RER reveals significant distributional effects that vary across production sectors, social classes, income groups, and regions. Maintaining a competitive RER, commonly used to enhance export competitiveness and stimulate economic growth, has heterogeneous impacts on different segments of the economy, underlining its complex and contested nature.

A competitive RER influences profitability in domestic currency differently across production sectors. Export-oriented industries typically benefit from enhanced price competitiveness in global markets, while sectors dependent on imported inputs may face increased costs, reducing their profitability. This divergence highlights the uneven distribution of benefits across the productive structure.

This heterogeneity is further amplified by the geographic concentration of production, leading to unequal regional impacts. For example, highly industrialized regions with a greater presence of export-oriented sectors tend to benefit more from a competitive RER, while areas reliant on sectors less integrated into foreign trade may face relative disadvantages. These differences provide insight into distinct regional development trajectories, highlighting the political and economic forces that can either reinforce or hinder a national growth strategy.

Similarly, a competitive RER impacts consumption patterns differently across income groups. Lower-income households, which tend to spend a larger share of their income on imported goods, may experience increased living costs due to higher import prices. In contrast, higher-income groups, often more involved in export-oriented activities or asset holdings, may disproportionately benefit from such policies. These effects can exacerbate existing inequalities and shape preferences regarding exchange rate management.

Additionally, as Lima and Porcile (2013) highlight, preferences regarding the RER vary not only between social classes but also within them. For example, workers in export-driven industries may support a competitive RER to protect jobs, while those in nontradable sectors might oppose it due to rising import costs.

These heterogeneous preferences give rise to distributive conflicts that influence government exchange rate policies. Policymakers must navigate these tensions to build a consensus or, at the very least, a coalition capable of sustaining a competitive RER. This challenge is compounded by the trade-offs involved, which can alienate certain groups.

The achievement and maintenance of a competitive RER requires substantial political support, which cannot be taken for granted. Policymakers must address the distributive conflicts inherent in such a policy by implementing compensatory mechanisms or fostering dialogue among stakeholders. For instance, targeted subsidies or social programs can help mitigate the adverse effects on lower-income households or import-dependent sectors, thus broadening the support base.

Ultimately, the long-term viability of a competitive RER is not solely an economic issue but also a political one. Its sustainability depends on creating a governance framework that balances competing interests, reduces inequalities, and fosters social cohesion. Without such a framework, efforts to maintain a competitive RER may face political resistance, undermining its potential contributions to economic development. Relevant references about this topic include Rapetti (2013), Gerchunoff and Rapetti (2016), Ugurlu and Razmi (2023), and Razmi (2022), among others.

6. Final remarks

There exists a robust theoretical framework suggesting that maintaining a competitive RER is an effective mechanism for fostering structural change and economic growth, particularly in developing countries that exhibit some sophistication in their productive structures. Nevertheless, due to the complex interplay of factors, sustaining the RER at such levels presents significant challenges, such as the potential increase in prices (Iasco-Pereira and Missio, 2024). Consequently, the literature advocating for this policy often recommends a comprehensive set of measures, wherein monetary, fiscal, and, notably, regulatory policies play pivotal roles in realizing these objectives.

Obviously, there are certain critical interpretations concerning this literature, particularly as it does not fully acknowledge the potential negative effects on the functional distribution of income, which can, according to these interpretations, not only hinder economic growth but also lead to structural changes in the "wrong direction", such as an increase in imports (Ribeiro et al., 2020; Cicero and Lima, 2023). Maintaining a competitive RER may require temporary wage suppression, especially when prices are rising. This can potentially harm growth in wage-led economies.

Nonetheless, an increased profit share is not invariably reliant on compressing domestic wages; it may result from enhanced capture of international profit shares by domestic sectors. In other words, from a Kaleckian perspective, maintaining a competitive RER may be linked to a heightened concentration of functional income distribution – where profit shares increase more than wages, presenting a fractional problem. Nevertheless, worker welfare (measured in terms of income) can improve. This improvement occurs because the total wage bill, in relative terms, may rise either through increased employment driven by new production activities (see Frenkel and Ros, 2006) or by a rise in the average real wage because of a strong labour market.

At this specific point, we recognize a significant limitation in the literature on BPCG and the Kaleckian approach growth models regarding the correct variable to measure worker welfare: Is it the number of jobs? Real wages? The total wage bill? Or the share of wages in income? In the perspective adopted in this work, there are good reasons to expect an increase in both the number of jobs and the total wage bill.

Competitive gains do not necessarily rely on compressing real wages. While such compression may occur in the short term, it warrants further investigation. Which worker classes truly

experience a decrease in real wages due to the depreciation of the RER? Is this effect substantial? Does the income distribution within wage groups diminish or increase? What is its impact on economic growth? Could the pressure from a more robust labour market over time offset the potential inflationary effects of a depreciated RER on real wages? Are incentives for reallocating labour towards more productive sectors being considered? We understand that the effects of the RER on income distribution should be studied alongside its effects on labour and capital productivity.

In summary, the above questions remain open, and research that advances in this direction can significantly contribute to the debate.

Appendix

Let the expression for y_d be:

$$y_d = \left(\sum_{i=1}^{k(\theta)} \rho_i(\theta)\varepsilon_i(\theta)\right) / \left(\sum_{i=1}^{n(\theta)} \varphi_i(\theta)\pi_i\right) y_E$$

We want to differentiate y_d with respect to θ. The derivative is:

$$dy_d/d\theta = \left[\left(N'(\theta)D(\theta) - N(\theta)D'(\theta)\right)/\left(D(\theta)\right)^2\right] y_E$$

where

$$N(\theta) = \sum_{i=1}^{k(\theta)} \rho_i(\theta)\varepsilon_i(\theta)$$

$$D(\theta) = \sum_{i=1}^{n(\theta)} \varphi_i(\theta)\pi_i$$

The derivatives are:

$$N'(\theta) = \sum_{i=1}^{k(\theta)}\left(\rho_i'(\theta)\varepsilon_i(\theta) + \rho_i(\theta)\varepsilon_i'(\theta)\right)$$

$$D'(\theta) = \sum_{i=1}^{n(\theta)} \varphi_i'(\theta)\pi_i$$

Therefore, the complete expression for the derivative is:

$$dy_d/d\theta = \left[\left(\sum_{i=1}^{k(\theta)}\left(\rho_i'(\theta)\varepsilon_i(\theta) + \rho_i(\theta)\varepsilon_i'(\theta)\right)\right)\left(\sum_{i=1}^{n(\theta)} \varphi_i(\theta)\pi_i\right) -$$

$$\left(\sum_{i=1}^{k(\theta)} \rho_i(\theta)\varepsilon_i(\theta)\right)\left(\sum_{i=1}^{n(\theta)} \varphi_i'(\theta)\pi_i\right)\Bigg] / \left[\left(\sum_{i=1}^{n(\theta)} \varphi_i(\theta)\pi_i\right)^2\right] y_E$$

From the initial conditions:

i) $\rho_i(\theta) = a_i(\theta) + b_i > 0$; $\rho_i'(\theta) = a_i(\theta) > 0$

ii) $\varphi_i(\theta) = -e_i(\theta) + f_i > 0$; $\varphi_i'(\theta) = -e_i(\theta) < 0$;

iii) $\varepsilon_i(\theta) = c_i(\theta) + d_i > 0$;

iv) $|\sum_{i=1}^{n(\theta)} \varphi_i(\theta)\pi_i| > 0$;

v) $\frac{d\,k}{d\,\theta} > 0$, $\frac{d\,n}{d\,\theta} < 0$ and $\frac{d\,k}{d\,\theta} > \frac{d\,n}{d\,\theta}$

It is possible to show that $dy_d/d\theta > 0$.

References

Araújo R.A. and Lima G.T. (2007), "A structural economic dynamics approach to balance of-payments-constrained growth", *Cambridge Journal of Economics*, 31(5), pp. 755-774.

Barbosa-Filho N. (2006), "Exchange rates, growth and inflation", paper presented at the *Annual Conference on Development and Change, Campos do Jordão*, Brazil, November.

Bond S., Harhoff D. and Van Reenen J. (1999), "Investment, R&D and financial constraints in Britain and Germany", *The Institute for Fiscal Studies Working Paper Series*, no. W99/5, London: The Institute for Fiscal Studies. Available online.

Botta A. (2009), "A structuralist north-south model on structural change, economic growth and catching-up", *Structural Change and Economic Dynamics*, 20, pp. 61-73.

Blecker, R. (2016), "The debate over 'Thirlwall's law': balance-of-payments-constrained growth reconsidered", *European Journal of Economics and Economic Policies: Intervention*, 13(3), pp. 275-290.

Bresser-Pereira L.C. (2012), "The exchange rate at the center of development economics", *Estudos avançados*, 26(75), pp. 7-28. Available online.

Bresser-Pereira L.C., Oreiro J.L. and Marconi N. (2015), *Developmental Macroeconomics: New Developmentalism as a Growth Strategy*, Abingdon (UK): Routledge.

Caglayan M. and Demir F. (2019), "Exchange Rate Movements, Export Sophistication and Direction of Trade: The Development Channel and North–south Trade Flows", *Cambridge Journal of Economics*, 43(6), pp. 1623-1652.

Cicero V.C. and Lima G.T. (2023), "Functional distribution of income as a determinant of importing behavior: An empirical analysis", *Structural Change and Economic Dynamics*, 65, pp. 393-405.

Cimoli M., Fleitas S. and Porcile G. (2013), "Technological intensity of the export structure and the real exchange rate", *Economics of innovation and new technology*, 22(4), pp. 353-372.

Dao M.C., Minoiu C. and Ostry J.D. (2021), "Corporate investment and the real exchange rate", *Journal of International Economics*, 131, art. 103437.

Demir F. and Razmi A. (2022), "The real exchange rate and development theory, evidence, issues and challenges", *Journal of Economic Surveys*, 36(2), pp. 386-428.

Dosi G., Pavitt K. and Soete L. (1990), *The economics of technological change and international trade*, Brighton: Wheatsheaf.

Eichengreen B. (2007), "The real exchange rate and economic growth", *Social and Economic Studies*, 56(4), pp. 7-20.

Fagerberg J. (1994), "Technology and international differences in growth rates", *Journal of Economic Literature*, 32, pp. 1147-1175.

Ferrari M.A.R., Freitas F.N.P. and Barbosa-Filho N.H. (2013), "Real exchange rate and external constraint", *Brazilian Journal of Political Economy*, 33(1), pp. 60-81.

Frenkel R. and Ros J. (2006), "Unemployment and the real exchange rate in La/n America", *World Development*, 34(4), pp. 631-646.
Gabriel L.F. and Missio F.J. (2018), "Real exchange rate and economic complexity in a North-South structuralist BoPG model", *PSL Quarterly Review*, 71(287), pp. 441-466. Available online.
Gerchunoff P. and Rapetti M. (2016), "La economía argentina y su conflito distributivo estructural (1930–2015)", *El Trimestre Económico*, 83(330), pp. 225-272.
Hall B.H. (1992), "Investment and research and development at the firm level: Does the source of financing matter?", *NBER Working Paper Series*, no. 4096, June, Cambridge (MA): National Bureau of Economic Research. Available online.
Himmelberg C.P. and Petersen B.C. (1994), "R&D and internal finance: A panel study of small firms in high-tech industries", *Review of Economics*, 76, pp. 38-51.
Iasco-Pereira H.C. and Missio F.J. (2024), "Exchange rate and inflation: a neo-structuralist approach for Brazilian manufacturing sectors (2010–2019)", *Journal of Post Keynesian Economics*, 47(3), pp. 589-628.
Iasco-Pereira H.C.I. and Missio F.J. (2022), "Real exchange rate and structural change: Theory and empirical evidence", *Investigación Económica*, 81, pp. 81-107.
Kaldor N. (1970), "The case for regional policies", *Scottish Journal of Political Economy*, 17(3), pp. 337-348.
Libman E., Montecino J.A. and Razmi A. (2019), "Sustained investment surges", *Oxford Economic Papers*, 71(4), pp. 1071–1095.
Lima G.T. and Porcile G. (2013), "Economic Growth and Income Distribution with Heterogeneous Preferences on the Real Exchange Rate", *Journal of Post Keynesian Economics*, 35, pp. 651-674.
Marconi N., Magacho G.R., Machado J.G. and Leão R.A.R. (2020), "Profit margins, exchange rates and structural change: empirical evidences for the period 1996-2017", *Brazilian Journal of Political Economy*, 40(2), pp. 285-309. Available online.
Marconi N., Araujo E., Brancher M.C. and Porto T.C. (2021), "The relationship between exchange rate and structural change: an approach based on income elasticities of trade", *Cambridge Journal of Economics*, 45(6), pp. 1297-1318.
McCombie J.S.L. and Roberts M. (2002), "The role of the balance of payments in economic growth", in Setterfield M. (ed.), *The economics of demand-led growth*. *Challenging the supply-side vision of the long run* (pp. 87-114), Cheltenham: Edward Elgar.
Missio F., Araújo R.A. and Jayme F.G. (2017), "Endogenous elasticities and the impact of the real exchange rate on structural economic dynamics", *Structural Change and Economic Dynamics*, 42, pp. 67-75.
Missio F.J. and Jayme Jr. F.G. (2012), "Structural heterogeneity and endogeneity of elasticities on the balance of payments constrained growth model", in Soukiazis E. and Cerqueira P.A. (eds.), *Models of balance of payments constrained growth* (pp. 239-267), London: Palgrave Macmillan.
Myrdal G. (1957): *Economic theory and underdeveloped regions*, London: Duckworth.
Oreiro J.L., Missio F.J. and Jayme Jr. F.G. (2015), "Capital accumulation, structural change and real exchange rate in a Keynesian-structuralist growth model", *Panoeconomicus*, 62, pp. 237-256.
Ottonello P., Perez D.J. and Witheridge W. (2024), "The Exchange Rate as an Industrial Policy", *NBER Working Paper*, no. w32522, Cambridge (MA): National Bureau of Economic Research. Available online.
Palazzo G. (2024a), "The Real Exchange Rate Role in a Resource-rich Developing Country: Heterogeneous Effects, Structural Bias and Hysteresis", *Ensayos Económicos*, 1(83), pp. 51-69.
Palazzo G. (2024b), "Real exchange rate and export surge episodes: What sectors take advantage of the real exchange rate stimulus?", *Structural Change and Economic Dynamics*, 68, pp. 446-467.
Palazzo G. (2024c), "Real exchange rate and import substitution episodes: Evidence from a developing economy", *World Development*, 184, art. 106752.
Palazzo G. and Rapetti M. (2023), "From macro to micro and macro back: Macroeconomic trade elasticities in a developing economy", *Structural Change and Economic Dynamics*, 65(C), pp. 223-252.
Palley T.I. (2003), "Pitfalls in the Theory of Growth: An application to the balance of payments constrained growth model", *Review of Political Economy*, 15(1), pp. 75-84.
Pasinetti L. (1981): *Structural change and economic growth: A theoretical essay on the dynamics of the wealth of nations*, Cambridge: Cambridge University Press.
Pasinetti L. (1993), *Structural economic dynamics: A theory of the economic consequences of human learning*, Cambridge: Cambridge University Press.
Prebisch R. (1950), The economic development of Latin America and its principal problems, NewYork: Economic Commission for Latin America, United Nations Department of Economic Affairs. Available online.
Rapetti M. (2013), "Macroeconomic policy coordination in a competitive real exchange rate strategy for development", *Journal of Globalization and Development*, 3(2), pp. 1-31.
Rapetti M. (2020), "The real exchange rate and economic growth: A survey", *Journal of Globalization and Development*, 11(2), art. 20190024.

Razmi A. (2022), "The Real Exchange Rate Policy Trilemma in Surplus-Labor Developing Economies", *Journal of Globalization and Development*, 12(2), pp. 263-290.
Razmi A., Rapetti M. and Skott P. (2012), "The real exchange rate and economic development", *Structural Change and Economic Dynamics*, 23(2), pp. 151-169.
Ribeiro R.S.M., McCombie J.S.L. and Lima G.T. (2020), "Does real exchange rate undervaluation really promote economic growth?", *Structural Change and Economic Dynamics*, 52, pp. 408-417.
Seers D. (1962), "A model of comparative rates of growth of the world economy", *The Economic Journal*, 72(285), pp. 45-78.
Thirlwall A.P. (1979), "The balance of payments constraint as an explanation of international growth rate differences", *Banca Nazionale del Lavoro Quarterly Review*, 32(128), pp. 45-53.
Thirlwall A.P. (2002), *The nature of economic growth: An alternative framework for understanding the performance of nations*, Cheltenham: Edward Elgar Publishing.
Ugurlu E.N. and Razmi A. (2023), "Political economy of real exchange rate levels", *Journal of Comparative Economics*, 51(3), pp. 918-940.