Real Exchange Rate, Capital Mobility and Structural Change in a Modified Kaldorian Model of Cumulative Causation

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Abstract: The objective of this article is to present a modified Kaldorian cumulative causation model in order to discuss the effects of changes in the rules monetary policy and in the degree of openness in the capital account over the time path of real output, nominal interest rates and inflation. Numerical simulations of the theoretical model show that monetary policy rules are relevant for long-run growth if and only if income-elasticity of imports is a function of the real exchange rate. In other words, long-run non-neutrality of monetary policy demands that a real exchange rate appreciation increases the degree of productive specialization of the economy, increasing the income elasticity of imports. Based on this framework, we argue that a monetary policy that is growth-friendly should be conducted in order to reduce the volatility of nominal interest rates and make a fast convergence of inflation rate to the long-run inflation target, fixed at a level nearest as possible of the international level. Besides that we also show that the degree of openness of capital account is not relevant for long-run growth either in the case where the degree of productive specialization of the economy is independent of real exchange rate so as in the case where specialization is a function of real exchange rate.

Key-Words: Dynamic models, Growth and Exports.

JEL code: E17, E52, F10

Resumo: o objetivo deste artigo é apresentar um modelo cumulative de causalidade kaldoriano a fim de discutir os efeitos de mudanças nas regras de política monetária e no grau de abertura da conta de capital sobre o padrão do produto real, taxas de juros nominais e inflação. Simulações numéricas do modelo teórico mostram que as regras de política monetária são relevantes para o crescimento de longo prazo se e somente se a elasticidade-renda das importações é uma função da taxa de câmbio real. Em outras palavras, a não-neutralidade de longo prazo da política monetária exige que uma apreciação da taxa real de câmbio eleve o grau de especialização produtiva da economia, elevando a elasticidade-renda das importações. Baseado neste arcabouço, argumentamos que uma política monetária que é amigável ao crescimento deveria ser conduzida a fim de reduzir a volatilidade nominal das taxas de juros e fazer uma convergência rápida da taxa de inflação para a meta de inflação de longo prazo, fixada o mais próximo possível ao nível internacional. Ademais, mostramos que o grau de abertura da conta de capital não é relevante para o crescimento de longo prazo, seja no caso onde o grau de especialização produtiva da economia é independente da taxa real de câmbio, seja no caso onde a especialização é uma função da taxa real de câmbio

Palavras-chave: modelos dinâmicos, crescimento e exportação

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1 – Introduction.

Neoclassical growth models take for granted that the ultimate limit to long-run growth is the supply of factors of production (cf. Solow, 1957). Aggregate demand is relevant only to determine the degree of productive capacity in the short-run, but has no lasting impact over the growth rate of productive capacity. In the long-run, Say's Law is valid, that is, supply determines demand.

However, supply of factors of production is not really independent of demand. The relation between the supply of production factors and aggregate demand was analyzed by Kaldor (1988), giving a new stimulus to the so-called demand-led growth theory[1]. The starting point of the demand-led growth models is that means of production used in a capitalist economy are themselves goods produced within the system. If that is so, the "supply" of means of production should never be considered as a datum independent of the demand for then. In this framework, the fundamental economic problem is not the allocation of a given quantity of resources over the possible alternatives; but the determination of the rate of growth of these resources. In the words of Setterfield:

> "*The use of produced means of production implies that the ´scarcity of resources´ in processing activities cannot be thought of as being independent of the level of activity in the economy. What is chiefly important in processing activities is the dynamic propensity of the economy to create resources (that is, to deepen and/or widen its stock of capital) rather than the static problem of resource allocation*" (1997, p.50).

Kaldor´s ideas about demand-led growth have been presented in formal models of cumulative causation where the rate of growth of output is determined by the growth rate of exports, which is determined by the growth rate of labor productivity (considering a fixed exchange-rate regime) induced by the growth rate of real output[2]. In this setting, it is possible the construction of dynamic models where initial conditions largely determine the long-run growth rate[3].

Kaldorian cumulative causation models have, in general, four equations: a first equation where the growth rate of real output is a function of the growth rate of exports; a second equation in which the growth rate of exports is a function of the rate of change of terms of trade and of the growth rate of World's income; a third equation that specifies the productivity growth rate as a function of the growth rate of real output (a simple formalization of Kaldor-Verdoorn law); and a fourth equation where the rate of change of domestic prices is determined by the rate of change in nominal wages, the growth rate of productivity and the rate of change of nominal exchange-rate. It is also assumed the existence of a fixed-exchange rate regime and/or that price-elasticity of exports are zero.

Up to now, no effort has been done in order to incorporate to these dynamic models some important aspects of open-economy macroeconomics as, for example, the *openness* of capital account and the existence of a floating exchange-rate regime. Besides that, Kaldorian models of cumulative causation ignore completely the effects of monetary policy over long-run growth, what is a surprising feature, given the obvious Keynesian *pedigree* of this class of growth models.

[1] We have to notice that the importance of aggregate demand for long-run growth was emphasized by other Keynesian authors before Kaldor. In the growth model of Joan Robinson (1962), for example, the growth rate of capital stock is determined by the interplay between propensity to invest of capitalists (determined by their animal spirits) and the propensity to save out of profits. An increase in the propensity to save out of profits will produce a reduction in the desired rate of accumulation, showing the fundamental importance of aggregate demand for long-run growth. However, it remains the idea that the availability if means of production sets an upper limit for long-run growth. In fact, the growth rate of the labor force is considered an exogenous variable in the system and can set an upper limit to economic growth since the economy could not grow indefinitely at a rate bigger than the one allowed by the expansion of the labor force (adjusted by technical progress) In 1988 article, Kaldor argued that, in the long-run, the growth rate of labor force is not independent of demand, but adjusts itself to the growth of demand for labor.

[2] Some empirical evidences about the validity of these classes of models must be obtained in Ledesma and Thirwall (2002).

[3] See Dixon and Thirwall (1975) and Setterfield (1997).

The objective of this article is to present a dynamic model of demand-led growth in order to analyze the effects of changes in monetary policy rules and in the degree of openness in the capital account over the time-path of the growth rate of real output, nominal interest rate and the rate of inflation.

Numerical simulations of the theoretical model show that monetary policy rules are relevant for long-run growth if and only if income-elasticity of imports is a function of the real exchange rate. In other words, long-run non-neutrality of monetary policy demands that a real exchange rate appreciation increases the degree of productive specialization of the economy, increasing the income elasticity of imports.

Based on this framework, we argue that a monetary policy that is growth-friendly should be conducted in order to reduce the volatility of nominal interest rates and make a fast convergence of inflation rate to the long-run inflation target, fixed at a level nearest as possible of the international level.

Besides that we also show that the degree of openness of capital account is not relevant for long-run growth either in the case where the degree of productive specialization of the economy is independent of real exchange rate so as in the case where specialization is a function of real exchange rate.

The present article is organized in 8 sections, including the introduction. In section 2 we show the theoretical structure of the modified Kaldorian cumulative causation model, supposing the degree of productive specialization as being given and independent of real exchange-rate. In section 3 we show the steady-state solution of the model at hand. Section 4 is dedicated to the numerical simulation of the model presented in section 2. Section 5 is dedicated to the analysis of the factors that determine the level of productive specialization of an open economy and the relation between productive specialization and real exchange rate. Section 6 shows the stead-state solution of the Kaldorian model in the case where the level of productive specialization is a function of real exchange rate. Section 7 is dedicated to the numerical simulation of the model presented in section 6. Finally, section 8 presents the final remarks and conclusions obtained in the present paper.

2 - The Structure of the Theoretical Model.

The model presented here is an extension of the Kaldorian model of cumulative causation developed by Setterfield (1997). It is well known that the standard model of cumulative causation has four dynamic equations: a first equation relating the growth rate of labor productivity with the growth rate of real output (the so-called Kaldor-Verdoorn Law), a second equation presenting the rate of inflation as the difference between the rate of increase in nominal wages and the growth rate of labor productivity, a third equation showing the growth rate of exports as a function of the evolution of price-competitiveness of exports and the growth rate of world's income and a forth and last equation showing the growth rate of real output as a function of the growth rate of exports.

In the model that we will develop now, we will do some modifications in the basic structure of the standard Kaldorian cumulative causation model. First of all, as suggested by Palley (2002), we will add two new equations to the standard model with the purpose to analyze the dynamics of the productive capacity of the economy. In fact, standard models of cumulative causation say nothing about the "supply side" of the economy, that is, about the evolution of productive capacity through time. This omission will be solved by means of adding a dynamic equation relating the growth rate of productive capacity with the investment rate, in a similar fashion of what was done by Domar (1936). The second equation to be introduced is a investment function in which investment rate at time *t* will be supposed as being a function of the growth rate of real output in time *t-1* – according with the so-called accelerator model of investment behavior – and of the real interest rate of time *t-1*.

In second place, we will suppose that the rate of change of nominal wages is not uniform in all over the world economy (cf. Setterfield, 1997, p.55), but is country-specific. In this setting, we will suppose that domestic Labor Unions can manage to fix the rate of change in nominal wages at a rate equal to inflation rate of the last period plus all the productivity gains occurred in the last period.

In third place, we will suppose an economy that operates under a floating exchange-rate regime in a setting of restricted (imperfect) capital mobility due to the presence of some form of capital controls. In this framework, the rate of change of nominal exchange-rate is supposed to be a linear function of the difference between the domestic nominal interest rate and the international nominal interest rate adjusted by the country-risk premium. Because of that, the interest rate differential will have an impact over the domestic rate of inflation (by means of exchange-rate variations) and overt the price-competitiveness of exports, opening a channel by which monetary policy can have an influence over long-run growth rate.

Finally, we will suppose that monetary policy is conducted under the institutional framework of an Inflation Targeting Regime, and the Central Banks sets nominal interest rates at each period based in a version of the so-called "Taylor rule".

The structure of the following model can be presented by means of the following system of equations:

$$\hat{q}_t = r + \alpha \hat{Y}_{t-1} \qquad (2.1)$$

$$\hat{\hat{Y}}_t = \sigma \frac{I_{t-1}}{Y_{t-1}} \qquad (2.2)$$

$$\frac{I_t}{Y_t} = \varphi_1 \hat{Y}_{t-1} + \varphi_2 \left(i_{t-1} - \hat{p}_{t-1} \right) \qquad (2.3)$$

$$\hat{p}_t = \hat{w}_t + \hat{e}_t - \hat{q}_t \qquad (2.4)$$

$$\hat{w}_t = \hat{p}_{t-1} + \hat{q}_{t-1} \qquad (2.5)$$

$$\hat{X}_t = \beta_j \left(\hat{p}_{w,t} + \hat{e}_t - \hat{p}_t \right) + \gamma \hat{Y}_{w,t} \qquad (2.6)$$

$$\hat{Y}_t = \lambda \hat{X}_t \qquad (2.7)$$

$$\hat{e}_t = \vartheta \left(i_t - i_t^* - \rho \right) \qquad (2.8)$$

$$i_t^d = \left(i_t^* + \rho \right) + \theta_1 \left(\hat{p}_{t-1} - \pi_t^* \right) + \theta_2 (\hat{Y}_{t-1} - \hat{\hat{Y}}_{t-1}) \qquad (2.9)$$

$$i_t = \theta_0 i_t^d + (1 - \theta_0) i_{t-1} \qquad (2.9a)$$

$$\pi_t^* = \omega \pi_{t-1}^* + (1 - \omega) \pi_{LP} \qquad (2.10)$$

Where: $\hat{q}_t$ is the growth rate of labor productivity in period *t* , $\hat{Y}_t$ is the growth rate of real output, $\hat{\hat{Y}}_t$ is the growth rate of productivity capacity in period *t*, I_t is planed investment in period *t*, $\hat{p}_t$ is the rate of inflation in period *t*, $\hat{w}_t$ is the rate of change in nominal wages in period *t*, $\hat{e}_t$ is the rate of change in nominal exchange rate in period *t*, $\hat{p}_{w,t}$ is the rate of inflation in the rest of the world in period *t*, $\hat{Y}_{w,t}$ is the rate of growth of world's income in period *t*, $\hat{X}_t$ is the growth rate of exports in period *t*, ρ is the country's risk premium; i_t is the nominal interest rate set by the Central Bank in period *t*, i_t^d is the nominal interest rate target for period *t*, π_t^* is the target inflation for period *t* and π_{LP} is the long-run target for inflation rate. The constants $r, \alpha, \sigma, \beta, \gamma, \lambda, \theta_0, \theta_1, \theta_2, \varphi_1, \omega \, e \, \gamma$ are all positive, but φ_2, ϑ are negative.

The equation (2.1) of the system presented above represents the "Kaldor-Verdoorn Law", according to which the growth rate of labor productivity is a positive function of the growth rate of real output due to the existence of static and dynamic economies of scale.

Equation (2.2) presents the growth rate of productive capacity in period *t* as a function of the rate of investment of period *t-1*. In this setting, the coefficient σ must be understood – as in Domar (1946) – as the "social productivity of investment", that is, as a coefficient that determines the increase in productivity capacity or in "potential output" that results from an increase in the level of realized investment expenditures.

Equation (2.3) shows the rate of investment that is desired by entrepreneurs for period *t* as a function of the growth rate of output in period t-1 and real interest rate in period *t-1*. This specification of the investment function combines the so-called "principle of acceleration" (cf. Harrod, 1939) with the Keynesian theory of the "marginal efficiency of capital" (cf. Keynes, 1936, ch.11) according to which desired investment is a negative function of the rate of interest.

Equation (2.4) shows the rate of inflation in period *t* as being equal to the rate of change in nominal wages plus the rate of change of nominal exchange-rate minus the rate of growth of labor productivity. This equation is deduced from a *mark-up* pricing rule such as $p = (1+z)\left[\frac{w}{q} + ae\right]$, where: z is the mark-up rate, a is the requirement of imported-raw materials per unit produced, e is the nominal exchange-rate, and q is the average productivity of labor (cf. Taylor, 1989).

Equation (2.5) shows the rate of change of nominal wages as equal to the sum of the rate of inflation in period t-1 and the rate of productivity growth. Labor Unions follow a very simple rule for wage bargains: the rate of change of nominal wages must be high enough to compensate loses of purchasing power due to inflation and to incorporate all productivity gains to real wages.

Equation (2.6) represents the growth rate of exports as a function of the rate of change of real exchange-rate (by definition, equals to rate of change of nominal exchange rate plus the international rate of inflation minus the domestic rate of inflation) and of the rate of growth of world's real income. We must emphasize that γ is the income-elasticity of exports.

Equation (2.7) shows the growth rate of real output as a function of the growth rate of exports. In this setting, coefficient λ must be understood as the non-resident autonomous expenditure multiplier.

Equation (2.8) shows the rate of change in nominal exchange-rate as a linear function of the difference between domestic nominal interest rate and the international nominal interest rates adjusted by the country's risk premium. So we are considering an economy where prevails a floating exchange rate regime in a context of restricted capital mobility due to the existence of some form of capital controls.

Equations (2.9) and (2.9a) presented the monetary policy rule adopted by the Central Bank. In equation (2.9) we can see that the nominal interest rate set by the Central Bank in period *t* has three determinants. The first one is the long-run equilibrium value for nominal interest rate, given by the sum of international interest rate and the risk-premium. The second component is the difference between actual rate of inflation and the target rate of inflation for period *t*. The third and last determinant is the difference between the actual growth rate of real output and the growth rate of productive capacity. In this setting, we are supposing that the Central Bank will change the nominal interest rate relative to its equilibrium value in order to achieve two policy objectives: kept inflation in line with target inflation for that period and to minimize the gap between the actual growth rate of real output and the growth rate of productive capacity.

Equation (2.9a) shows that the Central Bank adjusts slowly the actual value of nominal interest rate to the desired value of this rate, determined by equation (2.9). This equation is a simple formalization of the stylized fact about the behavior of the Central Banks in the operation of monetary policy, according to which Central Banks try to avoid sudden changes in nominal interest rates, in order to minimize interest-rate volatility (cf. Barbosa, 2004, p.105).

Finally, equation (2.10) shows that inflation target for period *t* is a weighted average of the rate of target inflation for period t-1 and the long-run inflation target. In this setting we are supposing that Central Bank operates monetary policy in order to produce a gradual convergence of actual inflation to the long-run inflation target, defined in an exogenous way.

Once that we have specified the structure of the model, it will be presented in a reduced form. After putting equations (2.1), (2.5) and (2.8) in (2.4) we arrive at the following expression:

$$\hat{p}_t = \hat{p}_{t-1} - \alpha\left(\hat{Y}_{t-1} - \hat{Y}_{t-2}\right) + \vartheta\left(i_t - i_t^* - \rho\right) \quad (2.11)$$

In equation (2.11) we can see that the rate of inflation in period *t* is a function of the last period rate of inflation, so that there is a strong degree of inflation inertia in this economy. Besides that, we can see also that growth acceleration between t-1 and t-2 is associated with a reduction in the rate of inflation. This surprising result is due to the effects of growth acceleration over the rate of growth of productivity, which causes a reduction of the rate of inflation. Finally, we can see that monetary policy has effect over inflation by means of the exchange rate channel, which appears to be in accordance with the empirical evidence for emergent economies.

Getting (2.8) in (2.6) and the resulting equation in (2.7) we arrive at the following expression:

$$\hat{Y}_t = \lambda\beta\alpha\left(\hat{Y}_{t-1} - \hat{Y}_{t-2}\right) + \lambda\gamma\hat{Y}_{t,w} + \lambda\beta\left(\hat{p}_{w,t} - \hat{p}_{t-1}\right) \qquad (2.12)$$

Equation (2.12) shows that:

1. A growth acceleration between *t-1* and *t-2* will have a positive impact over the growth rate of real output in period *t*.
2. An increase in the growth rate of world's income will increase the rate of growth of real output.
3. A reduction in the rate of inflation relative to the international level will increase the growth rate of real output.

Lagging (2.3) in one period and getting the resulting expression in (1.2), we arrive at the following expression:

$$\hat{\bar{Y}}_t = \sigma\left(\varphi_1 \hat{Y}_{t-2} + \varphi_2\left(i_{t-2} - \hat{p}_{t-2}\right)\right) \quad (2.13)$$

Based in (2.13) we can conclude that the rate of growth of productive capacity is a function of the growth rate or real output in period t-2 and of the level of real interest rate for that period.

Getting (2.9) in (2.9a), we arrive at the following expression:

$$i_t = (1-\theta_0)i_{t-1} + \theta_0\left(i_t^* + \rho\right) + \theta_0\theta_1\left(\hat{p}_{t-1} - \pi_t^*\right) + \theta_0\theta_2\left(\hat{Y}_{t-1} - \hat{\bar{Y}}_{t-1}\right) \quad (2.9b)$$

Equation (2.9b) shows that nominal interest rate set by the Central Bank in period t depends on the level of nominal interest rate that prevailed in period t-1 (interest rate inertia), the level of nominal interest rates of the rest of the world adjusted by the risk-premium, the difference between the rate of inflation in period t-1 and target inflation for period t and the difference between the last period growth rate of real output and growth rate of productive capacity.

The reduced form of the model presented so far is given by the following system of equations:

$$i_t = (1-\theta_0)i_{t-1} + \theta_0\left(i_t^* + \rho\right) + \theta_0\theta_1\left(\hat{p}_{t-1} - \pi_t^*\right) + \theta_0\theta_2\left(\hat{Y}_{t-1} - \hat{\bar{Y}}_{t-1}\right) \quad (2.9b)$$

$$\pi_t^* = \omega\pi_{t-1}^* + (1-\omega)\pi_{LP} \quad (2.10)$$

$$\hat{p}_t = \hat{p}_{t-1} - \alpha\left(\hat{Y}_{t-1} - \hat{Y}_{t-2}\right) + \vartheta\left(i_t - i_t^* - \rho\right) \quad (2.11)$$

$$\hat{Y}_t = \lambda\beta\alpha\left(\hat{Y}_{t-1} - \hat{Y}_{t-2}\right) + \lambda\gamma\hat{Y}_{t,w} + \lambda\beta\left(\hat{p}_{w,t} - \hat{p}_{t-1}\right) \quad (2.12)$$

$$\hat{\bar{Y}}_t = \sigma\left(\varphi_1 \hat{Y}_{t-2} + \varphi_2\left(i_{t-2} - \hat{p}_{t-2}\right)\right) \quad (2.13)$$

3 – The *Steady-State* equilibrium of the model.

The *steady-state* solution for the model presented by equations (2.9b)-(2.13) is such that $\hat{p}_t = \hat{p}_{t-1} = \hat{p}$; $\hat{Y}_t = \hat{Y}_{t-1} = \hat{Y}$ and $\pi_t^* = \pi_{t-1}^* = \pi_{LP}$ (2.14). Getting (2.14) in (2.11), we arrive at the following expression[4]:

$$i = i^* + \rho \quad (3.1)$$

In words: the long-run equilibrium value for nominal interest rate is equal to the sum of the world's nominal interest rate and the risk-premium. In the long-run, nominal rate of interest is independent of monetary policy.

From (2.12), we get the following expression:

$$\hat{Y} = \lambda\gamma\hat{Y}_w + \lambda\beta\left(\hat{p}_w - \hat{p}\right) \ (*)$$

Equation (*) shows the long-run equilibrium value for the growth rate of real output. We can see that long-run growth rate depends on two factors: the growth rate of world's income and the difference between the level of inflation in the rest of the world and the domestic rate of inflation. In this framework, money is not super-neutral, since changes in the rate of inflation (relative to the international level) has a persistent effect over the growth rate of real output. Since the relation between inflation and growth is negative, monetary policy will promote a robust long-run growth if and only if it keep inflation al low levels in comparison to the level prevailing in the rest of the world.

From (2.9b) we get the following expression:

[4] In what follows we will suppose that international rate of inflation, the growth rate of world´s income and risk-premium are constant in time.

$$\hat{p} = \pi_{LP} - \left(\frac{\theta_2}{\theta_1}\right)\left(\hat{Y} - \hat{\bar{Y}}\right) \quad (**)$$

Based on (**), we observe that long-run equilibrium rate of inflation will be equal to long-run target if and only if real output and productive capacity are growing at the same rate.

In order to determine if inflation will converge to its long-run target, we have first to calculate the expression for $\left(\hat{Y} - \hat{\bar{Y}}\right)$. Getting (*) in (2.13) we obtain:

$$\hat{\bar{Y}} = \sigma\varphi_1\left[\lambda\gamma\hat{Y}_w + \lambda\beta\left(\hat{p}_w - \hat{p}\right)\right] + \sigma\varphi_2\left(i - \hat{p}\right) \quad (***)$$

Subtracting (*) from (***), we arrive at the following expression:

$$\hat{Y} - \hat{\bar{Y}} = \left(1 - \sigma\varphi_1\right)\lambda\left[\gamma\hat{Y}_w + \beta\left(\hat{p}_w - \hat{p}\right)\right] - \sigma\varphi_2\left(i - \hat{p}\right) \quad (3.2)$$

Getting (3.2) in (**), we arrive at:

$$\hat{p} = \frac{\theta_1}{\theta_1 + \theta_2\left[\sigma\varphi_2 - (1 - \sigma\varphi_1)\lambda\beta\right]}\pi_{LP} - \frac{\theta_1\theta_2}{\theta_1\left\{\theta_1 + \theta_2\left[\sigma\varphi_2 - (1 - \sigma\varphi_1)\lambda\beta\right]\right\}}\left[(1 - \sigma\phi_1)\lambda(\gamma \hat{Y}_w + \beta \hat{p}_w) - \sigma\phi_2(i^* + \rho)\right] \quad (3.3)$$

In equation (3.3) we observe that, in general, long-run equilibrium rate of inflation is different from its long-run target. Convergence will only occur if $\theta_2 = 0$; i.e., de weight of differences between growth rates of real output and productive capacity in the Taylor's rule must be set equal to zero. This result is a natural consequence of the Tinbergen´s Economic Policy Theorem, according to which there must be equality between the number of policy goals and the number of policy instruments. Since, in the model at hand, Central Bank has only one instrument of monetary policy – the nominal interest rate – there must be only one goal for monetary policy: to control the rate of inflation.

Considering the fulfillment of the sufficiency condition for convergence of inflation to its long-run target, we must now turn our attention to the analysis of the behavior of the gap between growth rate of real output and the growth rate of productive capacity. A balanced growth path requires the equality between both rates in order to guarantees a constant rate of capacity utilization in the long-run.

Subtracting (3.1) and (3.2) in (3.3) we get the long-run equilibrium value of the gap between growth rate of real output and the growth rate of productive capacity, which is given by the following expression:

$$\hat{Y} - \hat{\bar{Y}} = \left(1 - \sigma\varphi_1\right)\lambda\left[\gamma\hat{Y}_w + \beta\hat{p}_w\right] - \sigma\varphi_2\left(i^* + \rho\right) + [\sigma\varphi_2 - \left(1 - \sigma\varphi_1\right)\lambda\beta]\pi_{LP} \quad (3.4)$$

The first two terms of the right-hand side of (3.4) are both positives[5], but the third term is negative, so the long-run equilibrium value of the *gap* must be positive or negative. However, the gap between the two rates is a function of the value for the long-run inflation target. Central Bank can set the value for the long-run in order to guarantees the equality between the growth rate of real output and the growth rate of productive capacity. In this setting, we can define the *Balanced Growth Rate of Inflation* (BGRI) as the inflation rate that guarantees the equality between the growth rate of real output and the growth rate of productive capacity[6]. The BGRI (π^*_{LP}) is determined by the following expression:

$$\pi^*_{LP} = \frac{\sigma\varphi_2\left(i^* + \rho\right) - \left(1 - \sigma\varphi_1\right)\lambda\left[\gamma\hat{Y}_w + \beta\hat{p}_w\right]}{\left[\sigma\varphi_2 - \left(1 - \sigma\varphi_1\right)\lambda\beta\right]} \quad (3.5)$$

[5] Considering $1 > \sigma\varphi_1$.

[6] This concept has some similarities with the *Minimum Unemployment Rate of Inflation* developed by Palley (2006). According to him, the existence of a backward bending Phillips curve for low inflation levels guarantees the existence of a rate of inflation that minimizes the rate of unemployment. Central Banks, operating in a context of Inflation Targeting, must then set nominal interest rates in order to achieve this rate of inflation. In our model, the problem is not to achieve the minimum unemployment, but to achieve the highest possible growth rate for real output that is sustainable in the long-run. This requires the equality between the growth rate of real output and the growth rate of productive capacity. The long-run target for inflation must be set in a level such that he differences between both rates is zero.

In equation (3.5) we can observe BGRI is a function of the international rate of interest, the growth rate of world's income and international rate of inflation. From this reasoning, we can conclude that BGRI have to be set taking in consideration the conditions prevailing in the world economy, or otherwise the long-run target could be set in a level to high or to low for a balanced growth path to exist.

In sum, the analysis of the steady-state solution of the model at hand allowed us to reach the following conclusions:

- There is an inverse relation between the growth rate of real output and the rate of inflation, given the growth rate of world's income and the international rate of inflation.
- The convergence of inflation rate to its long-run target requires that Central Bank has only one goal for monetary policy: to control inflation. This is equivalent to set a weight equal to zero for the gap between the growth rate of real output and the growth rate of productive capacity in the interest rate rule.
- A balanced growth path requires that Central Bank set a long-run target for inflation that is flexible and adjustable to the conditions prevailing in the word's economy. In particular, the long-run inflation target must be increased in periods of increasing levels of international interest rates and/or decreasing growth rates of world's economy.

4- Numerical Simulation of the Theoretical Model.

Once that we have presented the properties of the balanced growth path of the economy at hand, we must proceed to a numerical analysis of the dynamic paths for the economy in order to analyze the impact over these paths of changes in the parameters of the model that reflect changes in the rules of operation of monetary policy and/or the level of capital controls.

For the numerical simulation of the model we will consider the following values for the parameters and initial conditions of the system.

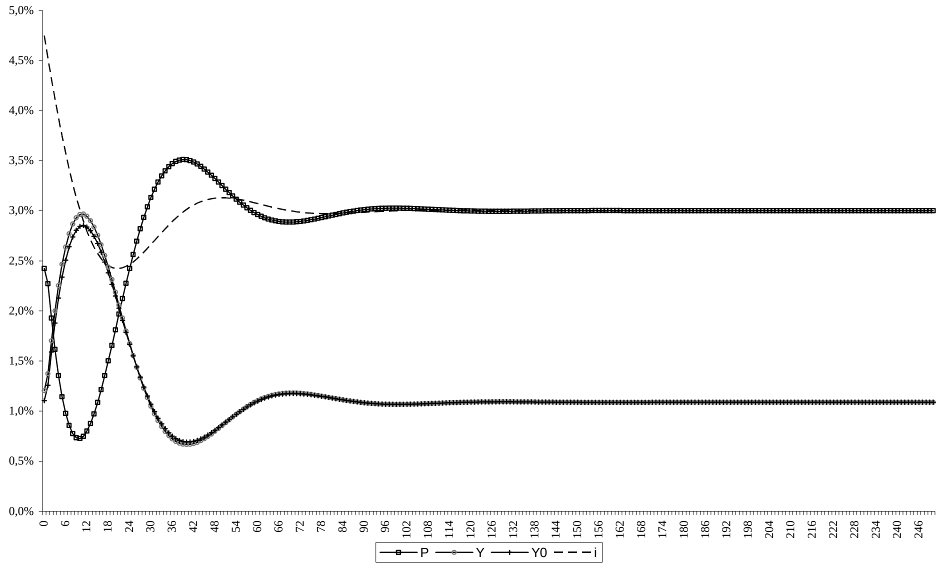
TABLE I: NUMERICAL VALUES USED IN THE STANDARD SIMULATION OF THE THEORETICAL MODEL

Parameters		**Initial Conditions (growth rates)**	
Alpha	0,1	Pt-1	0,03
Epslon	-0,25	Yt-1	0,035
Beta	1,1	Yt-2	0,021
Gama	0,5	Y0t-1	0,04
phi_2	-0,1	Rho	0,01
Lambda	0,75	Pw	0,025
Sigma	0,5	Yw	0,04
Phi	2	Pit-1	0,04
Theta_0	0,1	piLP	0,03
Theta_1	0,5	Iw	0,02
Theta_2	0,3	It_1	0,05
Omega	0,75		

Some of these values are based on "stylized facts" about the long-run dynamic behavior of capitalist economies. For example, we are supposing a value for the "social productivity of investment" (σ) equal to 0.5. Since capital-output relation is equal to ($1/\sigma$), then a value for σ equal to 0.5 means a capital-output relation of 2, what seems to be in accordance with the values found for this variable in many developed capitalist economies (cf. Maddison, 1991). Also a long-run inflation target of 3% per year seems to be in accordance with the experience of Inflation Targeting countries. Finally, a growth rate for the world economy of 4 % per year and an inflation rate at 2.5% per year for the rest of the world seem to be very plausible estimates for the long-run values of these variables.

The dynamics of the growth rate of real output and productive capacity, inflation and nominal interest rates can be seen by means of Figure 4.1 below:

Figure 4.1: Dynamics of the growth rate of real output and productive capacity, inflation and nominal interest rate in the standard simulation.



In the figure 4.1 above we can see that, for the values considered in the standard simulation, the selected variables converge to their long-run equilibrium values. In fact, nominal interest rate converges to its *steady-state* value of 3% per year, given by the sum of the international interest rate (2% per year) and the risk premium (1% per year). We can see also the convergence of inflation rate to its long-run target of 3% per year.

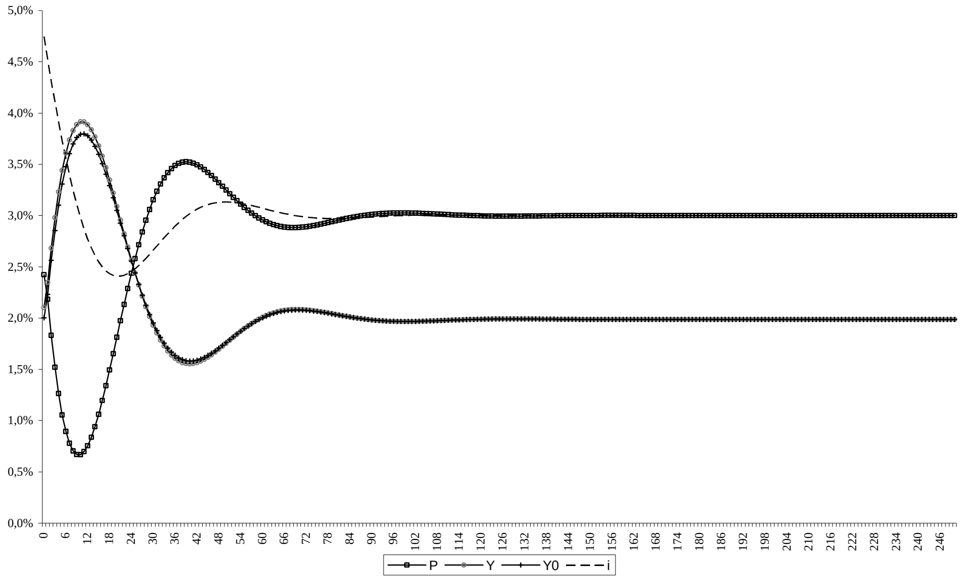
The growth rate of real output shows damped oscillations around its long-run equilibrium value of 1% per year. This low value for the long-run growth rate is the consequence of a low income-elasticity of exports – set equal to 0.5 in the standard simulation – and of a low value for the exports multiplier – set equal to 0.75 in the standard simulation. This low value for the exports multiplier is supposed to be the consequence of a high value for the income-elasticity of imports. The combination of a low income-elasticity of exports with a high income-elasticity of exports allows us to conclude that in the economy at hand there is a very high level of productive specialization, what have negative effects over the growth rate of exports and real output (cf. Dosi *et alli*, 1990).

Finally, the growth rate of productive capacity have a very similar behavior with the one of real output. This fact is a simple consequence of the demand-led nature of growth of the economy in consideration, in which growth of productive capacity adjusts itself to growth of demand and output.

We will now depart from the standard simulation in order to do two kinds of experiments. The first one will be testing the impact over the dynamics of the system of changes in the "structural" parameters of the economy, that is, in the parameters that reflect the level of productive specialization of the economy. The second one will be testing the impact over system dynamics off a change in "policy parameters", that is, parameters that represent the monetary policy and the level of capital controls. The objective of these experiments is to evaluate the contribution of monetary policy and industrial policy for the promotion of a robust growth in the long-run, considering the existence of a demand-led growth regime.

In the first experiment we will consider an increase in the income-elasticity of exports from 0.5 to 0.8; what reflects the adoption of an industrial policy concerned with the reduction in the level of productive specialization of the economy at hand. The dynamics of the selected variables can be seen by means of Figure 4.2 below:

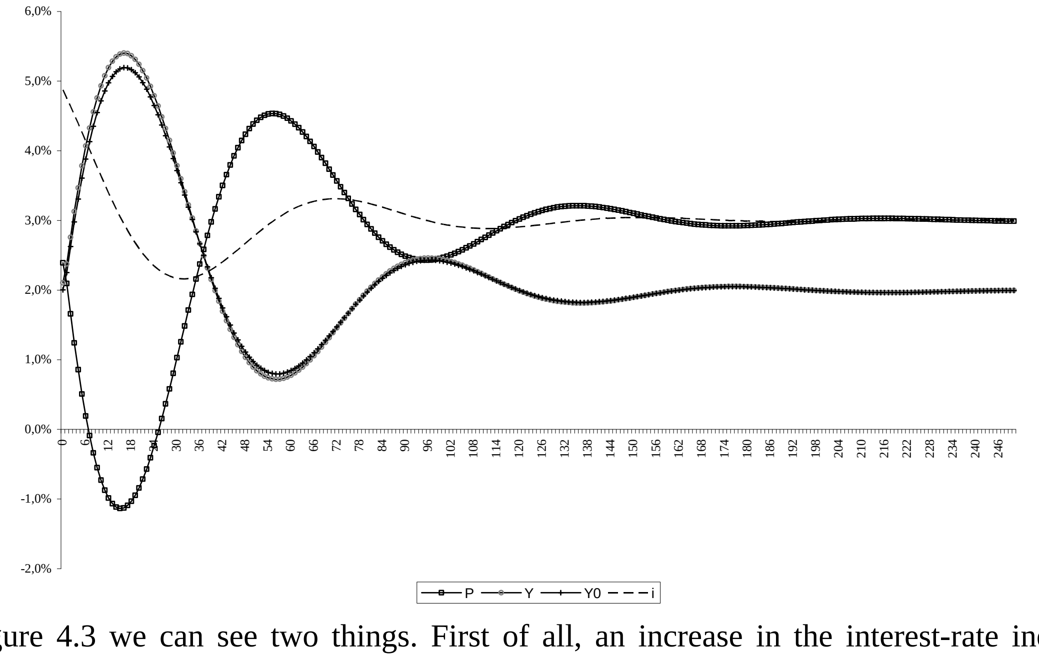
Figure 4.2: Dynamics of the growth rate of real output and productive capacity, inflation and nominal interest rate considering a once-and-for all increase in the income elasticity of exports.



An increase in the income elasticity of exports has a clear effect over the long-run equilibrium value for the growth rate of real output. In fact, as we can see in Figure 4.2, the growth rate of real output converges to a value of 2.0% per year, a 100% increase of the value observed in the standard simulation. The same effect can be observed for the growth rate of productive capacity. However, the dynamics of nominal interest rate and the inflation rate do not change at all. Industrial policy has a strong effect over long-run growth, but seems to have no consequence for the conduct of monetary policy.

In the second exercise we will consider an increase in the degree of "interest rate smoothing" by the Central Bank, that is, an increase in the coefficient that reflects the degree of interest-rate inertia in the economy at hand[7]. For such, we will suppose that θ_0 will be reduced from 0.1 to 0.05. The visualization of the dynamics of the selected variables can be made by means of Figure 4.3 below:

Figure 4.3: Dynamics of the growth rate of real output and productive capacity, inflation and nominal interest rate considering an increase in the income-elasticity of exports and in the level of interest-rate inertia.



In figure 4.3 we can see two things. First of all, an increase in the interest-rate inertia has no effects over the long-run values of the growth rate of real output, productive capacity, inflation and

[7] In this second exercise, we will take the same value of the income-elasticity of exports used in the first exercise.

nominal interest rates. So the degree of conservatism in the conduct of monetary policy is irrelevant for the long-run dynamics of the economy at hand. However, an increase in the interest-rate inertia has increased the amplitude of oscillations of the variables around their long-run equilibrium values. From this exercise we can conclude that higher is the degree of conservatism in the operation of monetary policy by the Central Bank, bigger will be the macroeconomic instability.

In the third experiment we will consider a decrease in the level of capital controls, so that the sensibility of the rate of change of nominal exchange rate to interest rate differential will increase[8]. More specifically, we will increase the value of ε from -0.25 to -0.75. The impact of this change over the dynamics of the selected variables can be seen by means of figure 4.4 below:

Figure 4.4: Dynamics of the growth rate of real output and productive capacity, inflation and nominal interest rate supposing an increase in the income-elasticity of exports and in the level of interest-rate inertia and a decrease in the level of capital controls.

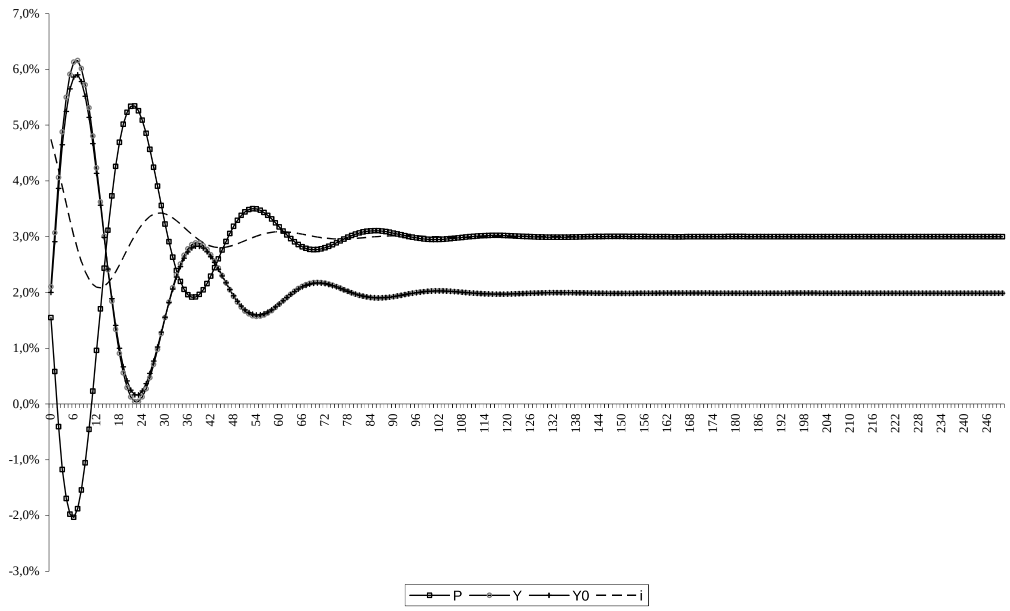
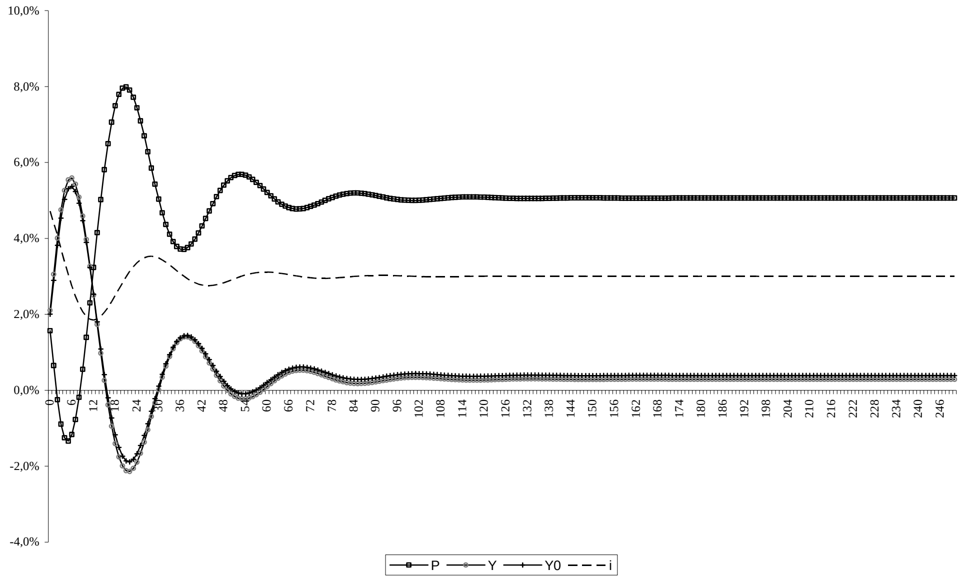


Figure 4.4 above shows that a reduction in the level of capital controls has no effect over the long-run equilibrium values of selected variables. However, we can see a clear increase in the amplitude of oscillations of these variables around their equilibrium values when we compare this dynamic with the one shown in Figure 4.3. From this reasoning we can conclude, in accordance with Ono, Silva, Oreiro and Paula (2005), that the degree of openness of capital account is irrelevant for long-run growth. However, a decrease in the level of capital controls will result in greater macroeconomic instability.

As a last experiment we will evaluate the impact over the dynamics of the selected of an increase of the long-run target for inflation relative to the international inflation levels. For such we will consider that the Central Bank increase the long-run inflation target from 3% per year for 5% per year, holding constants all the parameter values of the last simulation. Visualization of the effects of changes in the long-run inflation target can be done by means of figure 4.5 below:

Figure 4.5: Dynamics of the growth rate of real output and productive capacity, inflation and nominal interest rate supposing an increase in the income elasticity of exports, in the level of interest rate inertia , in the degree of openness of capital account (a decrease in the level of capital controls) and in the long-run inflation target.

[8] Holding constants all the parameters used in the last simulation.



As we can see in Figure 4.5, an increase in the long-run inflation-target has a clear negative impact over the long-run equilibrium value of the growth rate of real output of the economy at hand. More specifically, economy will converge towards a long-run growth rate of only 0.3% per year.

In sum, the numerical simulations of the theoretical model allowed us to conclude that:

- The adoption of policies that aim to increase income-elasticity of exports create a clear increase in the long-run growth rate of real output. So there is a case for industrial policies to promote long-run growth. Industrial policies must be directed towards sectors and firms that produce tradable goods with a high income-elasticity of exports.
- The degree of conservatism is the operation of monetary policy, expressed in the coefficient of interest-rate inertia, has no impact over long-run growth; but influences the amplitude of oscillations of the main macroeconomic variables around its long-run equilibrium values. More specifically, as higher is the degree of conservatism of the Central Bank, higher will be the macroeconomic instability.
- Policies that aim to increase the level of openness of capital account do not have any impact over long-run growth rate of real output or over the long-run equilibrium value of nominal interest rates. However these policies have the effect of increase the instability of the main macroeconomic variables.

5 – Growth and Productive Specialization: A Ricardian Model.

In the model presented in the last sections we saw that long-run growth rate is determined by two variables: the growth rate of the world's income and the income elasticity of exports.

In this section we will complete the analysis done so far by means of a deeper analysis of the determinants of the income-elasticity of exports and the exports multiplier. As we will see, these structural parameters are influenced by the degree of productive specialization of the economy; i.e. the number of different goods that an economy produce in a point of time. In this setting, there is a channel by which a permanent change in the level of real interest rate can influence the long-run growth rate of the economy at hand.

Our starting point will be a reformulation of the Ricardian model of international trade proposed by Dornbusch, Fischer and Samuelson (1977).

Let us consider a world economy composed of two countries (A and B). The only input used in production is labor and there is a *continuum* Z of commodities defined in the closed interval [0,1]. These commodities can be classified in a decreasing order of comparative advantage by means of the ranking of the labor requirement for production of each commodity in both economies. We will assume that:

$$\frac{a_1^*}{a_1} > \frac{a_2^*}{a_2} > ... > \frac{a_n^*}{a_n} > ... \qquad (5.1)$$

Where: a_1^* is the labor requirement for production of commodity 1 in country B and a_1 is the labor requirement for production of commodity 1 um country A.

Let $A(Z) = \frac{a^*(Z)}{a(Z)}$ the relative productivity of labor employed in the production of commodity Z. We will assume that: $A'(Z) < 0$.

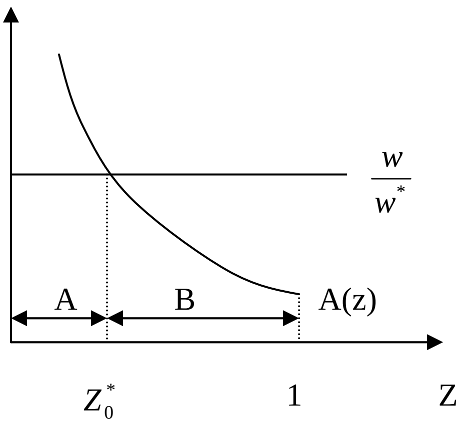
The international specialization of each commodity in country A or B will depend on the structure of relative wages. Commodity Z will be produced in country A if and only if the following condition was met:

$$a(z)w < a^*(z)w^* \quad \Leftrightarrow \quad \frac{a^*(z)}{a(z)} > \frac{w}{w^*} \qquad (5.2)$$

Where: w^* is the real wage that prevails in economy B; *w* is the real wage that prevails in economy A.

The determination of the level of international specialization can be visualized y means of figure 5.1 below:

Figure 5.1: Determination of the level of international specialization



In the modified version of the Ricardian model by Dornbusch *et alli* (1977), the structure of relative wages was determined by the *market-clearing* in the labor market. In the version presented here we will assume that real wage is determined by a bargaining process between firms and labor unions, and that there is an inverse relation between the level of the real wage in a country and the real exchange rate. So, the real wage paid in economy A can be expressed by:

$$w = f(q) \quad ; f' < 0 \quad (5.3)$$

Where: *q* is the real exchange rate.

In a world economy composed of only two countries, a real exchange rate appreciation in one country means real exchange rate depreciation in the other country. If the real exchange rate appreciates in country A, real wage must increase in this economy. The other side of this story will be a exchange rate depreciation in country B and a reduction in real wage in this country. So a real exchange rate appreciation in country A will displace the structure of relative wages upward in figure 5.1, reducing the number of commodities produced in country A and increasing the number of commodities produced in country B. From this reasoning we can conclude that a real exchange rate appreciation in country A will produce an increase in the level of productive specialization of this economy.

What are the effects of an increase in the level of productive specialization of economy A over its long-run growth rate? As shown by Dosi, Pavitt e Soete (1990, ch.7) an increase in the level of productive specialization of an economy will increase the marginal propensity to import of this economy, decreasing the value of exports multiplier. This reduction of exports multiplier will cause a reduction in the long-run equilibrium value of output growth.

From this reasoning, we can conclude that the level of real exchange rate have a lasting effect over the growth rate of capitalist economies, since real exchange rate is one of the determinants of the degree of productive specialization, which determines the marginal propensity to import and the exports multiplier.

As a final conclusion of this reasoning, we can say that real exchange rate can affect the growth rate of capitalist economies by other channels than its direct impact over the level of exports and imports. Real exchange rate has not only a static effect over these variables, but also a dynamic impact, influencing the growth rate of exports and imports. The literature about exchange-rate and growth emphasizes the *static effects* of real exchange rate changes over the level of current account balance by means of the estimations of price-elasticity of demand for exports and imports. These empirical studies show that price-elasticities are low; so that changes in the level of real exchange rate are supposed to have almost no effect over growth rates in a demand-led growth regime. In the words of McCombie and Roberts:

> "*There are numerous studies estimating import and export demand functions as part of a test of Thirwall's law, and these generally report estimated price elasticities that are either statistically insignificant, low or have a priori unexpected signs*"(2002, p.92).

These studies, however, do not take in consideration the impact of changes in the real exchange-rate over income elasticities of demand for exports and imports. But this channel seems to be the way by which exchange-rate policy can affect the long-run growth rates of capitalist economies.

6 – A Cumulative Causation Model with Structural Change.

In this section we will analyze the effects of changes in the level of productive specialization of the economy that are induced by changes in the real exchange rate over the *steady-state* equilibrium of the economy at hand.

We argued that marginal propensity to import and exports multiplier depends on the level of productive specialization of the economy, which is, in turn, influenced by real exchange rate[9]. In order to formalize these ideas, we will suppose that exports multiplier λ of equation (2.7) can be expressed by:

$$\lambda_t = \lambda_0 \left(\frac{e_{t-1} p^*_{t-1}}{p_{t-1}} \right) \quad (6.1)$$

Equation (6.1) shows that a real exchange rate appreciation in period *t-1* produces a reduction in exports multiplier in period *t*, since a real exchange rate appreciation induces an increase in the level of productive specialization and an increase in marginal propensity to import.

In this section we will only analyze the *steady-state* effects of changes in real exchange-rates. We know that in *steady-state*:

$$\lambda = \lambda_0 \varepsilon \quad (6.2)$$

Where: $\varepsilon = \frac{ep^*}{p}$ is the *steady-state* level of real exchange rate.

Getting (6.2) in (*) we arrive at the following expression:

$$\hat{Y} = \lambda_0 \varepsilon \left[\gamma \hat{Y}_w + \beta \left(\hat{p}_w - \hat{p} \right) \right] \quad (6.3)$$

In equation (6.3) we observed that the growth rate of real output is a function of the growth rate of world's income, the difference between domestic and international rates of inflation and the real exchange rate. From (6.3), we can conclude that a real exchange rate appreciation will reduce the growth rate of real output.

Assuming the same conditions listed in section 3, in particular, the hypothesis that θ_2=0, we know that long-run equilibrium rate of inflation will be equal to its long-run target. The equality between

[9] An empirical study about the determinants of the income-elasticity of exports and imports can be found in Barian (1997).

growth rates of real output and productive capacity will requires the fulfillment of the following condition:

$$0 = (1-\sigma\varphi_1)\lambda_0\varepsilon\left[\gamma\hat{Y}_w + \beta\hat{p}_w\right] - \sigma\varphi_2\left(i^* + \rho\right) + [\sigma\varphi_2 - (1-\sigma\varphi_1)\lambda_0\varepsilon\beta]\pi_{LP} \quad (6.4)$$

In equation (6.4) we can see that the existence of a balanced growth path ; i.e. the equality between the growth rates of output and productive capacity – is now compatible with an entire range of values for long-run target inflation and real exchange rate. In other words, there are numerous combinations between long-run target inflation and real exchange-rate for which a balanced growth path exist. These combinations will define the BG locus. In order to determine the shape of this locus we will differentiate (6.4) with respect to ε and π, arriving at the following expression:

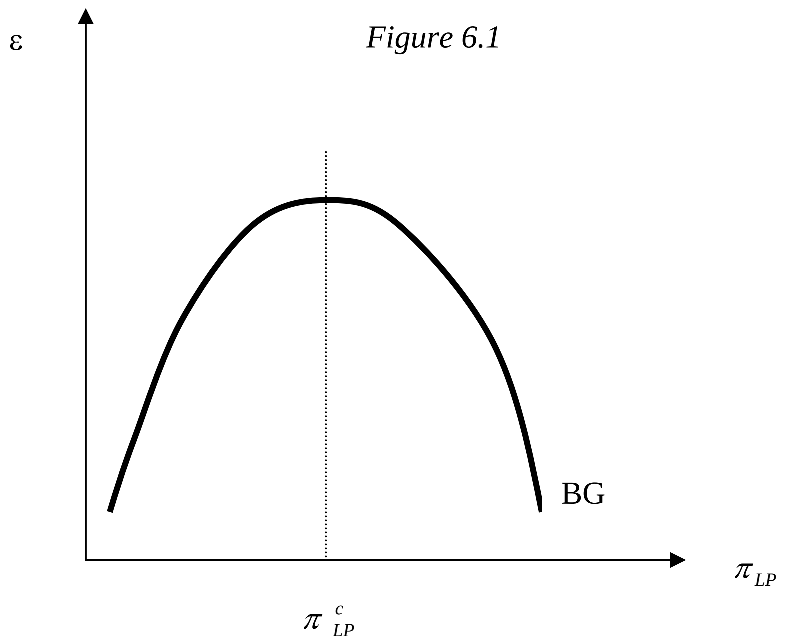
$$\frac{\partial\varepsilon}{\partial\pi_{LP}} = -\frac{[\sigma\varphi_2 - (1-\sigma\varphi_1)\lambda_0\varepsilon\beta]}{(1-\sigma\varphi_1)\lambda_0\left[\left(\gamma\hat{Y}_w + \beta\hat{p}_w\right) - \beta\pi_{LP}\right]} \quad (6.5)$$

Sign of the numerator in (6.5) is clearly negative, but denominator can be positive or negative, depending on the level or long-run inflation target. In fact, for very low levels of target inflation, denominator will be positive, so the partial derivative in (6.5) will also be positive. This means that, for very low levels of inflation, there is a positive relation between target inflation and real exchange rate if the economy is in a balanced growth path. For this range of BG locus, any reduction in the long-run inflation target will be followed by a real exchange-rate appreciation, with deleterious effects over growth rate of real output.

For very high levels of target inflation, denominator will be negative as the sign of the partial derivative in (6.5), meaning the existence of a negative relation between target inflation and real exchange-rate along the balanced growth path. For this range of BG loci, a disinflation will result in a real exchange rate depreciation with clear and positive effects over the growth rate of real output.

From this reasoning, we can conclude that, along the balanced growth path the relation between long-run inflation target and real exchange rate is non-linear, showing an inverted *U* shape pattern as we can see in Figure 6.1 below:

Figure 6.1



To close the model, we have to analyze the necessary conditions for a constant real exchange rate in the long-run. The dynamics of real exchange rate is given by:

$$\hat{\varepsilon} = \hat{e} + \hat{p}^* - \hat{p} \quad (6.6)$$

In words: the rate of change of real exchange-rate is equal to rate of change of nominal exchange-rate *plus* international rate of inflation *minus* domestic rate of inflation.

In *steady-state* is true that: $\hat{\varepsilon} = \hat{e} = 0$ and $\hat{p} = \pi_{LP}$. So we can conclude that a necessary condition for a constant real-exchange rate in *steady-state* is: $\pi_{LP} = \hat{p}^*$; that is, Central Bank must set a long-run target for inflation equal to the rate of inflation in the rest of the world. This condition defines a ER *locus*, representing all the combinations between long-run inflation target and real exchange rate for which real exchange rate is constant trough time. This *locus* can be seen in figure 6.2 below.

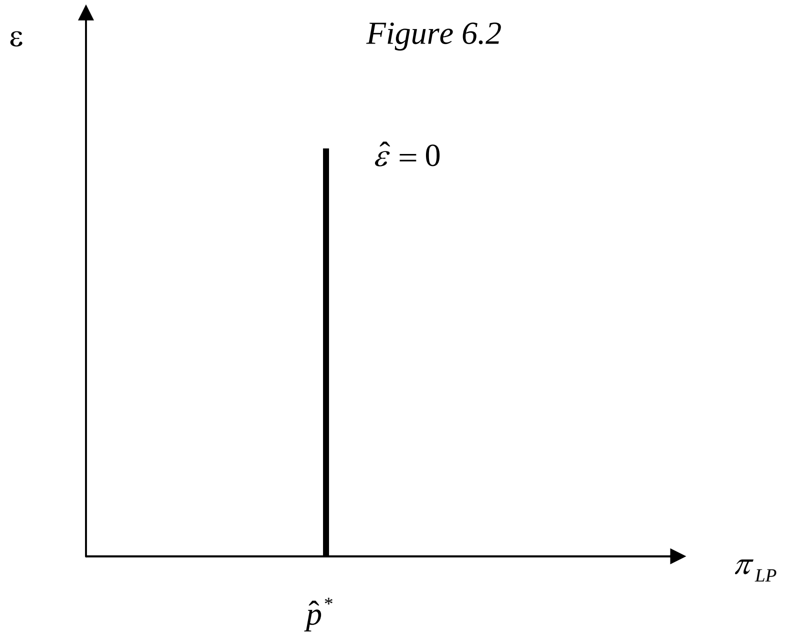


Figure 6.2

Long-run equilibrium values for target inflation and real-exchange rate will be determined in the interception of BG and ER *locus.* A possible long-run equilibrium is shown in figure 6.3 below:

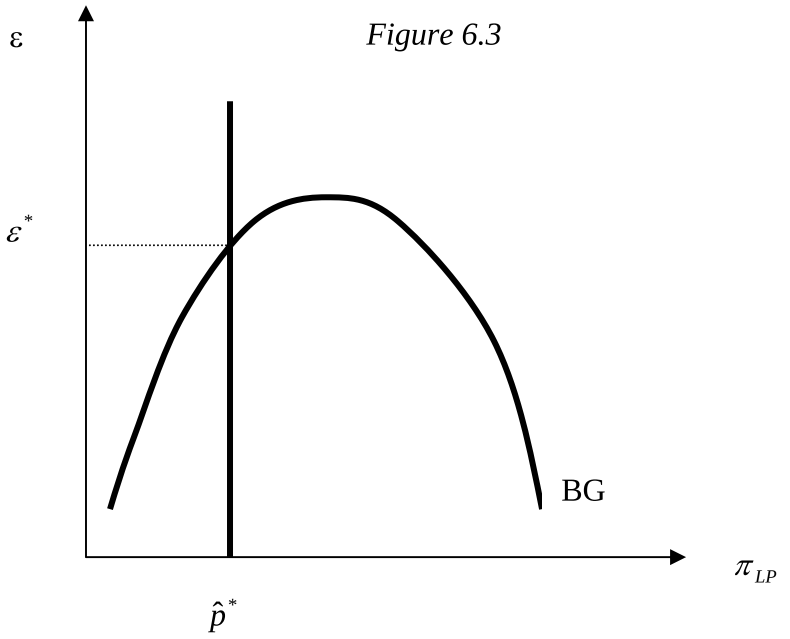


Figure 6.3

Since in *steady-state* the long-run inflation target will be equal to international rate of inflation, we can conclude that by means of equation (6.3) that long-run equilibrium value for real output growth is given by:

$\hat{Y} = \lambda_0 \varepsilon^* \gamma \hat{Y}_w$ (6.7)

In words: the long-run growth rate of real output depends only on the rate of growth of world's income and the equilibrium value of real exchange-rate.

From this reasoning, we can conclude that monetary policy has no effect over long-run growth. For a *steady-state* equilibrium exist, Central Bank has to set a long-run target inflation equal to the international level. Assuming that the economy is along a balanced growth path, real-exchange rate will be determined by international rate of inflation. Once real exchange rate is determined and, therefore, the long-run equilibrium level of productive specialization; growth rate of real output will depend only on the growth rate of world's income.

A last result to be emphasized is that the coefficient that measures the sensibility of capital inflows to the difference between domestic and international rates of interest has no impact over the long-run relation between target inflation and real exchange-rate. From this result we can conclude that policies that aim to increase the degree of openness of capital account do not affect the long-run equilibrium value of real exchange-rate and, therefore, do not have any impact over the long-run growth rate of real output. This last result is in accordance with the findings of Ono *et alli* (2005) where we found that the existence or not of capital controls do not have any influence over the growth rates of the selected countries.

7 – Numerical Simulation of the Model with Structural Change.

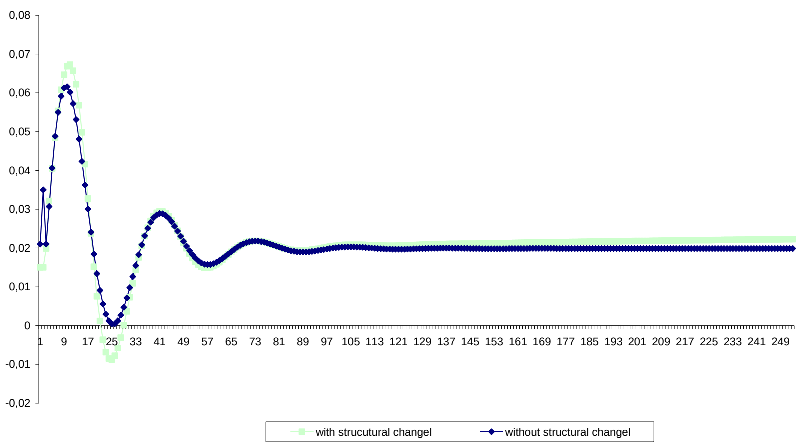
As done in section 4, we will now proceed at a numerical simulation of the model presented in the last section. The objective is to analyze the effects of changes in the rules of operation of monetary policy over the long-run growth rate of real output.

In the numerical simulation of the model with structural change, we will suppose that Central Bank is setting a long-run target for inflation that is higher than the international rate of inflation. This procedure will open a room for monetary policy to have effects over long-run growth, since we have saw that along a balanced growth path, monetary policy has no effect over real exchange-rate and growth rate of real output.

For such, we will consider the same numerical values for parameters and initial conditions used in the standard simulation reported in Table I, doing the required changes in order to incorporate the real exchange rate as a determinant of exports multiplier in equation (6.2).

Figure 7.1 below shows the time paths of the growth rates of real output with and without structural; that is, in the case where exports multiplier do not depend on real exchange rate (blue line) and in the case where exports multiplier depend on that rate (green line). As we can see in the figure below, the introduction of a channel by which the real exchange rate can affect the exports multiplier has a noticeable effect over the growth rate of output in the long-run. In fact, in the case where there is no such channel, the average growth rate along the entire simulation period is 2.1% per year; but in the case where there is such a channel, the average growth rate is 2.2% per year, a 5% increase. In a simulation period of 250 years, considering a real output of 100 units, real output would reach a value of 18.865,67 in the first case and a value of 22.509,00 in the second case, a difference of 20% between the first value and the last.

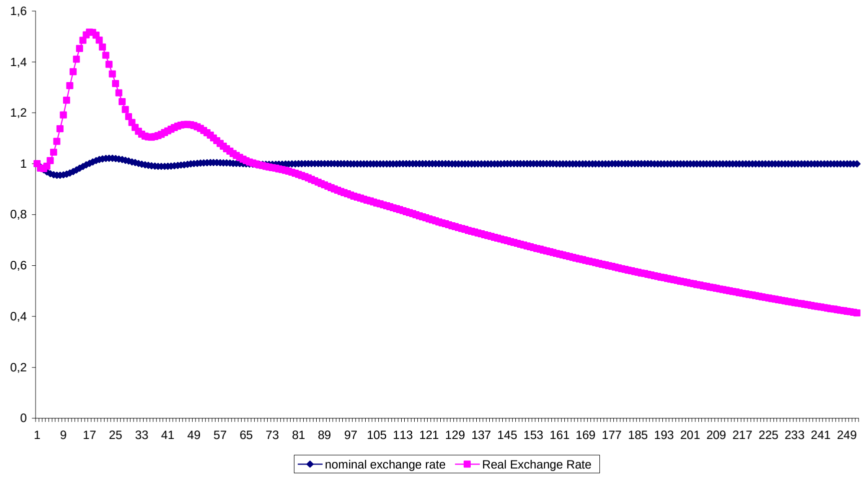
Figure 7.1 - Growth Dynamics with and without Structural Change



In the conditions supposed by the standard simulation, we can observe that nominal exchange rate will remain stable, but real exchange rate will show a huge appreciation, as we can see in figure 7.2 below.

Stability of nominal exchange rate was explained by the convergence of nominal interest rate to its long-run equilibrium value, given by the sum of international rate of interest and the risk premium. This convergence eliminates the incentives for flows and outflows of foreign capital from the economy at hand, therefore, stabilizing the nominal exchange rate. The appreciation of real exchange rate results from the combination of a domestic rate of inflation (equal to 3% per year) superior than the international level.

Figure 7.2 - Dynamics of Real and Nominal Exchange Rate



Departing from standard simulation we can test the effects of different values for the coefficient of interest-rate inertia (theta_0) and the speed of convergence to the long-run rate of inflation (omega) overt the average growth rate of real output and over the average real exchange rate along the entire simulation period. The results of the tests are reproduced in Tables II and III below.

In table III we observe that a reduction in the interest rate inertia – expressed by an increase in θ_0 – produces a real exchange rate appreciation, followed by a reduction in the average growth rate of real output. In other words, a greater volatility of nominal interest rate – because of smaller interest rate inertia – will produce either a real exchange rate appreciation and a reduction in the growth rate of real output. From this reasoning we can conclude that a monetary policy that aims to foster economic growth should be conducted in a way to minimize volatility of nominal interest rate.

In table III we can see that an increase in the speed of convergence of inflation to its long-run target – expressed by a reduction in the value of ω - is associated with a real exchange rate depreciation and a slight increase in the average growth rate of real output. This result is at odds with the common sense idea according to which a higher speed of convergence of inflation to its long-run target will impose higher sacrifices to society in terms of lower growth of real output, since a higher speed of convergence will require a high interest rates during the entire transition period. The explanation for this paradox is that how longer is the length of the period in which domestic inflation is higher than the international level, bigger will be the reduction of competitiveness of exports (bigger will be the real exchange rate appreciation) and, therefore, lower will be the long-run growth. In this setting, Central Bank has to set a long-run inflation target as near as possible of the international level, but also set a higher speed of convergence of inflation to its long-run target in order to maximize the growth rate of real output.

Finally, we must analyze the effects of different levels of capital mobility over the growth rate of real output. For such, we tested different values for coefficient ζ - that express the sensibility of the rate of change of nominal exchange-rate to the difference between domestic and international rates of interest – over the average growth rate of real output. Results are shown in Table IV below.

	TABLE II	
theta_0	Average "q"	Avergage "g"
0,1	0,8	2,177
0,2	0,65	2,167
0,3	0,61	2,162
0,4	0,59	2,158
0,5	0,58	2,157
	TABLE III	
Omega	Average "q"	Avergage "g"
0,9	0,76	2,177
0,75	0,80	2,177
0,6	0,81	2,2178
0,5	0,82	2,2178
0,3	0,82	2,2178
	TABLE IV	
Epsilon	Average "q"	Avergage "g"
-0,75	0,8	2,177
-0,5	0,799	2,184
-0,25	0,789	2,19
-0,15	0,78	2,19

As we can see in Table IV, changes in the degree of capital mobility have almost zero effect over real exchange rate and average growth rate of real output. In this setting, we can conclude that, even in the presence of a structural relation between real exchange rate and exports multiplier, policies that aim to increase the degree of openness of capital account – thereby reducing the level of capital controls – have no sizeable effects over economic growth in the long-run. This result is in accordance with the empirical literature about he effects of capital controls on economic growth (cf. Ono *et alli*, 2005) that shows the irrelevance of the level of capital mobility for long-run growth.

8 – Conclusions.

Though out this article we have presented a modified Kaldorian model of cumulative causation in order to analyze the effects of policies that aim to change the degree of capital mobility, and in the rules of operation of monetary policy over long-run growth.

In this setting, we observe that the effects of these policies depend critically of the existence of a channel by which real exchange rate can affect the level of productive specialization of the economy and, therefore, the marginal propensity to import and the value of exports multiplier.

If the level of productive specialization was independent of real exchange rate, such policies can, at most, affect the amplitude of oscillations of the growth rate of real output around its long-run equilibrium value, which is independent of such policies. However, if a real exchange rate appreciation produces an increase in the level of productive specialization than the specific form of the monetary policy rules will have an important effect over long-run growth.

More specifically, an increase in the long-run growth rate of real output can be achieved by means of policies that increase the interest-rate inertia and the speed of convergence of inflation to its long-run target.

Finally, we shown that the level of capital mobility – determined by the extension of capital controls – is irrelevant over long-run growth either in the case where productive specialization is independent of real exchange rate as in the case where the level of productive specialization depends of real exchange rate.

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