Exchange rate regimes, structural change and capital mobility in a developing economy

Stefan Wilson D'Amato and Luciano Dias de Carvalho

Abstract

This paper proposes to develop a balance-of-payments-constrained growth model to analyse the importance of the relationship between real exchange rate misalignment and the share of industry in output. Building on the work of Gabriel, Jayme and Oreiro (2016), the model is expanded to address: (i) the influence of price competitiveness on net exports; (ii) capital mobility; (iii) nominal exchange rate flexibility; (iv) the nominal wage as a fraction of the value of labour productivity; and (v) a quadratic relationship between the growth rate of the share of industry in output and exchange-rate misalignment. An important result is that both flexible and fixed exchange rate regimes are compatible with a balanced growth path.

Keywords

Monetary policy, foreign exchange rates, capital movements, industrial sector, gross domestic product, economic growth, developing countries

JEL classification

E12, E51, E22

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I. Introduction

The aim of this study is to explore new channels of influence between the real exchange rate and the share of industry in output and their importance for sustainable growth in developing economies, based on the model developed by Gabriel (2016) and Gabriel, Jayme and Oreiro (2016). Emphasis is placed on the influence of fixed and floating exchange rate regimes in determining the long-term stability of such economies, specifically when the presence of capital flows and a profit-driven accumulation regime is taken into account.

Rodrik (2009) and Szirmai (2012) highlight the role of industry as an "engine" of long-term economic growth. According to Szirmai (2012), there is a transfer of resources from the agricultural sector to the industrial sector, which gives rise to a "bonus" from structural change, due to higher labour productivity in industry. As a result, as aggregate productivity and per capita income increase, structural change becomes central to economic growth.

Thirlwall (1979) argues that, as a rule, long-term growth tends to be constrained by the balance of payments. Consequently, the author proposes that long-term economic growth be defined by the relationship between the rate of growth in exports and the income elasticity of imports. Thus, according to Thirlwall (2011), balance-of-payments equilibrium plays a key role in economic growth in developing countries.

Kaldor (1966 and 1970) discusses the role of exports as a core component in increasing the share of industry in the output of an economy. This increase contributes to the rise in aggregate productivity due to the presence, inherent to this sector, of dynamic returns to scale. As a result, capital accumulation and economic growth tend to intensify.

According to Frenkel and Rapetti (2014), for the share of industry in the South to increase,[1] the real exchange rate must be stable and undervalued, so that the level must necessarily be equal to or higher than the industrial-equilibrium real exchange rate.[2] Thus, the real exchange rate must remain above its competitive level (as determined by the industrial equilibrium exchange rate), where it stimulates the production and sale of goods with a greater technological component. This productive specialization is accompanied by structural change in the developing economy and, consequently, by economic growth.

Palley (2002) notes that the demand-led, balance-of-payments-constrained model of economic growth can pose obstacles to growth. First, the author argues that the world economy can be regarded as a closed system, in which not all countries in the world will export at the same time. Thus, such models are better suited to smaller open economies, which engage in trade and financial operations with the rest of the world.

Another important argument highlighted by the author concerns the failure of such models to consider the supply side. If the rate of productivity growth is higher than the rate of demand growth, there will be a steady increase in potential supply and unemployment in the economy. Indeed, Palley (2002) argues that, in the long run, demand and supply must grow together.

Gabriel (2016) and Gabriel, Jayme and Oreiro (2016) build on the argument developed by Palley (1996 and 2002) to examine the interaction between the real exchange rate and industry's share of gross domestic product (GDP) in the presence and absence of changes in the technology gap.

In particular, those papers show a linear relationship between the share of industry in GDP and the real exchange rate; i.e., the more depreciated the real exchange rate, the higher the share of industry in GDP. To be sure, this simplification does not seem to be the most apposite to reflect the true relationship between these two variables. When there is an excessive depreciation of the real exchange rate, sectors intensive in imported inputs and capital goods will tend to lose competitiveness to a greater extent than the gains of export-oriented sectors, thus reducing the share of industry in GDP.

[1] In the tradition of structuralist centre-periphery models, developed countries are referred to as the North, and developing countries, as the South.

[2] The real exchange rate at which a company operating at the technological frontier is internationally competitive.

The balance-of-payments-constrained economic growth model that will be developed assumes an economy with capital mobility and a nominal exchange rate susceptible to variation. Thus, the balance-of-payments equilibrium equation, which makes up the structural equations of the model, depends on the growth rate of capital flows and changes in the terms of trade and the nominal exchange rate.

In contrast to Gabriel (2016) and Gabriel, Jayme and Oreiro (2016), it will be assumed that the nominal wage in the South depends on the value of labour productivity. Thus, this present model will move away from the assumption of wage parity between Northern and Southern nations by measuring in the same currency and assume instead that the change in the nominal wage is always less than the change in the value of productivity. This assumption in turn assumes the existence of a profit-based accumulation regime.

One of the contributions of this paper is the formulation of an equation that represents the growth rate of industry's share of GDP as a quadratic function of the deviation of the real exchange rate from the industrial-equilibrium real exchange rate. Indeed, after the point considered critical, any increase in the exchange-rate imbalance will lead to a reduction in the growth rate of industry's share in GDP. Thus, this equation allows the formation of a stable long-term equilibrium path for developing economies.

Another relevant point concerns exchange rate regimes. This paper looks at the importance for developing economies of the type of exchange rate regime adopted as a development strategy. Thus, when analysing the model with the flexible exchange rate, the long-run equilibrium will trace a stable path when the economy has a sufficiently depreciated real exchange rate and the share of industry in GDP is relatively low. On the other hand, by keeping the exchange rate fixed, the model will present a stable equilibrium path over the long term. This path will be consistent with a sufficiently depreciated real exchange rate and a relatively higher industry share of GDP than under a flexible exchange rate.

The paper is divided into four sections, including this introduction. The second section sets out the concepts necessary for the development of the proposed model and highlights economic growth, structural change, capital mobility and exchange rate regimes. The third section presents and develops the balance-of-payments- and supply-constrained North-South economic growth model, which assumes capital mobility, structural change, partially endogenous currency supply and a flexible exchange rate. The fourth and final section presents the main conclusions.

II. Structure of the model

It is assumed, as in Palley (1996 and 2002), that the rate of growth in productive-capacity utilization is constrained on both the demand and supply sides. Demand is constrained by the balance of payments, while supply is bounded by the Harrod condition, according to which the current growth rate must be equal to the growth rate of potential output.

The long-term structure of the Southern model will be presented as:

$$\hat{x}_s = a_0 g_N + a_1\left(\hat{e} - \hat{p}_s\right) \quad a_0 > 0 \text{ and } a_1 > 0 \tag{1}$$

$$\hat{m}_s = b_0 g_s + b_1\left(\hat{p}_s - \hat{e}\right) \quad b_0 > 0 \text{ and } b_1 > 0 \tag{2}$$

$$\hat{p}_s + \hat{x}_s + \hat{f} = \hat{m}_s + \hat{e} \tag{3}$$

$$\hat{\lambda}_s = c_0 + c_1 h_s g_s \quad 0 < c_0 < 1 \text{ and } 0 < c_1 < 1 \tag{4}$$

$$g_s = \hat{\lambda}_s + \eta_s \tag{5}$$

Where $\hat{x}_s$ $(\hat{m}_s)$ corresponds, respectively, to the growth rate of exports (imports) from the South; a_0 (b_0) is the income elasticity of exports (imports); $a_1(b_1)$ represents the price elasticity of exports (imports); g_N (g_s) corresponds to the growth rate of the North (South); $\hat{p}_s$ is the inflation rate in the South; $\hat{e}$ represents the growth rate of the nominal exchange rate; $\hat{f}$ is the growth rate of capital flows; c_0 is the autonomous parameter that captures variables affecting labour productivity growth other than GDP growth in the South; c_1 represents the Kaldor-Verdoorn coefficient; h_s is the industry share of output in the South; $\hat{\lambda}_s$ corresponds to the rate of growth of labour productivity in the South; and, lastly, η_s is the growth of the workforce.

Expressions (1), (2) and (3) follow the work of Thirlwall and Hussain (1982). Thus, in equation (1), economic growth in the North and the rate of change of the real exchange rate have a positive impact on the growth rate of exports from the South.[3] In equation (2), economic growth in the South and the appreciation of the real exchange rate lead to an increase in the growth rate of imports from the South. Equation (3) expresses the intertemporal balance of payments equilibrium.

Equation (4) was based on the work of Gabriel (2016) and Gabriel, Jayme and Oreiro (2016), which corresponds to the Kaldor-Verdoorn law, since it captures the sensitivity of productivity growth to the growth of Southern domestic product (Dixon and Thirlwall, 1975; Fingleton and Mccombie, 1998; Harris and Liu, 1999; León-Ledesma, 2000; Ciriaci, 2006). However, the Kaldor-Verdoorn effect tends to be stronger as the industry share of domestic output in Southern countries increases.

Equation (5) demonstrates the existence of a balanced growth path from the moment when the rate of growth in labour productivity added to population growth (or labour force growth) equals the rate of economic growth in the South. Thus, this equation uses the assumption that the unemployment rate is constant over time.

Like Kalecki (1954), equation (6) assumes that the price of the good produced in the South is a function of a profit margin rate on unit production costs.[4]

$$p = (1+\mu)\left(\frac{W}{\lambda}\right) \qquad \mu > 0 \tag{6}$$

Where μ is the profit margin rate and λ is labour productivity.

It is explicitly assumed that the price is determined by the unit labour cost plus a margin on that cost. Thus, it is implicitly assumed that there are no imports of intermediate goods.

The Southern inflation equation used by Dixon and Thirlwall (1975), León-Ledesma (2000) and Ciriaci (2006) for the North-South model suggests:

$$\hat{p}_s = \hat{z}_s + \hat{w}_s - \hat{\lambda}_s \tag{7}$$

Where $\hat{z}_s$ corresponds to the profit margin growth rate; $\hat{w}_s$ represents the nominal wage growth rate, $\hat{\lambda}_s$ is the labour productivity growth rate and the subscript s denotes the economy of the South.

In a context where country risk is zero and, on average, the expectation of exchange rate depreciation is also zero, the growth rate of the nominal exchange rate is determined exclusively by the difference between real interest rates in the North and the South. The assumption is that any deficits or surpluses in the trade balance are compensated by the central bank.

$$\hat{e} = \varepsilon_0\left(r_N - r_s\right) \tag{8}$$

[3] For simplicity, the growth rate of inflation in the North is assumed to be zero $(\hat{p}_N = 0)$. Thus, the profit margin rate of the North is constant and, consequently, wage growth is equal to labour productivity growth.

[4] The profit margin rate is used as a proxy variable for companies' market power. Thus, a value equal to zero for this rate describes a market structure with perfect competition. In addition, it is appropriate to define $Z \equiv 1 + \mu > 1$.

Where $\hat{e}$ represents the growth rate of the nominal exchange rate; r_s (r_N) is the real interest rate in the South (North) and ε_0 is a positive coefficient that measures the prevailing exchange rate regime. Indeed, if the sensitivity of the real exchange rate to the interest differential is equal to zero (greater than zero) the exchange rate will be fixed (flexible). Where the sensitivity of the real exchange rate to the interest differential tends to infinity, the exchange rate will be flexible and there will be perfect capital mobility.

According to Krugman and Obstfeld (2003) and Romer (2012), the Fisher equation shows that the real interest rate is approximately equal to the nominal interest rate minus the inflation rate, as shown below for the case of the Southern economy:

$$r_s = i_s - \hat{p}_s \tag{9}$$

Where: i_s corresponds to the nominal interest rate in the South.

Under the above conditions, the growth rate of capital flow is:

$$\hat{f} = \varepsilon_1\left(i_s - \hat{p}_s\right) \tag{10}$$

Where ε_1 is a positive coefficient. It was assumed, without loss of generality, that the real interest rate in the North is zero.

The behaviour equation that will present the endogeneity of the nominal interest rate in the South can be described as follows:

$$i_s = j_0 + j_1 u_s \tag{11}$$

Where j_0 is an autonomous parameter; u_s is the degree of utility of productive capacity; j_1 is the sensitivity of the nominal interest rate in the South to effective demand/credit.[5]

According to Bresser-Pereira, Oreiro and Marconi (2014), the rate of profit margin growth varies according to the exchange rate misalignment, understood as the difference between the real effective exchange rate and the industrial equilibrium exchange rate. The expression that represents it is as follows:

$$\hat{z}_s = \alpha\varphi = \alpha\left(\theta - \theta^{ind}\right); \qquad \alpha > 0 \tag{12}$$

Where φ is the exchange rate misalignment, understood as the difference between the real effective exchange rate (θ) and the industrial equilibrium exchange rate (θ^{ind}) and α is a sensitivity coefficient of the growth rate of the profit margin in the South relative to the exchange rate misalignment.

In the labour market, firms are assumed to have a certain market power that prevents the nominal wage from being equal to the value of labour productivity, as shown below:

$$W_s = \left(\Lambda_s P_s\right)^{\phi} \tag{13}$$

Where ϕ is the elasticity of the nominal wage with respect to the value of labour productivity in the South ($0 < \phi < 1$) and Λ_s is marginal labour productivity in the South.

Therefore, the nominal wage growth rate in the South is:[6]

$$\hat{w}_s = \phi\left(\hat{\lambda}_s + \hat{p}_s\right) \tag{13.1}$$

[5] Here u acts as a proxy for credit demand and, for simplicity, j_1 will be assumed to be equal to one.

[6] Equation (13.1) shows that functional relationship (13) is consistent with a profit-based accumulation regime.

Thus, the South's nominal wage growth rate $(\hat{w}_s)$ depends on the sum of the labour productivity growth rate $(\hat{\lambda}_s)$ and the South's inflation rate $(\hat{p}_s)$, both weighted by elasticity ϕ.

Substituting equations (1), (2), (4), (7), (8), (9), (10), (11) and (12) in (3) gives the expression for demand.

$$u_s = \frac{1}{c}\left[\alpha\varphi A - \left(c_0 + c_1 h_s g_s\right)B + a_0 g_N - b_0 g_s\right] - j_0 \tag{3.1}$$

Where:

$$A \equiv \frac{1-\left(a_1 + b_1\right)\left(1-\varepsilon_0\right)-\left(\varepsilon_0+\varepsilon_1\right)}{1-\phi}$$

$$B \equiv 1-\left(a_1 + b_1\right)\left(1-\varepsilon_0\right)-\left(\varepsilon_0+\varepsilon_1\right)$$

$$C \equiv \varepsilon_0\left(a_1+b_1\right)-\left(\varepsilon_0+\varepsilon_1\right)$$

To find the supply side equation it is necessary to substitute equation (4) in expression (5) This gives the economic growth rate in the South, which is equal to the natural economic growth rate in the South (g_{ns}). Thus, the function is written as:

$$g_s = g_{ns} = \left(\frac{c_0 + \eta_s}{1 - c_1 h_s}\right) \tag{5.1}$$

Looking at the above expression, the industry share has a positive impact on the rate of growth. Thus, the higher the value of the industry share of output weighted by the Kaldor-Verdoorn coefficient, the higher the natural rate of growth. The equation described above is in line with the arguments defended by Kaldor (1966 and 1970), who stresses the role of industry as an "engine" of long-term economic growth.

By substituting expression (5.1) in equation (3.1), the obstacles to economic growth in the balance-of-payments-constrained models described by Palley (1996 and 2002) are avoided.

$$u^*_s = \frac{1}{c}\left[\alpha\varphi A - c_0 B - \left(\frac{c_0+\eta_s}{1-c_1 h_s}\right)\left(c_1 h_s B - b_0\right) + \alpha_0 g_N\right] - j_0 \tag{3.2}$$

For the parameters A and B to be positive, the sum of the price elasticities of exports and imports (Marshall-Lerner condition) must be sufficiently small or the sensitivity of the nominal exchange-rate variation to the interest differential, associated with capital mobility, must assume suitably small values. For the parameter C to assume positive values, the sum of the price elasticities of exports and imports must be greater than the ratio of the capital flow elasticity (corresponding to the real interest rate in the South) over the nominal exchange rate elasticity (relative to the difference between the North and South real interest rates), plus one, i.e. $a_1 + b_1 > \frac{\varepsilon_1}{\varepsilon_1} + 1$.

The difficulty in presenting concrete results regarding the values of the price elasticities of a nation's exports and imports is due to the great variability of values found in the empirical literature. After analysing the work of Zini Jr. (1988), Fullerton, Sawyer and Sprinkle (1999), Castro and Cavalcanti (1997), De Campos and Arienti (2002), Skiendziel (2008), Dos Santos and others (2011) and Kawamoto, Santana and Fonseca (2013), different values corresponding to the price elasticity of exports and imports were found.

III. Dynamic equations

Since industry has increasing returns to productive scale and, in addition, injects dynamism into the economy through technological progress, learning and spillovers into other economic sectors, industrialization becomes a key element for recovery and convergence in the North-South model (Szirmai, 2012; Felipe and others, 2007).[7]

In his empirical work, Rodrik (2009) notes that the accelerated growth that took place in developing economies from the 1960s onwards was due to the transfer of productive resources between sectors. This, because the growth of developing nations requires that the global economy be able to rapidly absorb their supply of tradable goods. Thus, for developing countries, the strategy that still exists is exchange rate depreciation, whereby export quantity increases, and that in turn stimulates industrialisation. It can be concluded, therefore, that industrial activities, operating with increasing returns to scale, have become the “engine” of long-term economic growth.

Szirmai (2012) highlights industrial participation as a key element for long-term economic growth. According to that author, as the transfer of resources and labour from the agricultural to the industrial sector takes place, there is a structural change bonus due to the fact that labour productivity in the agricultural sector is lower than labour productivity in industry.

According to Felipe and others (2007), the industrial sector is considered to have the greatest impact on economic growth, followed by the services sector and manufacturing. According to those authors, this is due to the linkages that the industrial sector provides to the economy. In their study, the activities responsible for those linkages were the electricity and infrastructure sectors.

According to Gabriel (2016), the dynamics of the industry’s growth rate in the South’s output is a function of the difference between price competitiveness and non-price competitiveness. Moreover, by assuming that the exchange rate is overvalued with respect to the industrial-equilibrium exchange rate, the share of industry in output is reduced, given that there is a transfer-out of productive activity abroad (Bresser-Pereira, Oreiro and Marconi, 2014).

Thus, the overvaluation of the exchange rate generates a negative change in the structure of the economy, causing what Palma (2005) calls “premature deindustrialization”.[8] Frenkel and Rapetti (2014) show that for the share of industry in the South to increase, the exchange rate must be stable and undervalued, with a level at or slightly above the industrial-equilibrium real exchange rate.

According to the above arguments, the dynamics of the industry share in the South is given by a non-linear (quadratic) function of exchange rate misalignment.

$$\hat{h}_s = \sigma\left(\varphi - \varphi^2\right) \tag{14}$$

Where σ represents the sensitivity of exchange rate misalignment to industrial sector development policies.

Thus, the growth rate of the industry share of output tends to increase as the real effective exchange rate depreciates relative to the industrial-equilibrium exchange rate. Beyond a certain critical point, any depreciation of the real effective exchange rate tends to reduce the industry share of output. This functional relationship thus captures the dual effect of exchange rate misalignment on industry’s share

[7] On this subject, there are other authors who analyse the laws developed by Kaldor, namely: Fingleton and McCombie (1998), Harris and Liu (1999), and Leon-Ledesma (2000), among others.

[8] Other texts describing the consequences of exchange rate overvaluation and deindustrialisation include Bresser-Pereira (2007) and Marconi and Rocha (2011).

of GDP. For exchange rate misalignment values below (above) the critical value, price competitiveness gains more than offset (do not offset) the increase in imported input costs. This causes the increase (decrease) in the industry share of output.

Under the assumption that inflation in the North is zero, the growth rate of the real exchange rate is as follows:

$$\hat{\theta} = \hat{e} - \hat{p}_s \tag{15}$$

By substituting equations (3.2), (7) and (13.1) in (15) it is possible to find the expression that describes the growth rate of the real exchange rate compatible with the balance of payments equilibrium and the equilibrium between aggregate demand and supply.

$$\begin{aligned}\hat{\theta} =& -\alpha\varphi\left[\varepsilon_0\left(\frac{A}{C}-\frac{1}{1-\phi}\right)+\frac{1}{1-\phi}\right]+c_0\left[1+\varepsilon_0\left(\frac{B}{C}-1\right)\right]+\\ &\left(\frac{c_0+\eta_s}{1-c_1h_s}\right)\left\{\varepsilon_0\left[c_1h_s\left(\frac{B}{C}-1\right)-\frac{b_0}{c}\right]+c_1h_s\right\}-\frac{\varepsilon_0 a_0 g_N}{c}\end{aligned} \tag{15.1}$$

From the above equation, it can be seen that the growth rate of the real exchange rate is positively affected by the profit margin and the industry share of GDP. Thus, assuming a positive change in exchange rate misalignment or in the industry share of GDP, there will be a depreciation of the real exchange rate growth rate.

Equations (14) and (15.1) form a two-dimensional system of non-linear differential equations.

1. Dynamic analysis with capital mobility and a floating exchange rate

The equation representing the location of $\hat{h}_s$ is described below:

$$\left(1+2\theta^{ind}\right)\theta-\theta^2=\theta^{ind}+\theta^{ind^2} \tag{16}$$

Deriving equation (16), which corresponds to the locus of the industry share of GDP with respect to the real exchange rate, gives the slope, the concavity of the curve and the critical point. As can be seen below:

$$\frac{\partial\hat{h}_s}{\partial\theta}=-2\theta+1+2\theta^{ind} \tag{16.1}$$

$$\frac{\partial^2\hat{h}_s}{\partial\theta^2}=-2<0 \tag{16.2}$$

Thus, it can be seen that the curve corresponds to a parabola with the concavity oriented downwards. This parabola presents a critical point for the real exchange rate, which turns its influence on the growth rate of the industry share of GDP from positive to negative, depending on whether it is above or below that critical level.[9]

[9] The critical value of the exchange rate is: $\theta^{cri}=\frac{1}{2}+\theta^{ind}$.

In addition, there are two distinct roots that make the locus of the industry share of GDP zero.[10] The values of the roots could only be determined after normalising the equilibrium exchange rate to be equal to one ($\theta^{ind} = 1$). Therefore, multiple equilibria will be found in the plane $(\hat{h}_s, \theta)$.

In contrast, the locus of $\hat{\theta}$ occurs when the change in the real exchange rate is constant $(\hat{\theta} = 0)$. The expression representing is as follows:

$$\theta^{\cdot} = \frac{1}{D}\left\{c_0\left[1+\varepsilon_0\left(\frac{B}{C}-1\right)\right]+\left(\frac{c_0+\eta_s}{1-c_1 h_s}\right)\left\{\varepsilon_0\left[c_1 h_s\left(\frac{B}{C}-1\right)-\frac{b_0}{c}\right]+c_1 h_s\right\}-\frac{\varepsilon_0 a_0 g_N}{c}\right\}+\theta^{ind} \tag{17}$$

Where: $D \equiv \alpha\left[\varepsilon_0\left(\frac{A}{C}-\frac{1}{1-\phi}\right)+\frac{1}{1-\phi}\right]$

The slopes of the loci $\hat{h}_s = 0$ and $\hat{\theta} = 0$ are, respectively:

$$\frac{\frac{\partial\theta^{\cdot}}{\partial\hat{h}_s}}{\hat{h}_s} = 0 \tag{16a}$$

$$\frac{\frac{\partial\theta^{\cdot}}{\partial\hat{h}_s}}{\hat{\theta}} = \frac{c_1\left(c_0+\eta_s\right)}{D\left(1-c_1 h_s\right)^2}\left[\varepsilon_0\left(\frac{B}{C}-1-\frac{b_0}{C}\right)+1\right] \tag{17a}$$

As can be seen, the derivative (16a) will present a line that will be parallel to the plane h_s since its slope is zero. To verify the slope of the locus of the exchange rate growth rate with respect to the industry share of GDP (17a), it is necessary to analyse the value of the parameter (D) and the term $\frac{B}{c}-1$. Like the other parameters, (D) will also be positive.

Therefore, for the Marshall-Lerner condition to be fulfilled,[11] it is necessary that $\frac{B}{c}-1 < 0$. In addition, $C\left[\varepsilon_0\left(\frac{B}{c}-1-\frac{b_0}{c}\right)+1\right] < \varepsilon_0 b_0$ better satisfies the assumed conditions. Thus, the higher the Marshall-Lerner condition, the greater the chance that the slope of the locus $\hat{\theta} = 0$ will be negative and concave.

The system of equations comprising equations (14) and (15.1) will be derived with respect to h_s and θ, in order to reveal the elements composing the Jacobian matrix, as shown below:

$$\begin{bmatrix}\hat{h}_s\\ \hat{\theta}\end{bmatrix} = \begin{bmatrix} 0 & \sigma\left(\theta^{cri}-\theta\right)\\ \frac{c_1\left(c_0+\eta_s\right)}{D\left(1-c_1 h_s\right)^2}\left[\varepsilon_0\left(\frac{B}{c}-1-\frac{b_0}{c}\right)+1\right] & -(D)\end{bmatrix}\begin{bmatrix} h_s-h^*_s\\ \theta-\theta^*\end{bmatrix} \tag{18}$$

According to equation (18) and recalling the assumption that the parameter (D) is positive, it is observed that: (i) the trace is negative ($-D$) and (ii) the determinant can have both negative and positive values. This is because it depends on the derivative of the growth rate of the industry share in the South relative to the exchange rate ($\boldsymbol{elementJ_{12}}$) and the growth rate of the real exchange rate relative to the South's industry share ($\boldsymbol{elementJ_{21}}$).[12] The conditions of the terms are as follows.

[10] The distinct real roots are: $\theta' = 1$ and $\theta'' = 2$.

[11] The depreciation of the real exchange rate will generate an increase in net exports if, and only if, the sum of the price elasticities of exports and imports is, in modulus, greater than one unit.

[12] According to Gandolfo (1997) and Chiang (2005).

Thus, based on the conditions shown in table 1 and knowing that the value of the trace is negative, the determinant for a long-run equilibrium path must necessarily be positive. Thus, by assumption, the value of the term J_{21} will be positive, since the term $\frac{B}{c} - 1$ assumes the negative value. Therefore, analysis of the exchange rate regime is crucial for verifying the long-run equilibrium path.

Table 1
Possible values of J_{12} and J_{21}

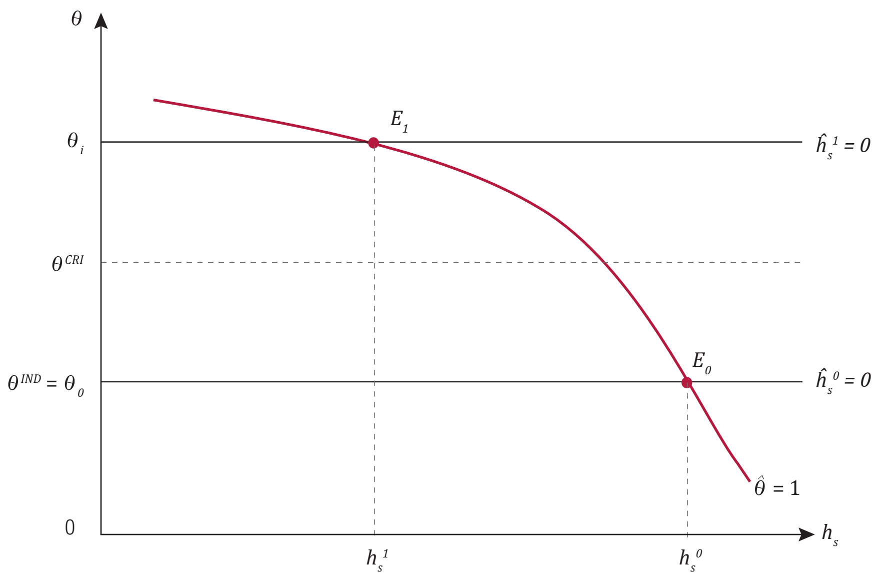
	Term sign	Necessary condition
(1)	$\sigma\,(1 + 2\theta^{ind} - 2\theta) > 0$	$\theta < \theta^{CRI}$
(2)	$\sigma\,(1 + 2\theta^{ind} - 2\theta) < 0$	$\theta > \theta^{CRI}$
(3)	$\left[\varepsilon_0\left(\frac{B}{C} - 1 - \frac{b_0}{C}\right) + 1\right] > 0 \; e\frac{B}{C} - 1 < 0$	$1 > \varepsilon_0\left(\frac{b_0}{C} - \frac{B}{C} + 1\right)$
(4)	$\left[\varepsilon_0\left(\frac{B}{C} - 1 - \frac{b_0}{C}\right) + 1\right] < 0 \; e\frac{B}{C} - 1 < 0$	$1 < \varepsilon_0\left(\frac{b_0}{C} - \frac{B}{C} + 1\right)$

Source: Prepared by the authors.

Also, the smaller the value of the nominal exchange rate sensitivity coefficient (ε_0), i.e., the less close the change in the nominal exchange rate is to the value equivalent to the fixed exchange rate regimefijo $(\varepsilon_0 = 0)$, the easier it is for condition (3) to be fulfilled. On the other hand, the higher the sensitivity of the nominal exchange rate, approaching one, similar to the case of the flexible exchange rate regime, the easier it becomes for condition (4) to be reached.

When the real exchange rate is lower than the critical real exchange rate, an unstable equilibrium path is found. Conversely, when the opposite is true, i.e. when the real exchange rate is higher than the critical real exchange rate, a stable long-run equilibrium path is observed. Therefore, two equilibria are found in figure 1.

Figure 1
Long-run equilibrium path for an economy with capital mobility and a flexible exchange rate



Source: Prepared by the authors.

Based on the above, the system is in stable equilibrium when the real exchange rate depreciates above the critical value. In this case the industry share of GDP is lower than in the second case. The latter presents the real exchange rate appreciated and below the critical level, with the industry share of GDP quite high in the economy. Neither result is in line with the main hypothesis of the paper, where the real exchange rate and the industry share of GDP should be high.

In the case of the flexible exchange rate regime, the relationship between the real exchange rate and the industry share of GDP is inverse, so that an increase in the real exchange rate reduces the share of industry in the economy. Moreover, stable long-run equilibrium is found only when the real exchange rate is quite depreciated, and the industry share of GDP is low.

It is also worth investigating the model with capital mobility and a fixed exchange rate, recalling that in this case the value of nominal exchange rate elasticity will be zero ($\varepsilon_0 = 0$). The loci of $\hat{h}_s$ and $\hat{\theta}$, the equilibrium dynamics and the phase diagram for an economy with capital mobility and a fixed exchange rate are analysed below.

2. Dynamic analysis with capital mobility and a fixed exchange rate

The equation for the locus of $\hat{h}_s$ when $\varepsilon_0 = 0$ is as follows:

$$\left(1+2\theta^{ind}\right)\theta-\theta^2=\theta^{ind}+\theta^{ind^2} \tag{19}$$

The locus of $\hat{\theta}$ can be verified as follows:

$$\theta^{\cdot}=\frac{1}{D}\left\{c_0+\left(\frac{c_0+\eta_s}{1-c_1h_s}\right)c_1h_s\right\}+\theta^{ind} \tag{20}$$

Where: $D \equiv \frac{\alpha}{1-\phi}$

The dynamics of the loci are shown in figure 2, which plots the relationship between the real exchange rate and the industry share of output in the South, as above:

$$\frac{\frac{\partial\theta^{\cdot}}{\partial\hat{h}_s}}{\hat{h}_s}=0 \tag{19a}$$

$$\frac{\frac{\partial\theta^{\cdot}}{\partial\hat{h}_s}}{\hat{\theta}}=\frac{c_1\left(c_0+\eta_s\right)}{D\left(1-c_1h_s\right)^2} \tag{20a}$$

As in the previous case, the derivative (19a) will be a horizontal line in the plane $(\hat{h}_s, \hat{\theta})$. Thus, no change in the industry share will affect the equilibrium exchange rate. When analysing the derivatives (20a), it is found that the slope will certainly be positive and convex.

The system consisting of equations (14) and (15.2) will be derived with respect to $\hat{h}_s$ and $\hat{\theta}$, assuming a fixed exchange rate regime. This can be obtained by assuming $\varepsilon_0 = 0$.

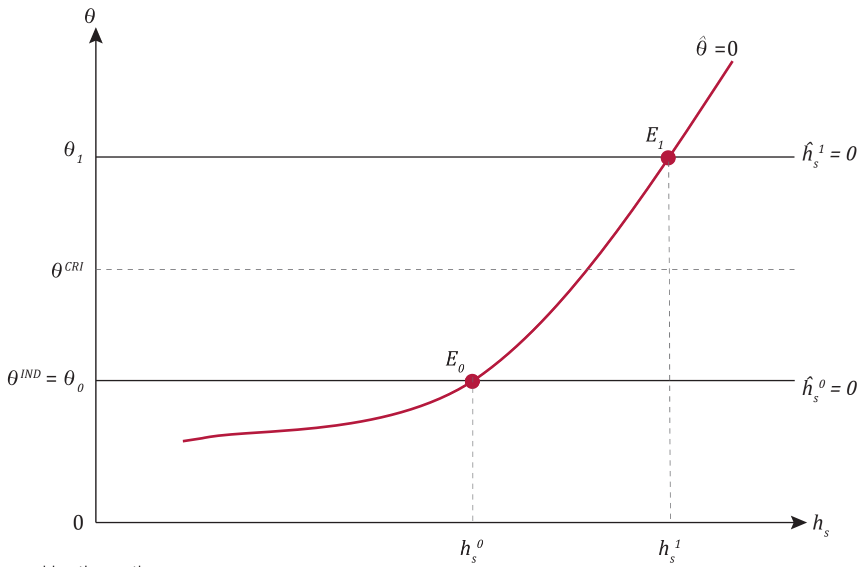
$$\begin{bmatrix}\hat{h}_s\\ \hat{\theta}\end{bmatrix}=\begin{bmatrix}0 & \sigma\left(\theta^{cri}-\theta\right)\\ \frac{c_1\left(c_0+\eta_s\right)}{D\left(1-c_1h_s\right)^2} & -\left(D\right)\end{bmatrix}\begin{bmatrix}h_s-h^*_s\\ \theta-\theta^*\end{bmatrix} \tag{21}$$

Looking at equation (21) and taking into account the negative value of the element J_{22}, it can be seen that the trace will be negative and the determinant depends on the ratio of the depreciation of the real exchange rate to the industrial equilibrium exchange rate (J_{12}).

Thus, unstable equilibrium occurs when the real exchange rate is lower than the critical real exchange rate, where the share of industry in GDP is relatively small. On the other hand, when the real exchange rate is sufficiently depreciated and the industry share of output in the South is relatively higher, the equilibrium will be stable in the long run. Thus, in the second case, when the exchange rate and the share of industry in GDP are high, the result converges to the hypothesis presented in this paper.

In this case, the model with capital mobility and a fixed exchange rate is shown in figure 2, which represents the long-run equilibrium path, since there are multiple equilibria.

Figure 2
Long-run equilibrium path for an economy with capital mobility and a fixed exchange rate



Source: Prepared by the authors.

When the economy has a fixed exchange rate regime and the exchange rate is depreciated, there is a high share of industry in the economy, which is the stable point in the long-run equilibrium path. Thus, the relationship between the real exchange rate and the share of industry in GDP is positive. However, when the real exchange rate falls below the critical point, the path becomes unstable in the long run.

IV. Conclusions

The aim of this paper was to analyse the interactions between different exchange rate regimes and the share of industry in GDP, in order, by that means, to verify the conditions for self-sustaining economic growth in a developing economy.

The model proposed in this paper indicates different long-run equilibria depending on the exchange rate regimes used. Assuming a flexible (fixed) exchange rate regime, the equilibrium relationship between the real exchange rate and the share of industry in output is inverse (direct).

Thus, with a flexible exchange rate, the long-run equilibrium will have a stable path when the real exchange rate is depreciating above the level of the critical real exchange rate and, at the same time, the industry share of output is relatively low. On the other hand, with a fixed exchange rate, the equilibrium will be stable when the real exchange rate is above the level of the critical real exchange rate and, at the same time, the share of industry in the economy is relatively high.

Thus, the model developed with capital mobility and fixed exchange rate fulfilled the initial hypothesis better, since it assumes a depreciated real exchange rate, as observed in the two cases presented, but with a high industry share of GDP, found only in the case where the exchange rate is considered fixed. Thus, monetary agents should set the value of the nominal exchange rate and depreciate the real exchange rate above the critical exchange rate in order to have a long-run equilibrium path.

The depreciation of the real exchange rate increases equilibrium effective demand, since depreciation stimulates net exports. The industry share of GDP in the South has an ambiguous effect. If the income elasticity of imports is sufficiently high (low), the increase (decrease) in industry's share tends to increase (reduce) the equilibrium installed capacity utilisation.

A particularly interesting result of the model is the importance of price elasticities of exports and imports for long-term stability. Once the Marshall-Lerner condition is satisfied, the locus $\hat{\theta} = 0$ will certainly be negative in the plane $(\hat{h}_s, \hat{\theta})$ in the presence of a fixed exchange rate. If the sum of the price elasticities of exports and imports is high, there will be a greater chance that the locus $\hat{\theta} = 0$ will be negatively tilted in the plane $(\hat{h}_s, \hat{\theta})$ when a floating exchange rate is adopted.

Finally, multiple long-run equilibria were verified for the two exchange rate regimes proposed. In particular, it was observed that under the flexible (fixed) exchange rate regime, stable equilibrium is found when the industry share of GDP in the South is relatively low (high).

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