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# Patterns of growth in structuralist models: the role of the real exchange rate and industrial policy

### **Gabriel Porcile**

Economic Affairs Officer, ECLAC and UFPR

### **Danilo Spinola**

United Nations University (UNU-MERIT) and Maastricht University

### **Giuliano Yajima**

Department of Social Sciences and Economics, Sapienza University of Rome

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## PATTERNS OF GROWTH IN STRUCTURALIST MODELS: THE ROLE OF THE REAL EXCHANGE RATE AND INDUSTRIAL POLICY

Gabriel Porcile<sup>1</sup>; Danilo Spinola<sup>2</sup>; Giuliano Yajima<sup>3</sup>

This paper presents a Balance-of-payments (BOP)-constrained growth model in which the interaction between the real exchange rate (RER) policy and industrial policy result in the emergence of different patterns of growth and income distribution. The paper relies on cumulative causation à la Kaldor and path-dependency to relate both types of policies. The transition from one equilibrium level of the RER to a new equilibrium level generates a process of learning that transforms the income elasticity of exports and hence the BOP-constrained rate of growth in the long run. The model produces a variety of outcomes that help explain the contradictory results that emerge from the empirical literature on the impact of the real exchange rate on economic growth in the long run.

Keywords: Real Exchange Rate; Structural Change, Growth models, Structuralist models, BOP-constrained growth.

JEL: O33, O40, O41

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<sup>1</sup> Economic Affairs Officer, ECLAC and UFPR. [jose.porcile@cepal.org](mailto:jose.porcile@cepal.org)

<sup>2</sup> United Nations University (UNU-MERIT) and Maastricht University. [sartorello@merit.unu.edu](mailto:sartorello@merit.unu.edu)

<sup>3</sup> Department of Social Sciences and Economics, Sapienza University of Rome. [giuliano.yajima@uniroma1.it](mailto:giuliano.yajima@uniroma1.it)

# PATTERNS OF GROWTH IN STRUCTURALIST MODELS: THE ROLE OF THE REAL EXCHANGE RATE AND INDUSTRIAL POLICY

## **1. Introduction**

Structuralist models take into account the specific role that different institutional settings, power relations and economic structures play in shaping economic outcomes<sup>4</sup>. This paper presents a model in which the interactions between structures, power and institutions result in the emergence of different patterns of growth and income distribution in peripheral economies. The structural dimension is captured by the country's pattern of international specialization, expressed in the income elasticity of exports and imports. The institutional dimension is captured by what Nelson and Sampat (2001) call "social technologies" which represent (implicit or explicit) forms of coordination widely accepted by and incorporated to the behaviour of public and private socioeconomic actors. Our focus is on institutions governing technical change and the behaviour of the real exchange rate. For simplicity, we will refer to them as "industrial policy" and "exchange rate policy", although they involve complex interactions among workers, capitalists and governments.

The key mechanism that relates policies to structures is learning by doing. Under certain conditions (discussed in the paper), the depreciation of the real exchange rate (RER) stimulates economic growth and investment, leading to the accumulation of knowledge, which in turn redefines the income elasticity of exports. The model thus entails a process of "deep path-dependence" as defined by Setterfield and Cornwall (2002), in the sense that its parameters change as the economy moves towards its long-run equilibrium, after a shock produced by the depreciation of the RER.

The modelling strategy combines a Neo-Kaleckian approach to investment and income distribution with a Balance-of-Payments (BOP) constraint on growth<sup>5</sup>. We assume a centre-periphery system, in which the centre is the technological leader and the periphery is specialized in sectors with lower income-elasticity of exports than the centre. The challenge of the periphery is to transform its pattern of specialization using the exchange rate and industrial policies. The paper presents three scenarios for the periphery that we consider representative of different combinations of these policies, which in turn reflect different power relations among three actors (the government, capitalists and workers). Each scenario is a stylized representation of growth patterns effectively observed in different countries or even in the same country at different points in time.

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<sup>4</sup> See Taylor (2004, p.3).

<sup>5</sup> The combination of Kaleckian and Thirlwallian features can be found in Dutt (1992). This model is an inspiration, but our model proposes rather different closure equations.

The first scenario is the “developmentalist state” (presented in section 3) in which the government aims at a competitive exchange rate while implementing a strong industrial policy to foster learning and structural change. The policy focus is on international competitiveness, and there is in power an “industrialist coalition” whose objective is to maximize the investment rate and close the technology gap with the technological leaders.

The second is the “heterogeneous preferences” scenario (section 4) in which there are contending forces over the RER which reflect the different objectives of governments, capitalists and workers. The RER endogenously responds to political conflict among domestic actors, probably in association with the alternation of power between centre-right and centre-left political coalitions in democracy. Various potential outcomes from this scenario are considered, and their implications for growth and distribution analysed.

The last scenario (section 5) is called “financialization”. The RER fluctuates out of the interaction between a government that uses monetary policy to control inflation, and international capital flows that arbitrate between the rates of return of assets denominated in different currencies. This scenario corresponds to a model in which there is a “neoliberal coalition” in power that focuses solely on curbing inflation while keeping the capital account fully open. The openness of the capital account implies that capitalists and workers have little direct influence over the RER, which is driven by shocks in the international financial markets.

Two caveats are necessary. First, in all cases we assume that technical change affects both productivity growth (and hence price competitiveness) and the pattern of specialization (reflected in the income elasticity of exports). Both effects are contemplated, but the main focus is on changes in the income elasticity of exports. Second, the institutional and political conditions are considered given in the model, which allows us to concentrate on the macroeconomic outcomes of each scenario.

## **2. Review of the literature on RER and Growth**

### *Review of the empirical literature*

The role of the exchange rate and industrial policies is at the core of the current debate on growth, structural change and income distribution in developing economies. This is so because of its role in the determination of prices and ultimately incomes levels, much like others nominal variables such as the wage and profit rates. In fact, the RER can count as both a cost for some agents – such as firms, who for instance might see their earnings reduced following a fall in the RER - and a component of revenue flows for others<sup>6</sup> - such as households, who on the contrary might experience an increase in their purchasing power. Although this

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<sup>6</sup> For a recent review of ongoing debate on this topic see Medeiros (2020).

debate is far from new, it was revived after Rodrik (2008), who pointed out the existence of RER level effects fostering the expansion of the tradable sector in developing economies. According to his study, a depreciated RER stimulates changes in the composition of output towards activities which are more dynamic from a technological standpoint, changing relative prices in their favour. This change in output composition would trigger a second mechanism, a sustained change in the level of output (that is, long run growth) as the economy as a whole would experience increasing returns to scale.

This two-step mechanism (Rodrik, 2008) has been supported by a number of empirical studies. Razmi et al. (2012), Rapetti et al (2012) and Ibarra & Blecker (2016) have provided evidences of a positive effect of a depreciated RER on output growth. Currency devaluation generates incentives for entrepreneurs in the tradable sector to invest via increased revenues and profit margins, thus increasing capital accumulation. Conversely, a persistent overvaluation of the RER would go in detriment of growth duration, as argued by Berg et al. (2012). Moreover, Gabriel et al. (2020) have argued that undervaluation works better for higher level of technological gap, as firms would compensate for their non-price competitiveness. Eichengreen (2007) and Frenkel & Ros (2006) reinforce this story by finding a positive association between a higher RER and a higher rate of employment growth, as a consequence of the boost in capital accumulation.

Additionally, the empirical literature focusing on the effect of a depreciated RER on structural change has provided some evidence of the positive causality pointed out by Rodrick. However, authors diverge on how to measure and conceptualize structural change. Mcmillan et al. (2014) see structural change as the “structural” component of increases in labour productivity, caused by labour reallocation toward more productive sectors. Freund & Pierola (2012) focus on the diversification of exported items and on the increase of the extensive margin, while Cimoli et al. (2013) stress the technological intensity of exports. Marconi et al (2016) suggest a positive effect of depreciation on the income elasticity ratio when the RER approach an “industrial equilibrium” exchange rate<sup>7</sup>, hypothesis empirically tested by Missio et al (2015) and by Nassif et al (2015), with data for Brazil.

In the two set of empirical works presented so far, positive effects RER depreciations seems to prevail over the negative ones<sup>8</sup>. Price effects prevail over income effects, that is, an increase in net export would overcompensate for the rises in external cost and the drop in real

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<sup>7</sup> The industrial equilibrium RER, as defined by Bresser-Pereira (2016), is the one that makes internationally competitive those industrial firms that are using state-of-the art technology.

<sup>8</sup> The mechanism in which RER depreciations affect firms’ revenues, thus increasing internal funding and spending in capital accumulation, is central in heterodox models along Kaleckian lines. Many heterodox works without a Kaleckian flavour highlight the structural change mechanism without discussing distributional changes (see Araujo & Lima (2007) and Araujo (2013)). Orthodox works state that the mechanism at play here is that currency devaluation corrects market and institutional failures thus acting as a second-best policy tool to promote economic growth.

disposable income. This seems at odd with the “Kaldor’s Paradox”<sup>9</sup> (Kaldor, 1978), in which growth in unit labour costs has a positive correlation with growth in manufacturing export share<sup>10</sup>. Nonetheless, there exist a number of contributions which point out toward a rejection of Rodrick’s story, both at the theoretical and empirical level. For what concern the depreciation-growth relationship, Diaz-Alejandro (1986) and Krugman and Taylor (1978) stands out for being the most influential works expressing this exchange rate pessimism, a take reprises more recently discussed by the theoretical works of Ribeiro et al (2016, 2017), empirically discussed in Ribeiro et al. (2019). The theoretical standpoint of these works is that an increase in RER would trigger inflationary pressure by raising the prices of imported capital goods and reducing real wages, in this way dampening consumption and thus aggregate demand. This can reduce economic growth and/or slowdown technical progress

Empirically, Nucci and Pozzolo (2001), investigating the relationship between RER fluctuations and investment decisions with microeconomic data from Italy, support the idea that exchange rate depreciation has a positive effect on investment through higher expected revenues but a negative effect through higher costs. Caglayan and Demir (2019) find evidence that the RER affects positively the expansion of low- or medium-skill manufactures, while skill-intensive manufactures are less responsive. A similar conclusion is suggested by Agosin et al (2012), by observing that export diversification does not improve following a RER depreciation. Ribeiro et al. (2019) argue that, once functional income distribution and the relative level of technological capabilities are explicitly considered, the direct impact of RER misalignments on growth performance of developing countries becomes statistically non-significant. They suggest that growth is explained mostly by technological capabilities and income distribution, as the variable RER becomes statistically not significant when capabilities, income distribution and RER are included separately in the regression. Finally, Ibarra and Blecker (2016), in their estimate of the Balance-of-Payments-constrained rate of growth of Mexico, conclude that the impact of the RER on exports is weak due to the high share of imported intermediate inputs in the total cost of Mexican exporters<sup>11</sup>.

In recent years, the dynamic of the RER in developing economies has been shaped by financial factors, mainly in form of currency volatility and rising external debt for the non-financial sector. Pro-cyclical capital inflows are behind the former, triggered by the boom in commodity prices and by rising interest rate differentials – resulting from the implementation of inflation targeting policies at the local level and the fall in global liquidity conditions. In turn, change in the business behaviour of local exporting firms into financial intermediation activities

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<sup>9</sup> The Kaldor paradox highlights that countries excelling in manufacturing exports also exhibit higher unit labour costs precisely because higher exports induce higher productivity and hence higher real wages. Thus, policies seeking to cut wages are unlikely to succeed in promoting exports and economic growth.

<sup>10</sup> Boggio & Barbieri (2017) argues the relevance of testing not the rates of change, but the level effects of unit labor costs .

<sup>11</sup> Similar results are reported for developed economies. Storm & Naastepad (2015), in turn, argues that the importance of non-price competitiveness is much higher than that of price competitiveness for explaining the German export success, contrary to the widely held perception that wage compression played a larger role.

are behind the latter – resulting from carry-trade opportunities and fiscal elusion motives. Evidence on the RER volatility negatively affecting both export volumes and diversification has been provided by Vieira and MacDonald (2016) and Agosin et al (2012), respectively, while Berg et al. (2012) and Vieira et al. (2013) found that also long run growth is negatively impacted.

In the annex we present a summary of the main findings of a sample of the literature. The main takeaway is that a depreciated RER may play a role in encouraging growth and structural change, but this association is highly dependent on how it interacts with technical change. There is also some evidence that the relationship between some of the abovementioned variables is nonlinear - for instance, between profit margins and RER (Marconi et al., 2020). Additionally, the instability of the RER generated by financial factors appears to be a serious obstacle in growth. In the next sections we present a model that suggests an explanation for these contradictory empirical results in terms of outcomes from different institutional scenarios.

### *Modelling the interaction between the exchange rate and the industrial policy*

In the canonical BOP-constrained growth model, the RER can only affect economic growth when it is changing (during the short-run transition). In the long run, the RER is stable and economic growth only depends on the income elasticity of exports, the income elasticity of imports, and the rate of growth of the rest of the world (Thirlwall, 1979)<sup>12</sup>. Formally, the long-run equilibrium growth rate is given by the BOP-constrained growth rate:

$$y = \frac{\varepsilon}{\pi} y^* + \frac{\gamma}{\pi} \dot{q}$$

Where  $\varepsilon$  is the income elasticity of exports,  $\pi$  the income elasticity of imports,  $y^*$  is the exogenous rate of growth of the centre,  $\gamma \equiv 1 - \mu_x + \mu_m > 0$ ,  $\mu_x \equiv \partial \ln(X) / \partial q > 0$  is the price elasticity of exports,  $\mu_m \equiv \partial \ln(M) / \partial q < 0$  is the price elasticity of imports,  $\gamma$  is assumed to be positive (the Marshall-Lerner condition holds) and  $q$  is the natural logarithm of the RER,  $q = \ln(P^*E/P)$ , where  $P^*$  and  $P$  are foreign and domestic prices, respectively, and  $E$  is the nominal exchange rate, defined as units of the domestic currency per unit of foreign currency.

The idea that only the rate of change of the RER is relevant for growth has been contested in the theoretical literature, which has pointed out different forms in which the level of the RER can affect the long-run rate of growth. These forms imply that, by changing price competitiveness, the RER changes the pattern of specialization and hence the income elasticity ratio<sup>13</sup>. In this paper we will explore a different mechanism relating the RER to the income

<sup>12</sup> We assume that the reader is already familiarized with BOP-constrained growth model. A comprehensive review of these models can be found in Blecker and Setterfield (2019), chapter 12.

<sup>13</sup> This is the mechanism suggested in Cimoli and Porcile (2014), Marconi et al. (2016), and Porcile and Spinola (2018). As it happens with the empirical results, there is no consensus in the theoretical literature about the

elasticity of exports. We keep the original tenet of Thirlwall's Law in which, when the RER is in equilibrium, it cannot affect the long-run rate of economic growth. However, if the income elasticity of exports and / or imports changes during the transition from one equilibrium value of the RER to the other, then the BOP-constrained rate of growth will be a function of the previous trajectory of the RER. The new long-run BOP-constrained rate of growth will not be the same as it was before the traverse.

What are the forces at work explaining the rise / fall of the income elasticity ratio during the transition? The most obvious suspect—well established in the literature<sup>14</sup>—is Kaldorian cumulative causation. While the RER is increasing (depreciating) there is an acceleration of growth because the external constraint is being eased (assuming the Marshall-Lerner condition holds). Faster growth leads to learning by doing and the accumulation of knowledge associated with experience in production<sup>15</sup>. Higher investments and increasing returns enhance the quality and technological intensity of the goods produced. A similar story is told by technology-gap models: learning by doing stemming from economic growth reduces the technology gap of the laggard economy with respect to the advanced economy, thereby changing the pattern of specialization and the income elasticity ratio (Verspagen, 1993; Porcile & Spinola, 2018).

Cumulative processes, however, are not mana from heaven. The intensity of learning and final impact on the new equilibrium depends on the firms' investments in technology and the institutional environment which boosts or hinders technical change. Evolutionary economists convincingly argue that policies and institutions for innovation and diffusion of technology (which we simply label here as "industrial policy") are extremely important for defining the rate of technical change in the economy<sup>16</sup>. The paths of cumulative learning will vary across countries as a result of their different industrial policies. Depreciation will therefore be growth-enhancing only when it goes hand in hand with industrial policy.

The idea of a cumulative process at work in growth acceleration is consistent with the finding of Rodrik (2008), who shows evidence suggesting that *"the growth spurt takes place after a decade of steady increase in UNDERVAL [the index of undervaluation of the domestic currency] and immediately after the index reaches its leak value"* p.387.

The next sections present different models of path-dependency in technology and growth. We take on board the definition of the medium run by Ribeiro et al (2016), as a period in which the RER changes due to different rates of growth in prices, wages, the monopoly power of firms and / or the exchange rate policy of the government. Only in the long run the RER attains its equilibrium value and remains stable.

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relation between depreciation, growth and structural change. See Dvoskin et al. (2020) for a theoretical critique of the potential benefits of depreciation on structural change.

<sup>14</sup> See Setterfield (2002) and Boggio and Barbieri (2017).

<sup>15</sup> Verdoorn (2002). See also Setterfield (2011).

<sup>16</sup> Cimoli et al (2010); Lee (2013); Lundvall (2016).



### 3. The developmentalist state

The first scenario to be addressed is one in which a developmentalist state in the periphery applies capital controls, sets a target for the RER based exclusively on objectives of international competitiveness, and deploys the arsenal of industrial policy to encourage structural transformation.

#### 3.1. Basic equations

The economy produces a composed good that can be sold in the domestic market or exported. Firms have some degree of monopoly power and set prices in accordance to the following equation:

$$(1) P = zaW$$

In equation (1)  $z$  is the markup factor,  $a$  labor per unit of production ( $L/Y$ ) and  $W$  are nominal wages. The profit share in GDP is  $\sigma = 1 - WL/PY$ . Using equation (1) in this equation gives:

$$(2) \sigma = \frac{z-1}{z}$$

Log-differentiating (1) with respect to time gives the inflation rate:

$$(3) \hat{P} = \hat{z} + \hat{a} + \hat{W}$$

Recall that  $q$  is defined as:

$$(4) q = \ln\left(\frac{P^*E}{P}\right)$$

Assume that prices are set in the foreign country following the same mark-up rule as in the home country  $\hat{P}^* = \hat{z}^* + \hat{a}^* + \hat{W}^*$ . It is straightforward forward that:

$$(5) \dot{q} = \hat{E} + (\hat{z}^* - \hat{z}) + (\hat{a}^* - \hat{a}) + (\hat{W}^* - \hat{W})$$

The equilibrium growth rate is given by the BOP-constrained growth rate:

$$(6) y = \frac{\varepsilon}{\pi} y^* + \frac{\gamma}{\pi} \dot{q},$$

Using equation (5) in (6) gives:

$$(7) y = \frac{\varepsilon}{\pi} y^* + \frac{\gamma}{\pi} [\hat{E} + (\hat{z}^* - \hat{z}) + (\hat{a}^* - \hat{a}) + (\hat{W}^* - \hat{W})]$$

Assume now that the mark-up factor is constant both in centre and periphery and hence  $\hat{z} = \hat{z}^* = 0$ . In addition, assume that  $-\hat{a} = \hat{W}$  and  $-\hat{a}^* = \hat{W}^*$ , i.e. Wages succeed in catching up with labour productivity in centre and periphery. These assumptions imply:

$$(8) \dot{q} = \hat{E}$$

As mentioned, the government has some degree of control over the nominal exchange rate, which implies that there are barriers to short-term capital flows in the home economy (i.e. the periphery imposes capital controls). The government is in the hands of a Korean type of developmentalist state, in which there is target for the RER ( $q_D$ ) based on a target for international competitiveness. Formally:

$$(9) \quad \dot{q} = \vartheta(q_D - q)$$

Using (9) in (6) gives the BOP-constrained growth rate as a function of the exchange rate policy:

$$(10) \quad y = \frac{\varepsilon}{\pi} y^* + \frac{\gamma}{\pi} [\vartheta(q_D - q)]$$

In the medium run, the economy will be growing above its previous equilibrium growth rate as a result of gains in price competitiveness stemming from the depreciation of the currency. In the long run the government attains the desired RER and hence  $q = q_D$  and  $y^D = (\varepsilon/\pi)y^*$ . However, as mentioned, the transition<sup>17</sup> towards the new RER changes  $\varepsilon$ . The increase in the rate of growth will foster learning by doing. Knowledge accumulates along with the stock of capital. The production structure is transformed as technical change reshapes the pattern of specialization and boosts non-price competitiveness.

The focus on the increase in growth stemming from the depreciation of the RER does not mean that the economy is not learning upon its previous equilibrium growth path. The assumption is that on the previous path the rate of learning in the periphery and the rate of learning in the centre keeps the specialization pattern of the periphery stable. What destabilizes the relative centre/periphery rate of learning and specialization is the acceleration of growth triggered by depreciation. Other economic or institutional shocks may boost growth as well, but we will keep the focus of the analysis on shocks arising from changes in the RER.

The increase in growth equals the rate of change of the RER times a constant factor  $\gamma/\pi$ . The simplest assumption is that the rise in the income elasticity of exports is a positive linear function of the rise in economic growth over the previous equilibrium path:

$$(11) \quad \dot{\varepsilon} = \left(\frac{\alpha}{1+\beta}\right) \frac{\gamma}{\pi} \vartheta(q_D - q).$$

The parameter  $\alpha$  translates the impact of the rise in knowledge accumulation on structural change, while the parameter  $\beta$  represents the inertial forces embedded in existing capabilities and production routines. From a policy perspective, industrial and technological policies should aim at enhancing  $\alpha$  and reducing the friction (inertia) factor  $\beta$ .

The economy traverses from an initial RER  $q_0$  to the desired RER  $q_D$ . The income elasticity of exports is equal to  $\varepsilon_0$  at the beginning of the transition. The increase in the income elasticity when the economy reaches its new equilibrium can be found by integrating both sides of

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<sup>17</sup> The evolution of the RER is given by  $q(t) = (q_D - q_0)e^{-\vartheta t} + q_D$

equation (10) with respect to  $q$ . The new value of the income elasticity of exports will be  $\int_{q_0}^{q_D} \dot{\varepsilon} dq = \varepsilon_D = \varepsilon_0 + \left(\frac{\alpha}{1+\beta}\right) \frac{\gamma}{\pi} \vartheta \int_{q_0}^{q_D} (q_D - q) dq$ . That will result in:

$$(12) \quad \varepsilon_D = \varepsilon_0 + \left(\frac{\alpha}{1+\beta}\right) \frac{\gamma}{\pi} \vartheta \frac{(q_D - q_0)^2}{2}$$

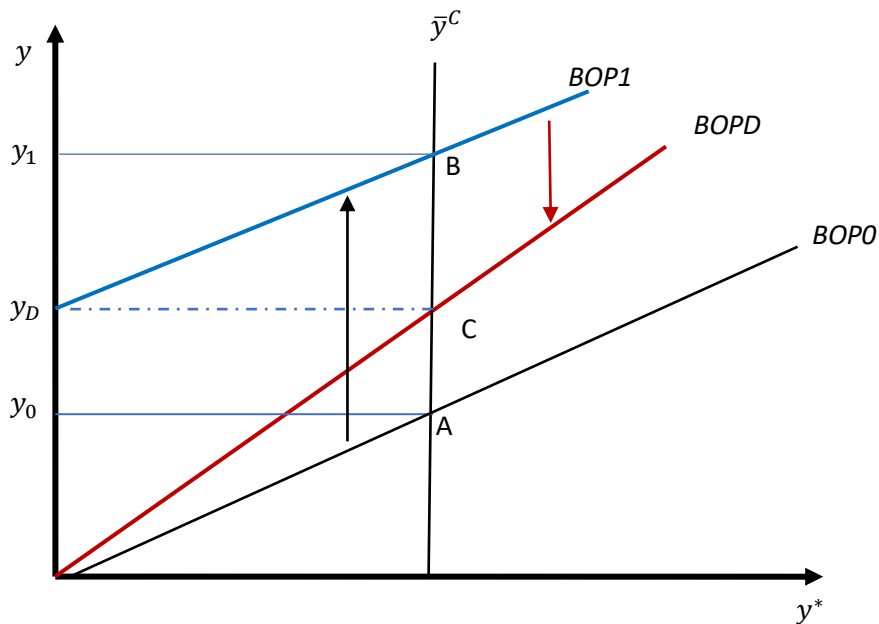
Equation (12) says that the new income elasticity of exports is a function of the distance between the two equilibrium values of the RER ( $q_0$  and  $q_D$ ), along with the technological efforts deployed by the country to take advantage of the surge in investments and increasing returns.

### 3.2. A graphic representation of structural change out of knowledge accumulation in the medium run

Figure 1 shows the adjustment process between two long-run equilibrium positions, always assuming that Marshall-Lerner holds. Initially the economy is at point A, which represents the BOP-constrained growth rate in equilibrium ( $y_0 = (\varepsilon_0/\pi)y^*$ ) for a given income elasticity of exports  $\varepsilon_0$ . The RER is on its initial equilibrium value  $q_0$ . The rise in the real exchange rate (from  $q_0$  to  $q_D$ ) allows the economy to grow at a higher rate while the RER is depreciating (the BOP0 curve shifts to BOP1). The new BOP-constrained growth rate is  $y_1 = \frac{1}{\pi} [(\varepsilon_0)y^* + \gamma \dot{q}]$  in point B. It is easy to see that the difference between BOP0 and BOP1 is that the BOP-constrained growth rate schedule no longer passes through the origin. The intercept of the BOP1 curve is  $(\gamma/\pi)\dot{q} > 0$ .

When the depreciation process ends, the growth-enhancing effect of depreciation would have ceased. However, the economy does not come back to BOP0 but to BOPD (the red line, new equilibrium in C). The reason is, as mentioned, that during the period of faster growth new investments and learning by doing allowed the economy to raise its income elasticity of exports. The new equilibrium features a higher RER, a higher income elasticity of exports ( $\varepsilon_D > \varepsilon_0$ ), and a higher rate of growth in equilibrium ( $y_D = (\varepsilon_D/\pi)y^* > y_0 = (\varepsilon_0/\pi)y^*$ ).

**Figure 1. A temporary rise in economic growth with long run implications: depreciation, cumulative learning and the BOP-constrained growth rate**



*Key to the variables*

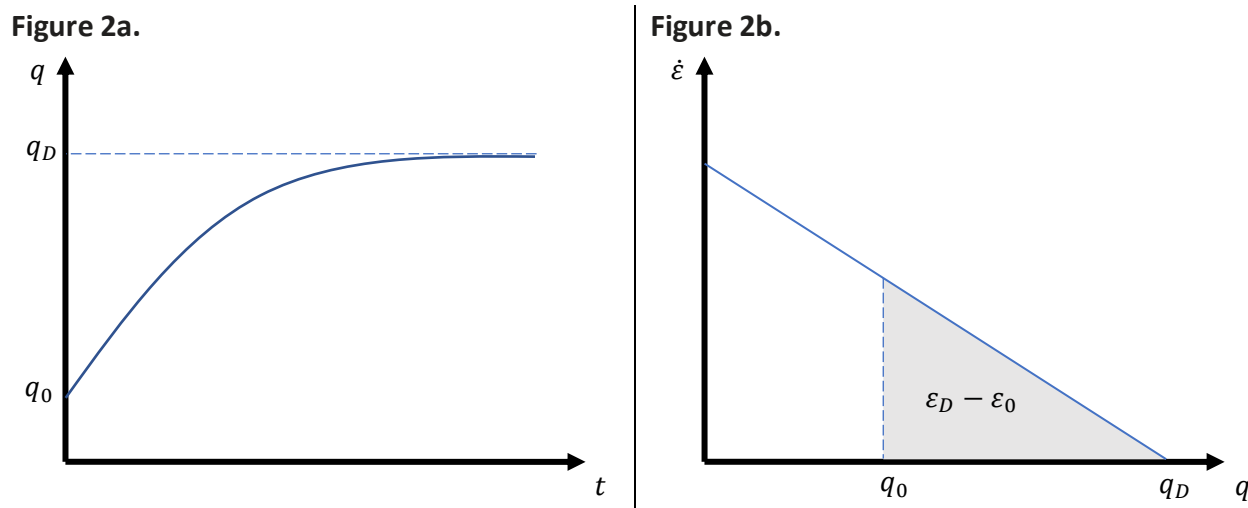
$$\text{BOPO: } y_0 = (\varepsilon_0/\pi)y^*$$

$$\text{BOP1: } y_1 = \frac{1}{\pi} [(\varepsilon_0)y^* + (\gamma/\pi)\dot{q}]$$

$$\text{BOPD: } y_D = (\varepsilon_D/\pi)y^* = \frac{1}{\pi} \left[ \varepsilon_0 + \left( \frac{\alpha}{1+\beta} \right) \frac{\gamma}{\pi} \vartheta \frac{(q_D - q_0)^2}{2} \right] y^*$$

Figure 2a presents the phase diagram of the motion of  $q$  as a function and the stable equilibrium at  $q_D$ . Figure 2 b shows the evolution of  $\varepsilon$  in response to changes in  $q$ .

**Figure 2. Evolution of the RER and income elasticity of exports in the developmentalist state**



The previous analysis gives results that are consistent with the evidence reviewed in section 2. Countries that allow the RER to depreciate attain higher rates of growth and a more diversified export structures than countries that appreciate their RER. The crucial institutional condition is that the developmentalist states not only pursues a competitive RER, but also applies comprehensive industrial policies to raise the parameter  $\alpha$  and reduces  $\beta$ . These are economies in which the rate of technical change sustains a process of catching up in income and productivity with the most advanced economies. However, the RER is a tool that has important downsides, as will be discussed in the next subsection.

### 3.3. Depreciation does not always help growth

Depreciations in certain cases can be harmful to both growth and learning. The RER has negative implications for income distribution (Blecker, 1989) and raises the price of imported capital goods (Ribeiro et al, 2017). This can reduce economic growth and/or slow down technical progress. The empirical literature suggests a nonlinear relation between depreciation and growth: a moderate degree of undervaluation favours growth, but after a critical threshold undervaluation has the opposite result. This suggests that the accumulation of knowledge may be better described in the following terms:

$$(13) \quad \dot{\varepsilon} = \left(\frac{\alpha}{1+\beta}\right) \frac{\gamma}{\pi} \vartheta [u(q_D - q) - v(q_D - q)^2]$$

Now the parameter  $u$  captures the positive effects on growth and learning produced by the depreciation; and  $v$  represents the negative effects coming from the higher cost of imported capital goods and the worsening of income distribution. Hence we have that

$\int_{q_0}^{q_D} \varepsilon dq = \varepsilon_D = \varepsilon_0 + \left(\frac{\alpha}{1+\beta}\right) \frac{\gamma}{\pi} \vartheta \int_{q_0}^{q_D} [u(q_D - q) - v(q_D - q)^2] dq$ . That will results in:

$$(14) \quad \varepsilon_D = \varepsilon_0 + \left(\frac{\alpha}{1+\beta}\right) \frac{\gamma}{\pi} \vartheta \left[ u \frac{(q_D - q_0)^2}{2} - v \frac{(q_D - q_0)^3}{3} \right]$$

Equation (13) no longer implies that a higher  $q_D$  necessarily leads to a higher  $\varepsilon_D$ . This will happen under the additional condition (besides industrial policy) that the difference between the initial RER and the target RER is not too high. Specifically, for having a positive impact on the income elasticity of exports, the distance between the two RERs must satisfy the following inequality:  $q_D - q_0 < 3u/2v$ . In economies whose production is destined mostly to the domestic market and which are highly dependent on imported capital goods, it is likely that  $v$  is high and  $u$  is low. Hence, it is less likely that depreciation would help a process of capital and knowledge accumulation. In those cases (high  $v$  and low  $u$ ), the RER is a rather inefficient instrument for economic development.

#### 4. Conflicting claims and the RER

In the previous section it was assumed that the developmentalist state has an unchallenged grip on the RER. This is a good approximation to the case of a few cases in Asia. However, in many developing economies there is resistance to depreciation. A higher RER means a lower wage share in GDP. Depreciation has redistributive consequences that elicit a response from workers' unions. In some Latin American countries (such as Argentina and Uruguay) there are strong labour unions that negotiate with the firms in a unified and structured way. This makes unviable for governments or firms to unilaterally set the RER they prefer based solely on the quest for international competitiveness. The following discussion is based on the analysis of RER dynamics when actors' preferences over the RER are heterogeneous, as suggested in Lima and Porcile (2013).

##### 4.1. Basic equations

We consider now the case in which workers consume imported goods. The cost of the workers' consumption basket is  $P^W = P^\tau (P^*E)^{1-\tau}$  where  $\tau$  is the share of domestic goods. The real wage in this economy is  $\omega = W/P^\tau (P^*E)^{1-\tau}$ . Since  $W = P/za$  and  $q = \ln(P^*E/P)$ , then  $\omega = 1/za(e^q)^{1-\tau}$ . As  $a = L/Y$ , real workers' consumption in GDP is:

$$(15) \quad (\omega L)/Y = 1/z(e^q)^{1-\tau}.$$

It can be seen that there is a negative association between the real exchange rate and the workers' consumption share in GDP. If workers are organized, they will react to a real

depreciation. Workers will demand higher nominal wages when the RER is high so as to sustain or increase real consumption. Formally, the increase in nominal wages will have two parts: a term that captures the increase in labour productivity ( $\hat{a}$ ); b) a term to correct the impact of the RER on the cost of the labor consumption basket:

$$(16) \quad \widehat{W} = \hat{a} + \varsigma \left[ \ln \left( \frac{1}{z(eq^W)^{1-\tau}} \right) - \ln \left( \frac{1}{z(eq)^{1-\tau}} \right) \right]$$

In equation (63)  $q^W$  is the RER aimed at by the workers and  $\varsigma$  the velocity the economy moves to equilibrium in the labour market. This can be expressed as:

$$(17) \quad \widehat{W} - \hat{a} = h(q - q^W), \text{ where } h \equiv \varsigma(1 - \tau)$$

We will keep the assumption that wages in the centre grow at the same rate as productivity in the centre.

Workers are not the only actors in the game. The government uses the exchange rate policy to sustain competitiveness and avoid an external crisis. Frequently, governments are more reactive to the capitalists' demands than to workers' demands. If capitalists' actors demand a higher profit share in GDP and a higher RER to export and invest, their representatives in government and parliament will make pressure in this direction. Consider the case discussed in Lima and Porcile (2013) in which both workers and the government have different preferences in terms of the RER. The government raises the rate of nominal devaluation if it sees that the RER falls below the RER it considers necessary to sustain international competitiveness. Formally:

$$(18) \quad \hat{E} = j(q^G - q)$$

Recall that the rate of change of the RER is  $\dot{q} = \hat{E} + (\hat{z}^* - \hat{z}) + (\hat{a}^* - \hat{a}) + (\widehat{W}^* - \widehat{W})$ . If the mark-up is constant in centre and periphery and assuming ( $\widehat{W}^* = \hat{a}^*$ ), this expression becomes  $\dot{q} = \hat{E} - \widehat{W} + \hat{a} = \hat{E} - h(q - q^W)$  (per equation 17)<sup>18</sup>. Using this result in (18), the rate of change of the RER will be given by:

$$(19) \quad \dot{q} = j(q^G - q) - h(q - q^W)$$

We will normalize  $h + j = 1$ . Then the differential equation (19) produces a stable equilibrium  $q_E$  when:

$$(20) \quad q_E = jq^G + (1 - j)q^W$$

Note that neither workers nor the government will ever be contented with the equilibrium value of the RER (unless in the very special case in which  $q^G = q^W$ , in which there

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<sup>18</sup> Since  $P = Wz/a$ , then the inflation rate (with a constant  $z$ ) is  $\hat{P} = \widehat{W} - \hat{a}$ . It is straightforward that  $\dot{q} = \widehat{P}^* + \hat{E} - \hat{P}$  and with  $\widehat{P}^* = 0$ , then  $\dot{q} = -\widehat{W} + \hat{a}$ , i.e. the rate of change of the RER equals the negative of the inflation rate.

are no conflicting claims on income shares at all).  $E$  and  $W$  grows at the same rate ( $\hat{E} = \hat{W} - \hat{a}$ ) keeping the RER constant on the equilibrium value defined in equation (20). Since  $q^W < q^G$ , the higher the bargaining power of workers  $h$ , the lower the RER in equilibrium; the higher the concern of the government with competitiveness ( $j$ )—and the efforts it makes for sustaining it—the higher will be the RER. Indeed, it is easy to see that the authoritarian developmentalist state is a special case of equation (19), in which  $j = 1$ , becoming similar to equation (9).

#### 4.2. The learning path

Now the BOP-constrained rate of growth in equilibrium in the medium run will be:

$$(21) \quad y = \frac{\varepsilon}{\pi} y^* + \frac{\gamma}{\pi} [j(q^G - q) - (1 - j)(q - q^W)]$$

As in the previous section, the rate of learning and the transformation of the production structure depend on the accumulated rate of growth over the initial equilibrium growth rate:

$$(22) \quad \dot{\varepsilon} = \left( \frac{\alpha}{1 + \beta} \right) \frac{\gamma}{\pi} \dot{q}$$

Using (19) in (22) gives:

$$(23) \quad \dot{\varepsilon} = \left( \frac{\alpha}{1 + \beta} \right) \frac{\gamma}{\pi} [j(q^G - q) - (1 - j)(q - q^W)]$$

Integrating both sides of the equation between with respect to  $q$  allows for finding the new value of the income elasticity of exports when  $q = q^E$ :

$$\int_{q_0}^{q^E} \dot{\varepsilon} dq = \left( \frac{\alpha}{1 + \beta} \right) \left( \frac{\gamma}{\pi} \right) \left[ \frac{q_E^2}{2} + (j - 1)q^W q_E - jq^G q_E - \frac{q_0^2}{2} - (j - 1)q^W q_0 + jq^G q_0 \right]$$

If we make  $j = 1$  and  $q^G = q_D$ , equation (24) gives the same result as equation (12).

Some interesting points emerge from equation (24). First, if there is no industrial policy, the higher the value of the RER in equilibrium, the higher the new income elasticity of exports. There is a trade-off between the wage share and the BOP-constrained growth rate because there is a trade-off between the wage share and the degree of diversification attained by the economy when the RER is in equilibrium. Given  $\alpha$  and  $\beta$ , the road to diversification implies a fall in the wage share (even though real wages may be increasing as the economy grows at a higher rate in equilibrium).

Second, although the model does not capture the dynamics of wages and inflation behind the stable RER, these dynamics may affect investment and learning. If the equality  $\hat{E} = \hat{W}$  is satisfied at very high levels of wages increases and rates of nominal devaluations of the exchange rate, inflation will be rampant, the intensity of conflict more acute and investment



will necessarily fall. Uncertainty and instability hamper technological change and the transformation of the production structure.

Last but not least, an increase in  $\alpha$  and a fall in  $\beta$  allows for a higher wage share for a given long-run BOP-constrained rate of growth<sup>19</sup>. Industrial policy allows minor depreciations to become an effective mechanism for diversifying the export structure. This explains why industrial policy is important for sustaining growth *without compromising, or even improving, income distribution*.

Industrial policy is central to mollify the distributive conflict in a democratic society in which workers, capitalists and government have heterogeneous preferences over the RER. In the Latin American countries, industrial policies had been highly ineffective (or inexistent), which made it more difficult for them to arbitrate the contradiction between price competitiveness (represented by the RER) and income distribution (represented by the wage share). There was no rapid diffusion of technology (which would shift outward the external constraint on growth and employment) to mollify the intensity of the distributive conflict. On the other hand, in advanced democracies (such as those in Northern Europe, and especially in the Nordic countries), highly institutionalized negotiations over wage shares and prices are combined with a large set of incentives to innovation and diffusion of technology. This combination keeps international competitiveness (based on technological learning) and equality moving hand in hand<sup>20</sup>.

## 5. Financialization and the neoliberal coalition: slow growth and instability

The third scenario assumes that the game is between a state whose sole objective is to control inflation and an international capital market that arbitrates between assets denominated in domestic and foreign currencies. This is an economy with a fully open capital account in which the government allows the RER to fluctuate as a function of short-term capital flows and seeks to control inflation using a Taylor rule for the interest rate. We call this a financialization scenario because the RER will depend on changes in the international financial markets and the government commitment to fight inflation.

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<sup>19</sup> The wage share does not depend directly on  $\alpha$  and  $\beta$ , as  $\omega = 1/za(e^q)^{1-\tau}$ . However, the trade off occurs in the diversification equation ( $\varepsilon$ ):  $\varepsilon = \left(\frac{\alpha}{1+\beta}\right)\frac{\gamma}{\pi} [j(q^G - q) - (1-j)(q - q^W)]$ . A reduction in  $j$  (and rise in  $1-j$ ) can only maintain a fixed  $\varepsilon$  with increases in  $\alpha$  and reduction in  $\beta$ . That would result in the same growth rate ( $\gamma$ ).

<sup>20</sup> As put by Andersen et al (2015): "In a sense it can be argued that competitiveness was enhanced by collective bargaining based on the relatively pragmatic positions of dominant trade unions and employers' associations. It is not that conflicts and power struggles were absent, rather there (...) a basic willingness to try to develop the collective bargaining systems." p.139.

### 5.1. Basic equations

Foreign capital will be attracted by the difference in the real interest rates at home and abroad. If real domestic interest rates are higher than the foreign interest rates, the domestic currency will be appreciated by capital inflows, as expressed in the following equation (where  $r^f$  is the international real interest rate,  $\varphi$  an adjustment parameter and  $r$  the domestic real interest rate):

$$(24) \quad \dot{q} = \varphi(r^f - r)$$

The government of the peripheral country is mostly concerned with inflation and adopt an inflation target  $\theta$  which it pursues using monetary policy. From equations (17), nominal wages will rise faster when the RER is higher than the RER aimed at by the workers. A rise in nominal wages, for a given rate of growth of productivity and a fixed mark-up, raises the inflation rate. The government will try to curb the surge in inflation by increasing the real interest rate to reduce aggregate demand. The reaction curve of the policy-maker can be expressed as a simple Taylor rule:

$$(25) \quad \dot{r} = \rho_0(\widehat{W} - \theta) - \rho_1 r = \rho_0[h(q - q^W) - \theta] - \rho_1 r = -g + \rho q - \rho_1 r$$

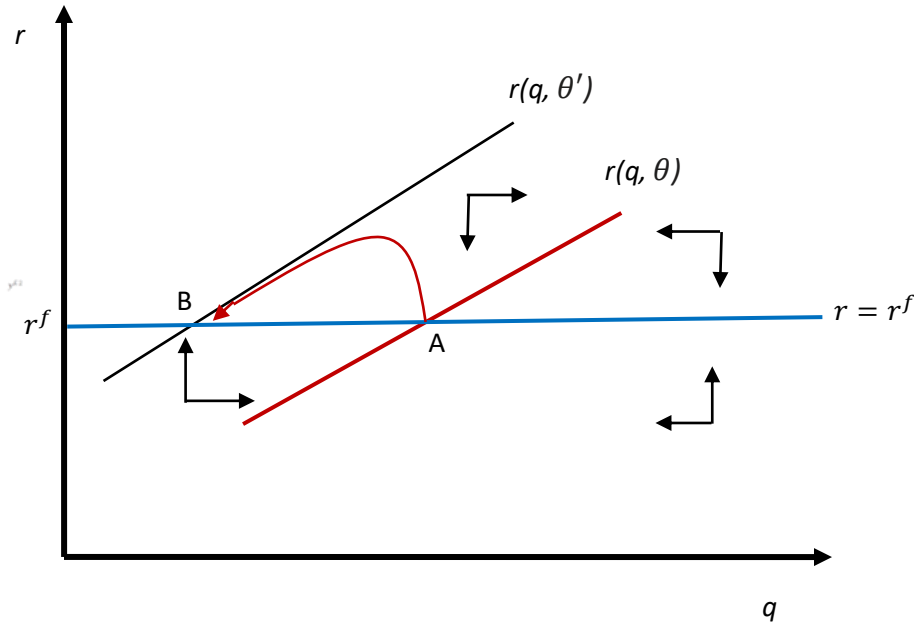
Where  $g \equiv \rho q^W - \theta$  and  $\rho \equiv \rho_0 h$ . The increase of the real interest rate will be a positive function of the RER (which boosts inflation) and a negative function of the real interest rate (which reduces aggregate demand). The system is stable, and the equilibrium values are:

$$(26) \quad r^E = r^f$$

$$(27) \quad q^E = \frac{g + \rho_1 r^f}{\rho}$$

Figure 3 shows the phase diagram of the system of differential equations formed by equations (27) and (28). Assume that the economy is initially at point A, and that the government adopts a stricter target for the inflation rate ( $\theta' < \theta$ ). The  $\dot{r} = 0$  isocline shifts to the left. To attain  $\theta'$ , the government increases the real interest rate, which leads to inflows of foreign capital that appreciates the RER. Gradually, the appreciation of the RER helps control inflation and the interest rate becomes less necessary to attain the new inflation target. The adjustment process ends with the same real interest rate as before (which is the international interest rate) and a lower real exchange rate in equilibrium.

Figure 3. The dynamic system in the financialization scenario



Key to variables and parameters:  $r$ : real interest rate;  $q$ : real exchange rate;  $\theta$ : initial inflation target;  $\theta' < \theta$  new (lower) inflation target.

The Jacobian of the dynamic system formed by equations (25) and (26) is:

$$(28) \quad J = \begin{vmatrix} 0 & -\varphi \\ \rho & -\rho_1 \end{vmatrix}$$

It can be readily checked that the trace is negative and the determinant positive, and hence the system is always stable.

### 5.2. The learning path

Figure 3 shows how the decision of the government of pursuing a lower inflation target leads to the appreciation of the RER. A similar effect would come from a fall in the international real interest rate (a fall in the horizontal line  $r^f$ ). Along the process of appreciation, there is a loss of accumulated knowledge and the new equilibrium entails a lower BOP-constrained growth rate. The exchange rate is the anchor of prices, with negative implications for competitiveness and structural transformation.

Another scenario emerges if the monetary policy is rather ineffective to curb aggregate demand, which in the model can be represented by a very low parameter  $\rho_1$ . Assume the extreme case in which  $\rho_1 = 0$ . The trace of the Jacobian (29) becomes zero and the system in this case is a centre. The RER and the real interest rate will chase each other without ever reaching their equilibrium values. It is then most likely that the negative effect of instability will

overcome any potential positive effect of depreciation on growth. Such instability increases with the radius of the circle defined by the orbit of the variables  $r$  and  $q$ .

Given the initial position of the economy (the initial value of  $r$  and  $q$ ), the economy is permanently moving in circles around the equilibrium point without ever reaching it. What are the implications for structural transformation of this kind of dynamics?

If fluctuations are small and predictable, they play no relevant role in decision making. If these fluctuations are wide, even if they were predictable, they compromise investment. Assume that investment increases when the BOP-constraint is eased ( $\dot{q} > 0$ ) and decreases when the BOP-constraint becomes more severe ( $\dot{q} < 0$ ). In addition, assume that:

$$(29) \quad \dot{\varepsilon} = \left( \frac{\alpha}{1+\beta_1} \right) \frac{\gamma}{\pi} \dot{q}, \text{ if } \dot{q} > 0$$

$$(30) \quad \dot{\varepsilon} = \left( \frac{\alpha}{1+\beta_2} \right) \frac{\gamma}{\pi} \dot{q}, \text{ if } \dot{q} < 0$$

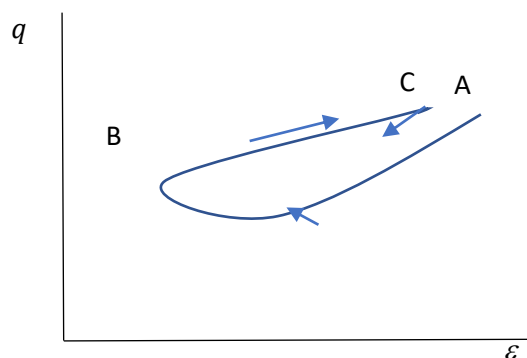
Assume now  $\beta_1 > \beta_2$ <sup>21</sup>. This assumption implies that the inertial forces are stronger when the economy is recovering than when the economy is losing capabilities. The rationale for this assumption is that building capabilities is a more difficult process (especially in a world in which technical change is extremely fast) than the loss of capabilities. It is necessary to run to stay in the same place (the “Red Queen Effect”). Institutions are not easily reconstructed; the skills lost in one period will not be available in the next; firms, networks and externalities will no longer be at hand. This is a hysteresis scenario which not only hinders structural transformation, but also implies regressive structural change after each appreciation / depreciation cycle of the RER. The economy cannot take the same path back to its previous equilibrium after the alteration of its economic structure. The description of an economy with a downward trend in competitiveness may not be realistic for a very long run, but it does represent protracted growth phases in developing economies, especially after a severe external crisis.

Figures 4a and 4b represent the movement of technological capabilities following the cyclical movement of the RER and over time, respectively. Figure 4a shows that  $\varepsilon$  falls with the appreciation of the RER, from points A to B. But when the RER returns to its original value, it follows a different path (from B to C) and reaches in equilibrium the same RER as before, but with a lower income elasticity of exports. Figure 4b shows the cyclical fluctuations of the income elasticity of exports and its declining trend over time.

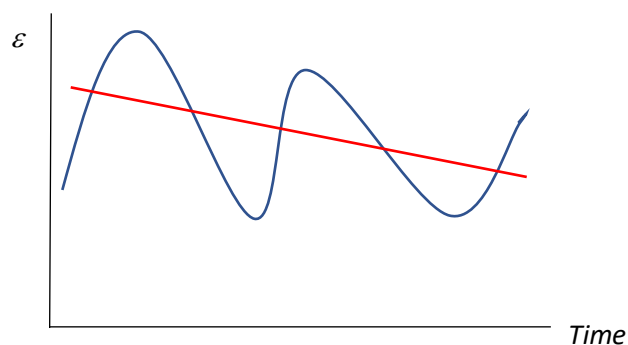
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<sup>21</sup> A similar assumption about different velocities of adjustment is suggested by Blecker and Setterfield (2019, p. 400-401).

**Figures 4a. Hysteresis in the evolution of  $\varepsilon$**



**Figure 4b. Cycles and trend in  $\varepsilon$  over time**



The trajectories described in figures 4a and 4b express the difficulties faced by an economy which fails to exercise some degree its control over its RER in times of financial globalization. This is an extreme scenario in the sense that the heavy lifting in fighting inflation is done by the RER (the effect of the monetary policy on aggregate demand is assumed to be zero at the end of the day) and the RER never settles to a stable equilibrium value. However, even in the previous scenario in which the RER is stable, the financialized economy remains vulnerable to shocks in the international interest rates. What is apparently a positive feature of the international economy (high financial liquidity in the international markets and low international interest rates) may become a serious problem if it means a significant appreciation of the domestic currency in the periphery, which carries significant consequences for the future growth path of its economy.

## 6. Concluding remarks

The empirical literature on RER and growth reports conflicting results, which are highly sensitive to the inclusion or not of a technological variable in the econometric exercises. We suggest a BOP-constrained growth model which can explain these mixed results as a function of the interplay between two kinds of policies, the exchange rate policy and the industrial policy. Such policies shape the institutional framework in which technological learning takes place and the RER evolves. We identify three institutional frameworks that express different political regimes and political dynamics: the developmentalist state, conflicting claims over heterogeneous preferences, and financialization. Table 1 summarizes the main features of each institutional regime.

The main argument is that periods of depreciation of the RER imply periods of higher rates of growth, which offer a window of opportunity for building new technological capabilities out of increasing returns—associated with learning by doing and the ensuing accumulation of knowledge. This process of technical change brings about a process of structural change, as captured by the rise in the ratio between the income elasticity of exports and imports. However, the window of opportunity opened by economic growth is not automatic. It will be seized upon or not depending on the institutional pattern that prevails. Developmentalist states tend to maximize growth and learning, while financialization tends to generate appreciation and more instability. The conflicting claims regime may offer a variety of results depending on the relative bargaining power of firms and workers, and especially on the ability of the government to implement industrial policy.

**Table 1. Summary: institutional patterns and outcomes**

Case	Developmentalist State	Conflicting Claims	Financialization
Political economy	Industrialist coalition	Government, capitalists and workers have different preferences over the RER	Neoliberal coalition
Policy focus	International competitiveness	Balancing international competitiveness with income distribution	Focus on the inflation rate
Capital account	Strong capital controls	Moderate capital controls	Fully open
Agents' objectives	Maximize the investment rate and close the technology gap with the technological leaders	Workers aims to raise real wages; firms aim to keep their mark-up; governments aim to avoid an external crisis	The government pursuit an inflation target; capitalists and workers try to expand their share in GDP.
RER behaviour	Government aims at a competitive RER $\dot{q} = \vartheta(q_D - q)$	Resistance to depreciation. Negotiation between government and workers. $\dot{q} = j(q^G - q) - h(q - q^W)$	International capital market arbitrates between assets denominated in domestic and foreign currencies. Government commitment to

	<p>RER may have important downside: negative implications for income distribution and raises the price of imported capital goods.</p> $\dot{q} = \vartheta[u(q_D - q) - v(q_D - q)^2]$		<p>fight inflation (Taylor rule).</p> $\dot{q} = \varphi(r^f - r)$ $\dot{r} = -g + \rho q - \rho_1 r$ <p>It is easier to lose capabilities than to build them (hysteresis).</p>
Role of industrial policy and learning path	Foster learning and structural change.	Sustaining growth without compromising income distribution.	There is no industrial policy. RER is the price anchor, with negative implications for competitiveness and structural transformation.

The model can be found implemented in .R in the following GitHub repository:

<https://github.com/danilospin/Lipi-Model>

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