Endogenous Productivity Regime and the Impact of Devaluations of Real Exchange Rate on Economic Growth

Hugo C. Iasco-Pereira[1]
Fabrício J. Missio[2]

Abstract

This article studies the influence of the real exchange rate on economic growth. For that, a model of cumulative and circular causation is developed. The argument pursued is that the real exchange rate influences the profit-rate of firms, affecting capital accumulation. The novelty of this article is to endogenize the parameters of the productivity regime regarding capital accumulation. By making the autonomous productivity growth and the magnitude of the Verdoorn's coefficient endogenous, the real exchange rate influences the labor productivity growth and the intensity of the Kaldor-Verdoorn mechanism. The model shows that devaluations of real exchange rate exert a positive impact on the economic growth of economies under profit-led regimes of demand and capital accumulation, provided by its positive effect on the growth rate of demand and labor productivity. The model also indicates that the devaluations of real exchange rate can exert a positive or negative impact on the economic growth of economies under a wage-led regime of demand and wage- (profit-) led capital accumulation regime.

Key words: Real Exchange Rate; Cumulative and Circular Causation; Economic Growth.

Resumo

O objetivo deste artigo é estudar a influência da taxa de câmbio real no crescimento econômico. Para tanto, desenvolve-se um modelo de causação circular e cumulativa. O argumento é que a taxa de câmbio real influencia a taxa de lucro das empresas e, por conseguinte, a acumulação de capital. A contribuição original deste artigo à literatura é endogenizar os parâmetros do regime de produtividade em relação à acumulação de capital. Ao tratar o crescimento autônomo da produtividade do trabalho e a magnitude do coeficiente de Verdoorn endógeno, a taxa de câmbio real influencia o crescimento da produtividade do trabalho e a intensidade do mecanismo Kaldor-Verdoorn. O modelo teórico demonstra que desvalorizações da taxa de câmbio real exercem um impacto positivo no crescimento econômico de econômico de economias com regime de demanda e acumulação de capital *profit-led*, o que é impulsionado por aumentos da demanda e pela produtividade do trabalho. Outro resultado é que desvalorizações cambiais podem produzir um efeito positivo no crescimento de economias com regime de demanda e acumulação de capital *wage-led*, o que depende da combinação de parâmetros do modelo.

Palavras-chave: Taxa de Câmbio Real; Causação Circular e Cumulativa; Crescimento.

Code JEL: O10 and O11

[1] PhD in Applied Economics – CEDEPLAR-UFMG, e-mail: hugo.carcanholo@gmail.com
[2] Professor at CEDEPLAR-UFMG, e-mail: fjmissio@cedeplar.ufmg.br

1- Introduction

Various studies confirmed the positive impacts of devaluations of the real exchange rate (RER, henceforth) on economic growth (e.g., Acemoglu et al., 2003, Easterly, 2001, Rodrik, 2008, Gala, 2008 Vieira and MacDonald, 2012, Rapetti et al., 2011). Usually, the Kaldorian literature explains it in terms of the balance of payment constraint growth models *a la* Thirlwall (1979).

A usual argument of the authors of this literature is the endogeneity of the income-elasticity of exports regarding the effects of RER on the productive structure. The argument is that a competitive RER favors manufacturing activities. As a result, the sectoral composition of income-elasticities of exports changes, in the sense that the share of manufacturing (more complex) goods in exports expands. As the income-elasticity of exports of these sectors are more significant, the consequence is a greater growth rate of output consistent with the equilibrium in balance of payment (Ferrari et al, 2013, Missio at al., 2017a,b are examples of this literature).

The *rationale* behind this approach is that a competitive RER influences the productive structure, which reflects upon the composition of income-elasticities of exports. As the fundamentals of economic growth are the parameters of external constraint, pursuing a competitive RER becomes a strategy to boost it. Such an approach, therefore, explains the influence of RER on economic growth via the *actual growth rate* (Thirlwall, 2001, McCombie, 2012). This article seeks to study the impacts of RER's devaluations over economic growth via the *natural growth rate*. The theoretical model, developed in this article, assumes that economic growth is demand-led and is characterized by a process of circular and cumulative causation. The growth rate of demand and labor productivity feed each other *a la* the canonical growth model of Kaldor-Dixon-Thirlwall (KDT, henceforth) (Kaldor, 1970, Thirlwall and Dixon, 1975). Within this framework, two elements are crucial in determining the possible growth paths: the demand growth and the parameters of labor productivity growth.

The canonical growth model KDT has some shortcomings to study the association between RER and economic growth. The demand is determined uniquely by the exports. The domestic demand is disregarded. It turns out, yet, that the devaluations of RER can exert contractionary effects on economic growth as long it reduces the real wages, damaging the domestic demand (Diaz Alejandro, 1963). In order to remedy it, the paper introduces the domestic demand into the picture in accordance with Bahduri and Marglin (1990). Another important shortcoming of the canonical growth model KDT is the exogeneity of the parameters of the Kaldor-Verdoorn mechanism. Although these parameters are crucial to explain the growth path, they are not explained. This paper endogenizes the parameters of the Kaldor-Verdoorn mechanism to the institutional regime, as Setterfield and Cornwall (2002) propose.

The paper's contributions to the existing literature are twofold. First, the paper provides a growth model of cumulative and circular causation, in which the RER influences the growth path by the demand-side and by the supply-side factors. The influence of devaluations of RER on economic growth, via the demand-side, is associated with the regime of demand. The influence of RER's devaluations on economic growth, via the supply-side, is connected with the influence of RER on capital accumulation, which affects the parameters of the Kaldor-Verdoorn mechanism. In this scheme, the demand-growth remains the primary determinant of labor productivity. The capital accumulation induced by the RER appears as

an argument that influences the degree of cumulative and circular causation of economic growth. Such contribution means that the labor productivity depends on the demand growth *a la* Verdoorn (1949) and Kaldor (1966) as on the capital accumulation *a la* Kaldor (1957) (Ros, 2015). Second, the paper displays that, in economies under profit-led regimes of demand and capital accumulation, the more intense degree of cumulative and circular causation induced by RER's devaluations boost economic growth. The paper also shows that, in economies under wage-led regimes of demand and capital accumulation, the less intense degree of cumulative and circular causation induced by devaluations of RER can exert a positive influence on the economic growth, under certain assumptions. The paper demonstrates that the more intense degree of cumulative and circular causation induced by RER's devaluations damage economic growth, in economies under a wage-led regime of demand and a profit-led regime of capital accumulation.

This article consists of four sections besides this introduction. Section 2 discusses the canonical Kaldorian growth model KDT, emphasizing its shortcoming to study the influence of RER on economic growth. Section 3 discusses the fundamentals of the developed model. Section 4 solves the model for the equilibrium values and discusses the impact of devaluations of RER on economic growth for different combinations of demand regimes and capital accumulation regimes. Section 5 ends the article with the conclusions.

2- The Canonical Growth Model of Cumulative and Circular Causation: the export-led approach of Kaldor-Dixon-Thirlwall

The growth model of Kaldor (1970), and Dixon and Thirlwall (1975), is the canonical model of the cumulative and circular causation within the Kaldorian tradition. This group of growth models is characterized by a demand-driven approach for economic growth, in which the exports assume preeminent importance. The growth rate of domestic economy $g_{d,t}$ is demand-determined, and the growth of exports $x_{d,t}$ is the unique source of demand:[3]

$$g_{d,t}=\gamma(x_{d,t}) \quad (1)$$

where the subscripts *d* and *t* denote for domestic economy and time, respectively.

The growth of exports is described as a function of changes in domestic and foreign prices, abroad income, represented by the variables $p_{d,t}$, $p_{f,t}$ and z_t respectively:

$$x_{d,t}= -np_{d,t} + \delta p_{f,t} + \epsilon z_t \quad (2)$$

where the parameter n, δ and ϵ represent the price-elasticity of demand for exports, the price-elasticity of demand for imports, and income-elasticity of demand for exports, respectively.

The changes in domestic prices are modelled as:

$$p_{d,t} = w_{d,t} - r_{d,t} + \mu_{d,t} \quad (3)$$

where the variables $w_{d,t}$, $r_{d,t}$, $\mu_{d,t}$ are the growth rate of nominal wage, labor productivity and markup rate on unit labor cost, respectively.

The growth of labor productivity is modelled following Kaldor-Verdoorn's law:

$$r_{d,t} = r_{d,a} + \lambda_d g_{d,t} \quad (4)$$

The labor productivity is a positive function of demand growth due to the existence of increasing returns to scale (Young, 1928, Verdoorn, 1949, Kaldor, 1966). The parameter $r_{d,a}$ is the autonomous productivity growth, while λ_d is the elasticity of productivity growth to demand growth: as higher is the pace of demand growth, higher the growth rate of labor productivity.

[3] The lower caser letter means that the variable in growth rate.

Introducing (4), (3), (2) into (1) leads to the growth rate of the economy:

$$g_{d,t}^{*} = \gamma[n(w_{d,t} - r_{d,a} + \mu_{d,t}) + \delta p_{f,t} + \epsilon z_t](1 + \gamma n\lambda_d)^{-1} \quad (5)$$

Assuming that $w_{d,t}=\mu_{d,t}=z_{f,t}=p_{f,t}=0$ (for the sake of simplicity), as Dixon and Thirlwall (1975) do:

$$g_{d,t}^{*} = \gamma[n(-r_{d,a})](1 + \gamma n\lambda_d)^{-1} \quad (5.1)$$

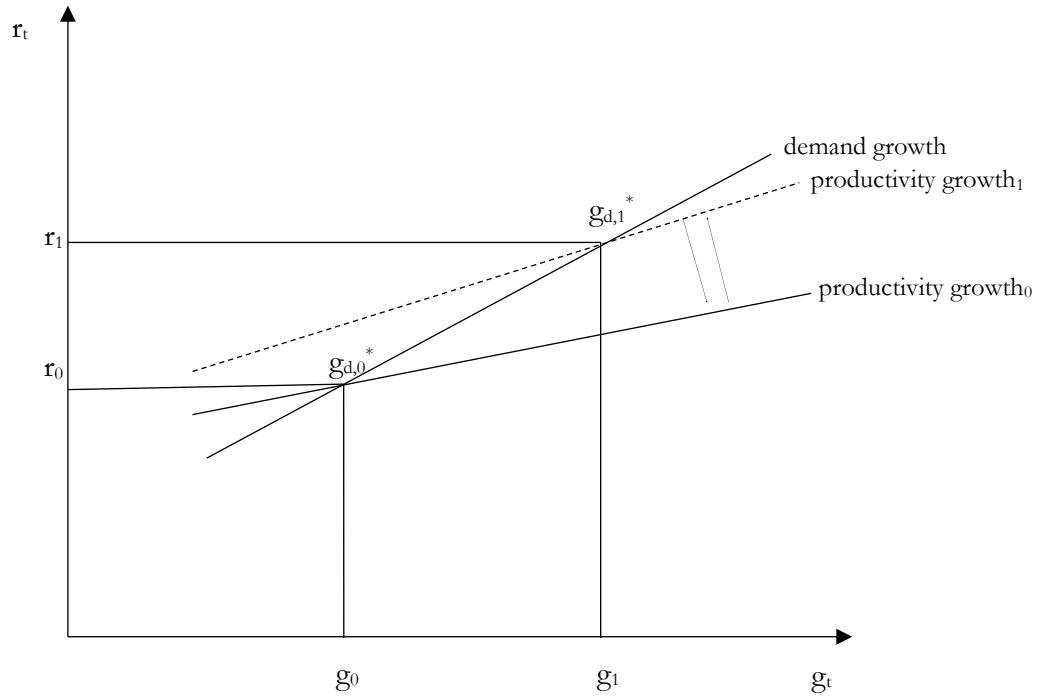
equations (5) and (5.1) are the growth rate of output. The economic performance is positively associated to increases in autonomous productivity (n is negative) and to Verdoorn's coefficient. Put differently, as higher are the parameters $r_{d,a}$ and λ_d, greater the growth rate of output. The productivity rises as more rapidly is the growth rate of demand. The cumulative and circular causation logic of the export-led approach of KDT model is provided by the feedback interaction between the growth rate of demand and labor productivity. Demand growth (equation (1)) and labor productivity growth (equation (4)) feed mutually, forming a system of equations presented graphically in Figure 1.

The general solution of equation (5.1) is represented by (Y is the initial value of income):

$$Y(t) = Ye^{\gamma[n(-r_{d,a})(1+\gamma n\lambda_d)^{-1}]} \quad (6)$$

The stationary equilibrium of this system of equation requires that the parameters γn be smaller than one and that $\gamma n\lambda_d$ be smaller than γn: $\gamma n\lambda_d<\gamma n<1$, which is assumed.

Figure 1- Economic growth in KDT Model



An inspection of Figure 1 displays that, *ceteris paribus*, as greater is the productivity growth, greater is the economy's growth. The position of the productivity regime curve determines the economic performance. Displacements upwards (downwards) of productivity line due to changes in $r_{d,a}$ accelerate (slow down) the growth rate of economy $g_{d,t}^{*}$. Whilst as steeper (flatter) is the productivity equation, higher (lower) the growth rate of economy $g_{d,t}^{*}$. Figure 1 illustrates it: in the equilibrium value $g_{d,0}^{*}$, the parameters $r_{d,a}$ and λ_d are smaller than

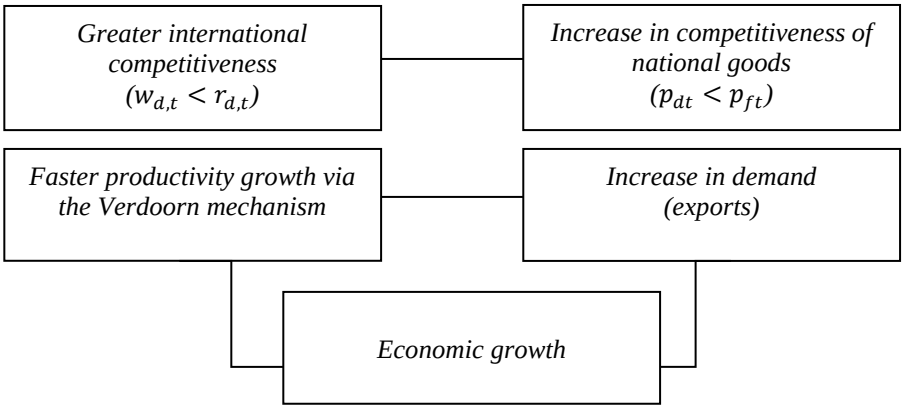
in the equilibrium value $g_{d,1}^{*}$. Similarly, any increment in demand growth (exports) increases the economy's growth, by dislocating the demand line to the right.

2.1- *The Limited Comprehension about the effects of RER on Economic Growth*

The KDT growth model has a limited comprehension of the effects of RER on economic performance:

i- The RER does not appear as an argument in the canonical model. The international competitiveness of domestic production is represented by the difference between nominal wage and labor productivity. The KDT growth model tells the traditional narrative of an export-led growth theory. A great competitiveness induced by smaller increases in nominal wages than labor productivity promotes economic growth by expanding exports:

Figure 2 - International Competitiveness and Economic Growth



ii- The exports are the unique source of demand in a manner that the economy always will grow more rapidly because of a great international competitiveness. However, the effects of great international competitiveness induced by a lower rate of growth from wages go further than merely expanding exports. There are effects associated with other sources of demand via income distribution. The reduction in wages can bring down the demand growth, as its effects on income distribution are also associated with domestic demand (Diaz Alejandro, 1963).

iii- The parameters of the Kaldor-Verdoorn mechanism are central to explain the cross-country differences in terms of economic performance. However, too little attention is paid to explain its determinants. Both parameters $r_{d,a}$ and λ_d are assumed as given and constant in the original KDT model. The autonomous productivity growth and the Verdoorn's coefficient are understood as a function of capital accumulation (which embodies technical progress) induced by the demand growth (Kaldor, 1957). In particular, r_a is the autonomous rate of capital accumulation per worker, while λ is the capital accumulation induced by demand growth and the pace of technical progress incorporated in capital accumulation (Dixon and Thirlwall, 1975).

iv- Taking the Kaldor-Verdoorn mechanism exogenously produce important consequences to understand the economic development and the effects of RER on economic growth. Firstly, there is a strong emphasis on the initial condition that, in the absence of shocks, determines the relative growth of economies (Setterfield, 1997). As productivity equation parameters are given and constant, economies that grew more in the past grow more

currently (Setterfield, 1997). Falling behind and catching up between economies are not theoretically possible (León-Ledesma, 2002). Some authors have efforted to remedy this shortcoming. Setterfield (1995, 1997) endogenized the magnitude of the Verdoorn coefficient for institutions. León-Ledesma (2002) argued that non-price variables as innovative activities, investment, and education are important sources of productivity growth, as is demand growth. Ocampo (2005) has argued that either shifts or the productivity regime equation's slope are positively associated with technological progress. The empirical evidence of Romero and Britto (2017) and Romero (2019) confirm the positive association between the magnitude of Verdoorn's coefficient and the research intensity and innovations. Secondly, the effects of RER on labor productivity via demand growth is only a part of the story. The RER influences capital accumulation, technological progress, and the R&D of firms (Souto e Resende, 2018), which is associated with labor productivity. Therefore, the RER influences labor productivity via demand growth and via its effects over technological progress, which should be considered together to provide a better understanding of the effects of RER on economic growth.

A growth model is developed hereafter within the cumulative and circular causation tradition to understand the effects of RER over the economic performance, considering the raised limitations about the canonical KDT growth model.

3- A Growth Model of Cumulative and Circular Causation

The growth model developed in this article follows the analytical structure of Setterfield and Cornwall (2002), in which the economic growth is taken as a cumulative and circular process, and three elements are interwoven that, combined, constitute the *Macroeconomic Regime* (MR):

(1) *Demand Regime* (DR): the demand regime describes the formation of demand growth. The theoretical model of this article expands the sources of demand in addition to the exports, considering the domestic sources of demand: investment, consumption, and imports.

(2) *Productivity Regime* (PR): the productivity regime describes labor productivity growth determinants. The model of this article assumes that labor productivity growth is determined by the Kaldor-Verdoorn mechanism.

(3) *Institutional Regime* (IR): the non-price variables that affect the size of r_a and λ constitute the institutional regime. The institutional regime encompasses the macro-institutional structure within the economic behavior that occurs and constitutes the operating system related to the social infrastructure, uncertainty, social conflict, stability, long-run expectations, income distribution claims (Setterfield and Cornwall, 2002). An institutional regime based on the absence (existence) of distributive conflict and uncertainty, concerning the profit-share of GDP and a growing up (slowing down) demand, generates a period of strong (weak) capital accumulation (Setterfield and Cornwall, 2002). Consequently, the parameters r_a and λ are higher (lower), which enhance (diminish) the growth rate of productivity and demand (Setterfield and Cornwall, 2002).

Furthermore, the model is developed assuming that:

(1) The RER, represented by Θ_t, is the price of foreign currency in terms of the domestic currency (it is the price of the national currency to the eyes of the foreign buyer). As lower is the Θ_t, cheaper is the domestic goods in the international market. It is assumed that Θ_t is

determined exogenously by the monetary authority in order to make domestic goods more competitive in relation to foreign goods.

(2) The income distribution between workers and capitalists is the link between RER and demand growth: RER influences consumption (wage-share), investment (profitability), and net exports (international competitiveness).

(3) The productivity regime is endogenous to RER. The argument is that the RER influences the magnitude of parameters r_a and λ via its effects on the investments (that embodies technological progress).

The theoretical model is developed following the subsequent steps. Firstly, the link between RER, prices and income distribution is modeled. The demand and productivity regimes are modeled, connecting RER, income distribution, demand, and labor productivity growth.

3.1- *RER, Prices, and Income Distribution*

Following the Kaleckian tradition, the prices of exported domestic goods $P_{dx,t}$ (in foreign currency) are modelled following a markup rule under the costs:

$$P_{dx,t}= \Theta_t\{[(\Theta_t^{-1}M_t)^{\sigma}N_t^{1-\sigma})^{\psi}+(W_t/R_t)^{1-\psi}](1+ MK_t)\} \quad (7)$$

The variables M_t, N_t, E_t, R_t stand for the imported inputs used in production, the national inputs employed in production, the nominal wage, and the labor productivity, respectively. The parameter ψ represents the share of inputs in costs, and $(1-\psi)$ is the share of labor in costs. The parameter σ is the share of imported inputs in all inputs, while $(1-\sigma)$ is the share of domestic inputs in all inputs employed in production. Lastly, the vector $(1+MK_t)$ is the markup rule.

The log-difference of equation (7) means that the changes in the prices of exported goods are represented by:

$$p_{dx,t}= \theta_t - \psi\sigma\theta_t +\psi\sigma n_t +\psi(1-\sigma)z_t+(1-\psi)(w_t-r_r)+mk_t \quad (8)$$

Assuming that $n_t=m_t=w_t=0$ (by the benefit of simplicity):

$$p_{dx,t}= (1 - \psi\sigma)\theta_t - (1-\psi)r_r + mk_t \quad (8.1)$$

Blecker (1989) argues that the markup rate is endogenous to RER. The argument is that devaluations of RER allow the domestic firms to increase their markup in order to take benefits from the enhanced competitiveness in relation to foreign goods, then:

$$MK_t = MK_d + mk_1\Theta_t^{-1} \quad (9)$$

Where the constant MK_d represents the desired markup, and the parameter mk_1 captures the sensibility of markup to RER. The equation (9) in log-diff is:

$$mk_t = -mk_1\theta_t \quad (9.1)$$

Equation (9.1) means that the devaluations of RER increase the growth rate of markup.[4]

Introducing the equation (20.1) into (19.1):

$$p_{dx,t}= (1 - \psi\sigma - mk_1)\theta_t - (1-\psi)r_r \quad (8.2)$$

Equation (19.2) means that devaluations of RER make the domestic goods cheaper in international market. However, as greater is the share of imports, used as input in production and markup response to the RER, lower is such effect (assuming that $0< |\psi\sigma + mk_1|<1$). Moreover, as it is assumed a declining real wage, labor productivity increases reduce the prices, which is weighted by the share of labor in costs.

Another way to solve the equation (8.2) is for the changes in markup rate of firms:

[4] See Marconi *et al.* (2020) for an interesting argument for the Brazilian case.

$$mk_t = p_{dx,t} - (1 - \psi\sigma)\theta_t + (1- \psi)r_r \quad (10)$$

Equation (10) means that the devaluations of RER have a profitability effect as long it increases the markup rate of firms. A devaluation of 1% in RER increases the markup rate by (1 - $\psi\sigma$) %. In addition, rises in the prices of exported goods increase the markup rate of firms. As it is assumed a declining real wage, the gains of labor productivity are absorbed by the capitalists by a greater markup rate or enhanced profitability.

Kalecki (1956) claims that the functional income distribution between wage- and profit-share in GDP can be written as a positive function of markup rate. The greater the markup rate, the greater (smaller) the profit- (wage-) share in GDP. Simply, it is assumed that the equation (10) represents roughly the changes in the profit-share in GDP, represented by π_t:

$$\pi_t = p_{dx,t} - \theta_t(1 - \psi\sigma) + (1- \psi)r_r \quad (11)$$

Therefore, the income distribution between workers and capitalists is influenced by the RER and by the labor productivity growth. Devaluations of RER/increases in labor productivity increase the profit-share in GDP, or, in another manner, it reduces the wage-share in GDP.

3.2- *Demand Regime*

The demand regime is formed by consumption, investment, exports, and imports, represented, respectively, by c_t, i_t, x_t and m_t:

$$y_t = c_t + i_t + x_t - m_t \quad (12)$$

The behavior of changes in consumption is modeled as:

$$c_t = (1 - \sigma_\omega)\omega_t + (1 - \sigma_\pi)\pi_t \quad (13)$$

the variables ω_t, σ_ω and σ_π represent the changes in the wage-share in GDP, the marginal propensity to save of workers and entrepreneurs, respectively. The changes in wage-share in GDP can be written as the inverse of the changes in the profit-share in GDP: $-\pi_t$. Therefore, rearranging the equation (13):

$$c_t = (\sigma_\omega - \sigma_\pi)\pi_t \quad (14)$$

The effects of changes in the functional income distribution between workers and capitalists on consumption are associated with the difference between the parameters σ_ω and σ_π. Increases in the profit-share boost (reduce) the consumption if $\sigma_\omega > \sigma_\pi$ ($\sigma_\omega < \sigma_\pi$).

The behavior of investment is modeled using the investment function of Bhaduri and Marglin (1990):

$$i_t = i_0 + i_1\pi_t + i_2y_t \quad (15)$$

where the constant i_0 captures the changes in the expectations of entrepreneurs, the parameter i_1 is the sensibility of investment to changes in profit-share, while i_1 is the sensibility of investment to changes in demand growth. Both parameters are positive.

The behavior of exports and imports is modeled as:

$$x_{d,t}= -np_{d,t} + \delta p_{f,t} + \epsilon z_t \quad (16)$$

$$m_t = m_1y_t \quad (17)$$

equation (16) equals (2), assuming that $p_{f,t}=z_t=0$, and introducing (8.2) into (16):

$$x_{d,t}= -n[(1 - \psi\sigma - mk_1)\theta_t - (1- \psi)r_r] \quad (16.1)$$

That is, devaluations in RER and increases in labor productivity increase the exports. The imports, in turn, depend positively on the growth of domestic demand. As higher is the growth of domestic demand, the higher is the growth rate of imports.

Putting (14), (15), (15), (16.1) and (17) into (12):

$$y_t = (\sigma_\omega - \sigma_\pi)\pi_t + i_0 + i_1\pi_t + i_2y_t - n[(1 - \psi\sigma - mk_1)\theta_t - (1- \psi)r_r] - m_1y_t$$

Introducing (11) and solving for y_t:

$$y_t = i_0 - b_1\theta_t + b_2 r_r \quad (18)$$

where the parameter b_1 represents the expression $\{(1 - \psi\sigma)[(\sigma_\omega - \sigma_\pi) - i_1] - n(1 - \psi\sigma - mk_1)\}(1 - i_2 + m_1)^{-1}$, while b_2 represents the expression $\{(1- \psi)[(\sigma_\omega - \sigma_\pi) + i_1] + n(1- \psi)\}(1 - i_2 + m_1)^{-1}$. By assuming that the expression $(1 - i_2 + m_1)$ is positive, the effects of RER and labor productivity on demand growth are ambiguous and are associated with the combinations of parameters:

(1) *The wage-led case*: if the expressions $\{(1 - \psi\sigma)[(\sigma_\omega - \sigma_\pi) - i_1] - n(1 - \psi\sigma - mk_1)\}(1 - i_2 + m_1)^{-1}$ and $\{(1- \psi)[(\sigma_\omega - \sigma_\pi) + i_1] + n(1- \psi)\}(1 - i_2 + m_1)^{-1}$ are negative, devaluations of RER and increases in labor productivity, by increasing the profit-share in GDP, reduce the demand growth. The demand regime is wage-led. As a result, the smaller wage share in GDP, induced by devaluations in RER or by the greater labor productivity, reduces consumption, which is not compensated by the investment and exports.

(2) *The profit-led case*: if the expressions $\{(1 - \psi\sigma)[(\sigma_\omega - \sigma_\pi) - i_1] - n(1 - \psi\sigma - mk_1)\}(1 - i_2 + m_1)^{-1}$ and $\{(1- \psi)[(\sigma_\omega - \sigma_\pi) + i_1] + n(1- \psi)\}(1 - i_2 + m_1)^{-1}$ are positive, devaluations of RER and increases in labor productivity, by increasing the profit-share in GDP, increase the demand growth. The demand regime is profit-led. Consequently, the smaller wage share in GDP, induced by devaluations in RER or by the greater labor productivity, reduces the consumption, which is compensated by the investment and exports.

3.3- *Productivity Regime: endogenizing the Kaldor-Verdoorn's Mechanism*

The productivity regime is determined by the Kaldor-Verdoorn mechanism:

$$r_t = r_a + \lambda_t y_t \quad (19)$$

The demand growth is the main determinant of labor productivity growth. Various authors have pointed out that the parameters of productivity regime are not constant over time or exogenous, such as Setterfield (1995, 1997), Setterfield and Cornwall (2002), Ocampo (2005), Romero and Britto (2017) and Romero (2019). The argument pursued in this article is that the parameters of equation (19) are endogenous to technological progress. As greater is the technological progress, more significant are the parameters of the productivity regime. Consequently, new technologies yields (i) a faster pace of autonomous growth of labor productivity and (ii) a greater labor productivity growth induced by demand growth.

The endogeneity of the parameters r_a and λ_t are modelled in following way:

$$r_{a,t} = F(I_t);\ f'>0 \quad (20)$$

$$\lambda_t = F(I_t);\ f'>0 \quad (21)$$

Assuming that the capital accumulation embodies new technologies, the parameters r_a and λ_t are endogenous to the variable investment.[5] Hence, new investments that embody technological progress increase both parameters. It turns out that the changes in investment are modeled as a function of changes in the profit share of GDP and demand growth. Although devaluations of RER always reduce the profit-share in GDP, its effects over demand growth depend on if the demand regime is wage- or profit-led:

(1) *The wage-led case*: in this scenario, devaluations of RER reduce the pace of capital accumulation because its contractionary effects over the demand growth are not compensated by the expansionary effects over the profit-share in GDP. The regime of capital accumulation is wage-led. Devaluations of RER make the pace of technological progress slower. As a

[5] In this case, the variable investment I_t (in upper letters) represents the variable investment in level.

result, the parameters r_a and λ_t become smaller: the autonomous labor productivity growth become smaller and the Kaldor-Verdoorn mechanism is less intense.

(2) *The profit-led case*: in this scenario, devaluations of RER increase the pace of capital accumulation because it produces a greater demand growth and profit-share in GDP. The regime of capital accumulation is profit-led. Devaluations of RER make the pace of technological progress faster. As a result, the parameters r_a and λ_t become greater: the autonomous labor productivity growth becomes greater, and the Kaldor-Verdoorn mechanism is more intense.

4- Interaction between Demand and Productivity Regimes: the impact of devaluations of RER

Solving the system of equations, as Naastepad (2005) solves:

$$y_{t,dr} = i_0 - b_1\theta_t + b_2 r_r \quad (22)$$

$$y_{t,pr} = (r_t - r_{a,t})\lambda_t^{-1} \quad (23)$$

where $y_{t,dr}$ represents the demand growth associated with the labor productivity growth and RER, and $y_{t,pr}$ is the demand growth derived from the productivity regime. Equaling the equations (22) and (23) yields the equilibrium labor productivity growth r_r^*:

$$r_t^* = (i_0 - b_1\theta_t + \lambda_t^{-1} r_{a,t})(\lambda_t^{-1} - b_2)^{-1} \quad (24)$$

Introducing (24) into (22) yields the equilibrium growth rate of demand y_r^*:

$$y_t^* = i_0(1 + b_2) + [-b_1 - b_1 b_2(\lambda_t^{-1} - b_2)^{-1}]\theta_t + b_2[\lambda_t^{-1} r_{a,t}(\lambda_t^{-1} - b_2)^{-1}] \quad (25)$$

The inclinations of regimes of productivity and demand regarding changes in RER are:

$$dr_t^*/d\theta_t = -b_1(\lambda_t^{-1} - b_2)^{-1} \quad (26)$$

$$dy_t^*/d\theta_t = -b_1 - b_1 b_2(\lambda_t^{-1} - b_2)^{-1} \quad (27)$$

The effects of RER on the equilibrium values r_t^* and y_r^* are associated with the combinations of parameters. It is assumed that the expression $(\lambda_t^{-1} - b_2)^{-1}$ is positive, which is very reasonable as the Verdoorn coefficient is around 0.5 (λ_t^{-1} is around 2), and b_2 is likely to be less than 1. Therefore, the combinations of regimes of demand and capital accumulation determine how the RER influences r_t^* and y_r^*. The effects of devaluations of RER will be discussed for three different combinations of demand and capital accumulations regimes in what follows.

4.1- *Profit-led Regimes of Demand and Capital Accumulation*

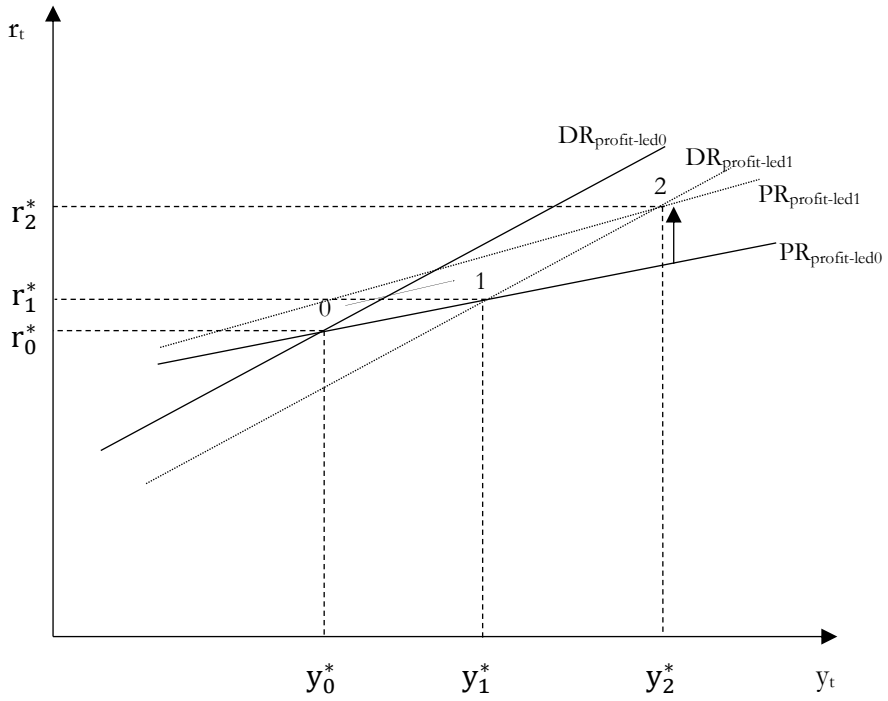
In the scenario in which the regimes of demand and capital accumulation are profit-led, devaluations of RER increase both demand growth as productivity growth: the parameters b_1 and b_2 are positive. Therefore, the expressions (26) and (27) are negative:

$$dr_t^*/d\theta_t = -b_1(\lambda_t^{-1} - b_2)^{-1} < 0$$

$$dy_t^*/d\theta_t = -b_1 - b_1 b_2(\lambda_t^{-1} - b_2)^{-1} < 0$$

This suggests that devaluations of RER boost the growth of demand and labor productivity. Figure 3 illustrates the effects of devaluations of RER.

Figure 3- Profit-led Regimes of Demand and Capital Accumulation



Part of the story about RER devaluations' effects is represented by the displacement of the demand regime upwards. As the demand regime is profit-led, RER devaluations boost the demand growth. As a result of the circular and cumulative process, the growth rate of labor productivity increases: the equilibrium values provided by the model change from the point 0 to 1 ($y_1^*>y_0^*$, $r_1^*>r_0^*$).

The other part of the story is associated with the effects of devaluations of RER over the productivity regime. Within an economy under a profit-led regime of capital accumulation, devaluations of RER boost the capital accumulation/technological progress. Consequently, the parameters r_a and λ_t of productivity regime become larger: the autonomous labor productivity growth enlargers and the Kaldor-Verdoorn mechanism becomes more intense. Graphically, the line of productivity regime dislocates upwards and turns steeper: the equilibrium values provided by the theoretical model change from the point 1 to 2 ($y_2^*>y_1^*$, $r_2^*>r_1^*$).

Therefore, devaluations of RER boost the economic growth in economies under profit-led regimes of demand and capital accumulation.

4.2- *Wage-led Regimes of Demand and Capital Accumulation*

In the wage-led scenario, the parameters b_1 and b_2 are negative, consequently, the expression (26) is positive:

$$dr_t^*/d\theta_t = -b_1(\lambda_t^{-1} - b_2)^{-1}>0$$

which suggests that devaluations of RER harm the growth of labor productivity.

On the other hand, the effects of devaluations of RER on the demand growth are not straightforward. Devaluations of RER reduce the demand growth, but its contractionary effects over the labor productivity increase the wage-share in GDP, which has the opposite

(expansionary) effect on demand growth. Then, the effects of RER devaluations on the demand growth depend on which effect prevails:

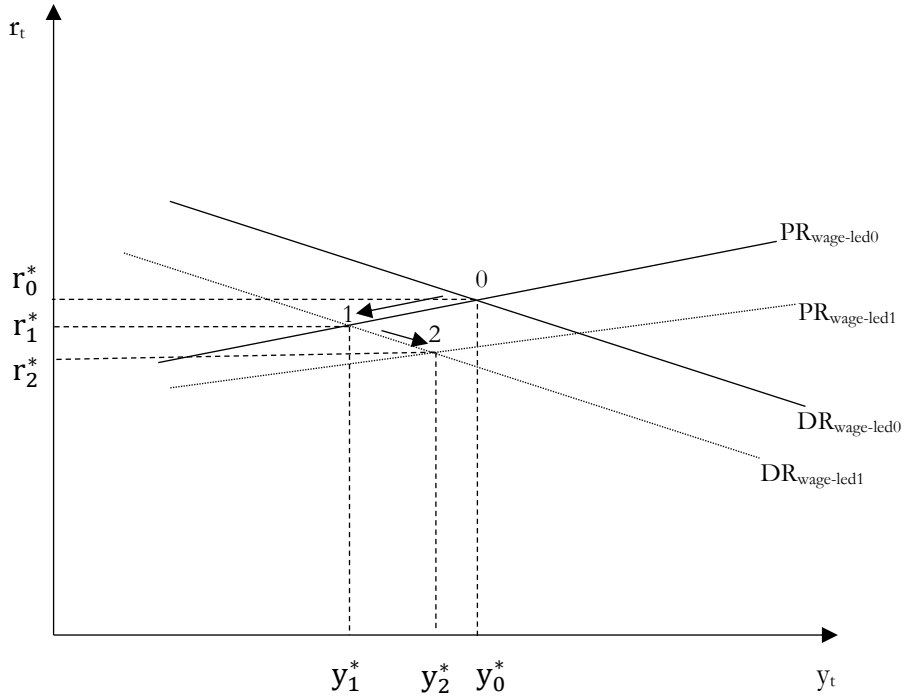
(1) The first scenario of wage-led demand regime: if the parameter $|b_1|$ is greater than the expression $|b_1 b_2(\lambda_t^{-1} - b_2)^{-1}|$, the expression (27) is positive:

$$dy_t^*/d\theta_t = -b_1 - b_1 b_2(\lambda_t^{-1} - b_2)^{-1} > 0$$

this suggests that the contractionary effects of RER devaluations on demand growth prevail to detriment of its positive effects on wage-share in GDP via the lower labor productivity growth. Therefore, RER devaluations reduce demand growth.

Figure 4 illustrates the effects of devaluations of RER for an economy under wage-led regimes of Demand and Capital Accumulation of the first scenario.

Figure 4- Wage-led Regimes of Demand and Capital Accumulation (first scenario)



Once again, part of the story about the effects of devaluations of RER is represented by the displacement of the demand regime downwards. As the demand regime is wage-led, and $|b_1| > |b_1 b_2(\lambda_t^{-1} - b_2)^{-1}|$, devaluations of RER harm the demand growth. As a result of the circular and cumulative process, the growth rate of labor productivity reduces. Hence, the equilibrium values provided by the theoretical model change from point 0 to 1 ($y_1^* < y_0^*$, $r_1^* < r_0^*$).

The other part of the story concerns the effects of RER on the productivity regime. As the economy is under a wage-led capital accumulation regime, devaluations of RER harm the capital accumulation/technological progress. Consequently, the parameters r_a and λ_t of the productivity regime become smaller. Graphically, the line of productivity regime dislocates downwards and turns flatter: the equilibrium values provided by the model change from point 1 to 2 ($y_1^* < y_2^*$, $r_2^* < r_1^*$).

Therefore, devaluations of RER harm the economic growth in economies under wage-led regimes of demand and capital accumulation of the first scenario. It should be noticed, however, that endogenizing the productivity regime implies a better situation after devaluations of RER, when compared to the situation in which the productivity regime is

exogenous: $y_1^* < y_2^* < y_0^*$ and $r_2^* < r_1^* < r_0^*$. This is because of the reduction of labor productivity induced by the lower pace of technological progress (a result of the devaluation of RER), which increases the wage-share in GDP.

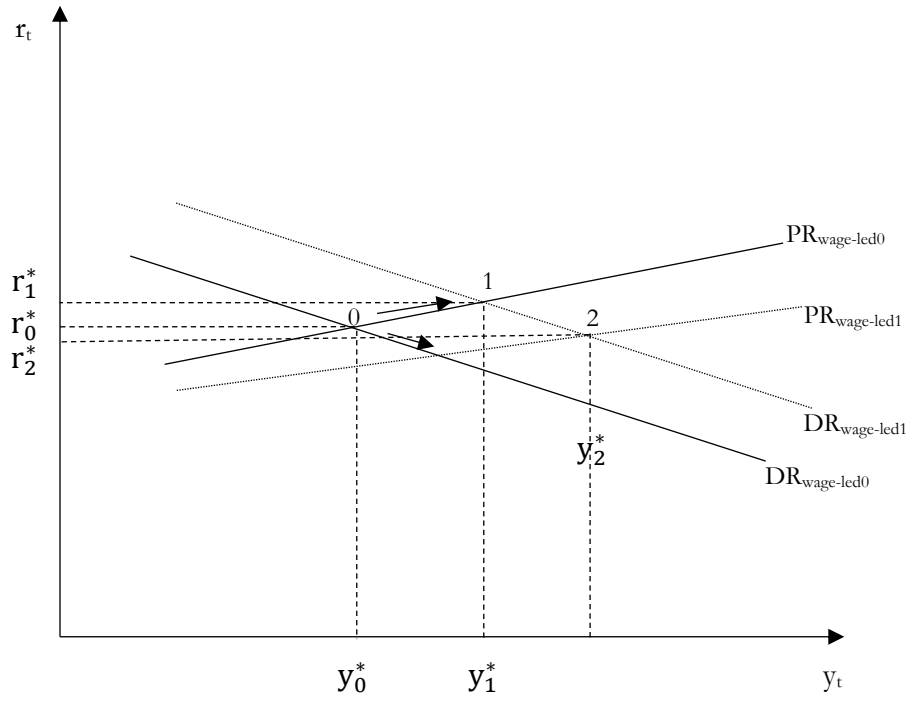
(2) Second scenario of wage-led demand regime: if the parameter $|b_1|$ is smaller than the expression $|b_1 b_2(\lambda_t^{-1} - b_2)^{-1}|$, the expression (26) is negative:

$$dy_t^*/d\theta_t = -b_1 - b_1 b_2(\lambda_t^{-1} - b_2)^{-1} < 0$$

This suggests that the expansionary effects of RER on wage-share in GDP via the lower labor productivity prevail to detriment of its negative effects on demand growth. Therefore, devaluations of RER boost the demand growth.

Figure 5 illustrates the effects of devaluations of RER for an economy under wage-led regimes of Demand and Capital Accumulation of the second scenario.

Figure 5- Wage-led Regimes of Demand and Capital Accumulation (second scenario)



Devaluations of RER displace the demand regime upwards. The demand regime is wage-led, but $|b_1| < |b_1 b_2(\lambda_t^{-1} - b_2)^{-1}|$, thus, that devaluations of RER boost the demand growth and the growth rate of labor productivity. Hence, the equilibrium values provided by the model change from point 0 to 1 ($y_1^* > y_0^*$, $r_1^* > r_0^*$).

However, as the economy is under wage-led capital accumulation regime, devaluations of RER harm the capital accumulation/technological progress. Consequently, the parameters r_a and λ_t of the productivity regime become smaller. Graphically, the line of productivity regime dislocates downwards and turns flatter: the equilibrium values provided by the model change from point 1 to 2 ($y_1^* < y_2^*$, $r_2^* < r_1^*$).

Therefore, the effects of devaluations of RER, when the expansionary effects of RER on wage-share in GDP via the lower labor productivity prevail to the detriment of its negative effects on demand growth, are positive, boosting the economic growth.

4.3- *Wage-led Regime of Demand and Profit-led Regime of Capital Accumulation*

In the scenario in which the regime of demand is wage-led (the parameters b_1 and b_2 are negative), and the regime of capital accumulation is profit-led, the expression (26) is positive:

$$dr_t^*/d\theta_t = -b_1(\lambda_t^{-1} - b_2)^{-1}>0$$

this suggests that devaluations of RER harm the growth rate of labor productivity.

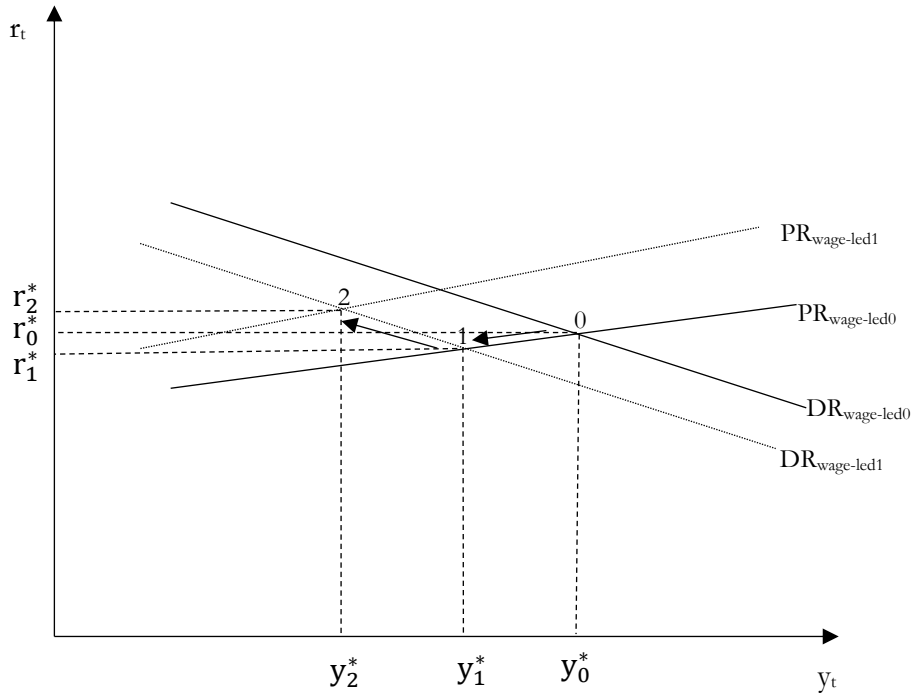
In contrast, once again, the effects of RER's devaluations on the demand growth are not straightforward. Its effects on the demand growth depend on which effect prevails (the contractionary effects on demand growth or its expansionary effects on wage-share in GDP): (1) First scenario of wage-led demand regime: if the parameter $|b_1|$ is greater than the expression $|b_1b_2(\lambda_t^{-1} - b_2)^{-1}|$, the expression (27) is positive:

$$dy_t^*/d\theta_t = -b_1 - b_1b_2(\lambda_t^{-1} - b_2)^{-1}>0$$

this suggests that the contractionary effects of RER on demand growth prevail in the detriment of its positive effects on wage-share in GDP via the lower labor productivity. Therefore, devaluations of RER reduce demand growth.

Figure 6 illustrates the effects of devaluations of RER for an economy under a wage-led regime of demand and a profit-led regime of capital accumulation of the first scenario.

Figure 6- Wage-led Regime of Demand and Profit-led Regime of Capital Accumulation (first scenario)



In this scenario, devaluations of RER reduce the growth rate of demand and labor productivity: the demand regime line dislocates downward, from 0 to 1 ($y_0^* > y_1^*$, $r_0^* > r_1^*$). As the economy is under a profit-led capital accumulation regime, devaluations of RER increase the parameters r_a and λ_t. The line of productivity regime dislocates upwards and turns steeper: the equilibrium values provided by the model change from point 1 to 2 ($y_1^* > y_2^*$, $r_2^* > r_1^*$).

In sum, devaluations of RER harm the economic growth in economies under wage-led regimes of demand and a profit-led regime of capital accumulation of the first scenario. It should be noticed that endogenizing the productivity regime implies a worse situation after devaluations of RER, compared to the situation in which the productivity regime is exogenous: $y_2^* < y_1^* < y_0^*$ and $r_1^* < r_0^* < r_2^*$. This is due to the increment of labor productivity induced by the greater pace of technological progress, which reduce the wage-share in GDP.

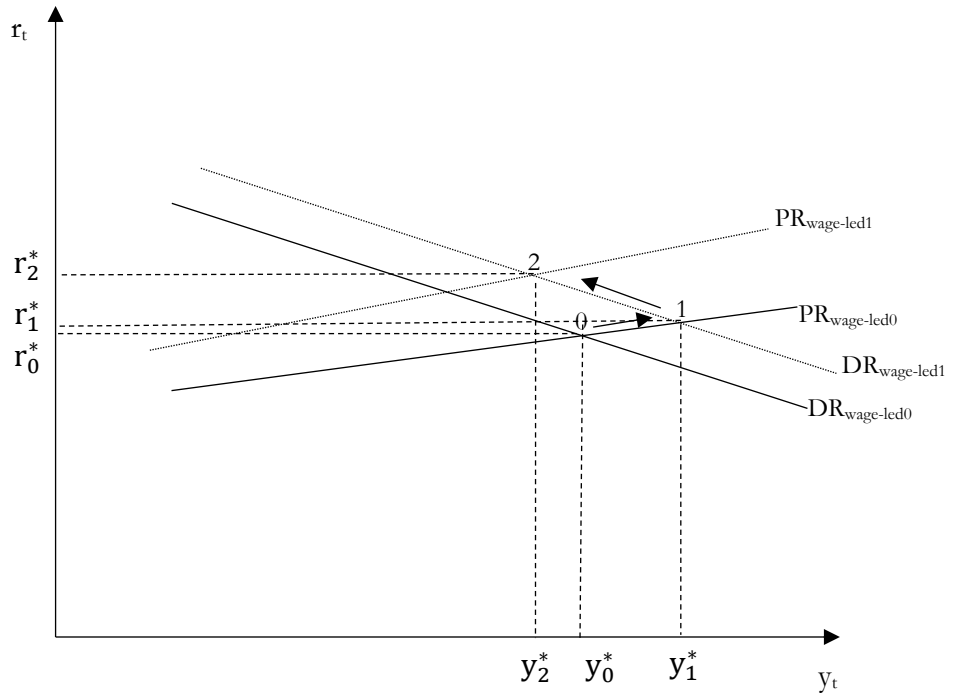
(2) Second scenario of wage-led demand regime: if the parameter $|b_1|$ is smaller than the expression $|b_1 b_2(\lambda_t^{-1} - b_2)^{-1}|$, the expression (26) is negative:

$$dy_t^*/d\theta_t = -b_1 - b_1 b_2(\lambda_t^{-1} - b_2)^{-1} < 0$$

this suggests that the expansionary effects of RER on wage-share in GDP via the lower labor productivity prevails in the detriment of its negative effects on demand growth. Therefore, devaluations of RER boost the demand growth.

Figure 7 illustrates the effects of devaluations of RER for an economy under a wage-led regime of demand and a profit-led regime of capital accumulation of the second scenario.

Figure 7- Wage-led Regime of Demand and Profit-led Regime of Capital Accumulation (second scenario)



In this scenario, devaluations of RER increase the growth rate of demand and labor productivity: the demand regime line dislocates upwards, from 0 to 1 ($y_0^* < y_1^*$, $r_0^* < r_1^*$). As the economy is under a profit-led capital accumulation regime, devaluations of RER increase the parameters r_a and λ_t. The productivity regime line dislocates upwards and turns steeper: the equilibrium values provided by the model change from point 1 to 2 ($y_1^* > y_2^*$, $r_2^* > r_1^*$).

Therefore, devaluations of RER harm the economic growth in economies under wage-led regimes of demand and a profit-led regime of capital accumulation of the second scenario. Once again, by endogenizing the productivity regime, the situation after devaluations of RER is worse, compared to the situation in which the productivity regime is exogenous:

$y_2^* < y_0^* < y_1^*$ and $r_0^* < r_1^* < r_2^*$. This occurs due to the increment of labor productivity induced by the greater pace of technological progress, which reduce the wage-share in GDP.

5- Concluding Remarks

This paper proposed a growth model, within the Kaldorian tradition of circular and cumulative causation, to study the influence of RER devaluations on economic growth, solving some limitations of the canonical KDT growth model on this issue. The most interesting characteristic of this model is the fact that it explicitly considers the RER, whilst its influences on economic growth occur via both demand-side as supply-side factors. Put differently, the influence of RER is not restricted uniquely to the demand-side, but it also occurs via the supply-side.

From the demand side, the influence of RER on economic growth is associated with the regime of demand. Devaluations of RER, in economies under a profit-led regime, positively impact the growth rate of demand and labor productivity. Nevertheless, in economies under a wage-led regime, the effects of RER devaluations are not straightforward. Its influence depends on which effect prevails: its direct contractionary effects on demand growth or its indirect expansionary effect on demand growth via its negative influence on labor productivity (that exerts a positive influence on wage-share in GDP). If the first effect prevails, devaluations of RER reduce the growth rate of demand and labor productivity. However, if the second effect prevails, devaluations of RER boost the growth rate of demand and labor productivity.

From the supply side, the influence of RER on economic growth is associated with the regime of capital accumulation. The model endogenized the parameters of productivity-regime regarding capital accumulation (which embodies technological progress). As faster is the pace of capital accumulation, the greater is the autonomous productivity growth. Moreover, the intensity of the Kaldor-Verdoorn mechanism also depends on capital accumulation, which means the RER influences the magnitude of the effect of growing demand on labor productivity. The demand growth is still the primary determinant of labor productivity. The RER influences labor productivity by changing productivity-regime parameters via its effects on capital accumulation/technological progress. In this regard, devaluations of RER in economies under a profit-led regime boost capital accumulation, which positively impacts labor productivity: the autonomous productivity increases, and the Kaldor-Verdoorn mechanism becomes more intense. In contrast, devaluations of RER in economies under a wage-led regime damage the capital accumulation, which negatively impacts labor productivity: the autonomous productivity reduces, and the Kaldor-Verdoorn mechanism becomes less intense.

As a circular and cumulative causation process, the impact of devaluations of RER on economic growth is associated with the interaction between the demand-side and supply-side factors. The model has shown that devaluations of RER:

(i) in economies under a profit-led regime of demand and capital accumulation, expand the demand growth, which, via the Kaldor-Verdoorn mechanism, increases labor productivity growth. In addition, the devaluations of RER induce a faster pace of capital accumulation/technological progress. Thereby, autonomous productivity increases and the Kaldor-Verdoorn mechanism becomes more intense, reinforcing the expansionary cycle. Therefore, the impacts of devaluations of RER on economic growth, in this case, are positive.

(ii) in economies under wage-led regimes of demand and capital accumulation, if the contractionary effects on demand growth prevail (first scenario), shorten the demand growth. Moreover, the devaluations of RER induce a slower pace of capital accumulation/technological progress in a way that the autonomous productivity reduce, and the Kaldor-Verdoorn mechanism becomes less intense, counterbalancing the contractionary process. Therefore, the impacts of devaluations of RER on economic growth, in this case, are negative. Nevertheless, it should be highlighted that making the parameters of the productivity regime endogenous to RER, implies a better situation after devaluations of RER, when compared to the situation in which the productivity regime is exogenous. In contrast, if the expansionary effects of RER devaluations on demand growth via its negative influence on labor productivity (that exerts a positive influence on wage-share in GDP) prevails (second scenario), devaluations of RER exert a positive influence on demand growth. Once again, the devaluations of RER induce a slower pace of capital accumulation and technological progress, reducing the autonomous productivity and the intensity of the Kaldor-Verdoorn mechanism. Into the extent that the labor productivity lowers (the wage-share in GDP increases), the economic growth accelerates. Therefore, the impacts of devaluations of RER on economic growth, in this case, are positive.

(iii) in economies under a wage-led regime of demand and a profit-led regime of capital accumulation, in the first scenario, shorten the demand growth. Furthermore, RER devaluations induce a faster pace of capital accumulation/technological progress. In this way, autonomous productivity increases, and the Kaldor-Verdoorn mechanism becomes more intense, reinforcing the contractionary process. In the second scenario, RER devaluations boost the demand growth, but the increases in labor productivity induced by the RER devaluations damages economic performance. Therefore, the impacts of devaluations of RER on economic growth, in both cases, are negative. It should be highlighted that making the productivity regime endogenous worsens the economic performance after RER devaluations, compared to the situation in which the productivity regime is exogenous.

References

Acemoglu, D. Johnson, S. Robinson, J. Thaicharoen, Y. Institutional causes, macroeconomic symptoms: volatility, crises and growth. Journal of Monetary Economics, Number 50, Pages 49-123, 2003.

Bhaduri, A. and Marglin, S. Unemployment and the real wage: the economic basis for contesting political ideologies. *Cambridge Journal of Economics*, Volume 14, Pages 375–393, 1990.

Blecker, R. International competition, income distribution and economic growth. Cambridge Journal of Economics, Volume 13, Number 3, Pages 395-412, 1989.

Blecker, R. Long-Run Growth in Open Economies: Export-Led Cumulative Causation or a Balance-of-Payments Constraint? In: The Oxford Handbook of Post-Keynesian Economics, Volume 1: Theory and Origins, Edited by G. C. Harcourt and Peter Kriesler, 2013.

Diaz Alejandro, C. A Note on the Impact of Devaluation and the Redistribution Effect. The Journal of Political Economy. Volume 71, Number 6, Pages 577-580, 1963.

Dixon, R. Thirlwall, A. P. A Model Growth-Rate Differences on Kaldorian Lines. *Oxford Economic Papers*, New Series, Volume 27, Issue 2, Pages 201-214, 1975.

Easterly, W. The Lost Decades: Developing Countries' Stagnation in Spite of Policy Reform 1980–1998. Journal of Economic Growth, Number 6, Pages 135-157, 2001.

Ferrari, M. Freitas, F. Barbosa, N. A taxa de câmbio real e a restrição externa: uma proposta de releitura com elasticidades endógenas. *Revista de Economia Política*. Volume 33, Number 1, Issue 130, Pages 60-81, 2013.

Gala, P. Real Exchange Rate Levels and Economic Development Theoretical Analysis and Empirical Evidence. Cambridge Journal of Economics, Number 32, Pages 273-288, 2007.

Kaldor, N. A Model of Economic Growth. *The Economic Journal*. Volume 67, Number 268, pages 591-624, 1957.

Kaldor, N. Causes of the Slow Rate of Economic Growth of the United Kingdom. An Inaugural Lecture. Cambridge University Press, 1966.

Kaldor, N. The Case for Regional Policies. *Scottish Journal of Political Economy*. Volume 17, Issue 3, Pages 337-443, 1970.

Marconi, N. Magacho, G. Machado, J. Leão, R. Profit Margins, Exchange rates and structural change: empirical evidences for the period 1996-2017. *Brazilian Journal of Political Economy*. Vol. 40, nº2, pp. 285-309, 2020.

McCombie, J. Criticisms and Defences of the Balance of Payments Constrained Growth Model: Some Old, Some New. In Soukiazis, E. Cerqueira, A. P. (2012) Models of Balance of Payments Constrained Growth History, Theory and Empirical Evidence. Palgrave Macmillan.

Missio, F. Araujo, R. Jayme Jr. F. Endogenous elasticities and the impact of the real exchange rate on structural economic dynamics. *Structural Change and Economic Dynamics*. Volume 42, Pages 67-75, 2017.

Missio, F. Jayme Jr. F. Structural Heterogeneity and Endogeneity of Elasticities on the Balance of Payments Constrained Growth Model. In In Soukiazis, E. Cerqueira, A. P. (2012) Models of Balance of Payments Constrained Growth History, Theory and Empirical Evidence. Palgrave Macmillan.

Missio, F. Jayme Jr. F. Araújo, R. Endogenous Elasticities and the Impact of the Real Exchange Rate on Structural Economic Dynamics. Volume 42, Pages 67-75, 2017.

Naastepad, C. Technology, demand and distribution: a cumulative growth model with and application to the Dutch productivity growth slowdown. Cambridge Journal of Economics. Volume 30, Number 3, Pages 403-434, 2005.

León-Ledesma, M. Accumulation, innovation and catching-up: an extended cumulative growth model. Cambridge Journal of Economics. Volume 26, Number 2, Pages 201-216, 2002.

Rapetti, M. Skott, P. Razmi, A. The real exchange rate and economic growth: are developing countries different? *International Review of Applied Economics*. Volume 26, Volume 6, Pages 735-753, 2011.

Rodrik, D. The real exchange rate and economic growth: Theory and evidence, John F. Kennedy School of Government, Harvard University, 2008.

Romero, J. Britto, G. Increasing returns to scale, technological catch-up and research intensity: endogenising the Verdoorn coefficient. *Cambridge Journal of Economics*, Volume 41, Issue 2, Pages 391–412, 2017.

Romero, J. A Kaldor-Schumpeter model of cumulative growth. Cambridge Journal of Economics. Volume 43, Number 6, Pages 1597-1621, 2019.

Ros, J. Development Macroeconomics in Latin America and Mexico Essays on Monetary, Exchange Rate, and Fiscal Policies. PallGrave Macmillian, New York - NY, 2015.

Setterfield, M. Cornwall, J. A neo-Kaldorian perspective on the rise and decline of the Golden Age. In: Setterfield, M. The Economics of Demand-led growth Challenging the Supply-side Vision of the Long Run. Edward Elgar Publishing Limited., Northampton, Massachusetts -USA, 2002.

Setterfield, M. Historic Time and economic theory. *Review of Political Economy*. Volume 7, Number 1, Pages 1-27, 1995.

Setterfield, M. 'History versus equilibrium' and the theory of economic growth. *Cambridge Journal*. Volume 21, Number 3, Pages 365-378, 1997.

Setterfield, M. Exploring the Supply Side of Kaldorian Growth Models. Trinity College Department of Economics, *Working Paper* 12-06 https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2114536, 2012.

Shaikh, A. Capitalism, Competition, Conflict, Crises. Oxford University Press, New York NY, 2016.

Souto, K. C. Resende, M. F. C. Real Exchange Rate and Innovation: empirical evidences. Brazilian Journal of Political Economy, Volume 38, Number 2 (151), Pages 280-303, 2018.

Thirlwall, A. The balance of payments constraint as an explanation of international growth rate differences. *BNL Quarterly Review*, Volume 32, Issue 128, pages 45-53, 1979.

Thirlwall, A. The Relation between the Warranted Growth Rate, the Natural Rate, and the Balance of Payments Equilibrium Growth Rate. *Journal of Post Keynesian Economics*. Volume 24, Number 1, Pages 81-88, 2001.

Ocampo, J. Rada, C. Taylor, L. Growth and Policy in Developing Countries A Structuralist Approach. Columbia University Press, New York – USA, 2009.

Verdoorn, P. J. Factors that Determine the Growth of Labour Productivity [Translated by A.P Thirlwall from original 1949 article in Italian]. In: McCombie, J, C. Pugno, M. Soto, B. (2002). Productivity Growth and Economic Performance Essays on Verdoorn's law. Palgrave Macmillan Ltd, 2002.

Vieira, F. MacDonald, R. A Panel Data Investigation of Real Exchange Rate Misalignment and Growth. Estudos Econômicos, Volume 42, Number 3, Pages 433-456, 2012.

Young, A. A. Increasing returns and economic progress. *The Economic Journal*, Volume 38, Number. 152, pages 527–542, 1928.