REAL EXCHANGE RATE AND ELASTICITY OF LABOR SUPPLY

IN A BALANCE-OF-PAYMENTS-CONSTRAINED MACRODYNAMICS

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Abstract: It is elaborated a balance-of-payments-constrained dynamic macroeconomic model in which the real exchange rate and the elasticity of labor supply interact in several ways to jointly determine economic growth and income distribution. Indeed, the elasticity of labor supply plays a paramount role not only in the determination of the binding constraint to growth, but also in the evolution of the interclass distributive conflict by affecting the bargaining power of workers through its effect on the rates of employment and labor productivity growth in the modern sector of the economy.

Key-words: macrodynamics; real exchange rate; elasticity of labor supply.

Resumo: Elabora-se um modelo macrodinâmico de restrição de balanço de pagamentos em que a taxa de câmbio real e a elasticidade da oferta de trabalho interagem de diversas maneiras na determinação conjunta do crescimento econômico e da distribuição de renda. A elasticidade da oferta de trabalho desempenha um papel fundamental não apenas da determinação da restrição crucial ao crescimento, mas também na evolução do conflito distributivo interclasse ao afetar o poder de barganha dos trabalhadores através de seu efeito sobre as taxas de emprego e variação da produtividade do trabalho no setor moderno da economia.

Palavras-chave: macrodinâmica; taxa de câmbio real; elasticidade da oferta de trabalho.

Classificação JEL: E12; E24; E25

Classificação Anpec: Área 3 – Macroeconomia, Economia Monetária e Finanças.

Introduction

In the structuralist and post-Keynesian traditions the long run rate of growth of the economy depends on the Balance-of-Payments (BOP) constraint. The interest in BOP-constrained growth increased steadily since the publication of Anthony Thirlwall's seminal paper (Thirlwall, 1979; see also Dutt, 2002, and McCombie and Thirlwall, 1994), which offered a concise formalization of this theory.[1] In Thirlwall's model the rate of growth of the economy (y)[2] compatible with current account equilibrium depends on the rate of growth of the world economy (z), the price elasticity of the demand for exports (ϕ) and imports (ν), the income elasticity of the demand for exports (ε) and imports (π), and the rate of change of the real exchange rate ($q = p^* + e - p$). [3] Formally:

$$y^* = \frac{(1 + \phi + \nu)q + \varepsilon z}{\pi}$$

The model is extremely useful in highlighting the role of structural variables in long run growth, as reflected in the ε/π ratio. On the other hand, as it is assumed that purchasing power parity holds in the long run, then the real exchange rate will be in equilibrium ($q = 0$) and would not affect the rate of growth.

In turn, the influence of the real exchange rate has received great attention in the literature on economic growth in developing countries. Several works have emphasized the importance of keeping a high, competitive real exchange rate to sustain exports and foster growth in the long run (Hausmann *et al*, 2005; Montiel and Hinkle, 1999; Razin and Collins, 1997). Lessons from the growth experience in developing countries over the past fifty years confirm the importance of this variable. Countries that sustained very high levels of economic growth over decades, like Korea, Taiwan, Singapore and more recently China, kept their real exchange rate at competitive levels (ECLA, 2001; Eichengreen and Hatase, 2005; French-Davis, 1999, pp. 60-62; Haggard, 1991; UNCTAD, 2005a, pp.12-20). This was as well the experience of Brazil, the best performer in Latin America until the 1980 crisis, a country that adopted a crawling-peg policy that avoided valorization and boosted manufactured exports until the late seventies. Combined with a more active industrial policy, the pragmatic management of the real exchange rate in Brazil contributed to surmount the external constraint on growth.

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[1] Key previous contributions were due to Harrod (1939), Kaldor (1957, 1964) and Seers (1962). Raúl Prebisch (1950, 1963, 1981) and the Economic Commission for Latin America (ECLAC) were the leading advocates of this perspective in Latin America. The model has proved to be consistent with the empirical evidence on economic growth of several developed and developing countries. See, among others, Bértola *et al* (2002), Cimoli and Correa (2005), Holland *et al* (2004), López and Cruz (2000), McCombie (1997) and Moreno-Brid and Pérez (1999).

[2] Small letters represent proportional rates of growth of the variables.

[3] The real exchange rate is defined as $Q = P^*E/P$, where E is the nominal exchange rate denominated in units of domestic currency per unit of foreign currency, P^* is the price level in the foreign country and P the domestic price level. The rate of change of Q is given by $q = p^* + e - p$, where $q \equiv d(\log Q)/dtQ$, e is the devaluation rate and p^* and p are foreign and domestic inflation rates, respectively. The principle of purchasing power parity implies that in the long run $q = 0$.

Inversely, countries that overvalued their currency were frequently caught in low-growth traps, suffering from long periods of feeble growth (Cimoli, 1992; Frenkel and Taylor, 2005). This was the experience of Argentina, Chile and Uruguay in the second half of the seventies, and that of Argentina, Brazil and Uruguay in the nineties. The valorization of the domestic currency has short run stimulating effects on growth based on the increase in domestic demand and the reduction of inflation. But to the extent that it also generates current account disequilibrium and (eventually) a mounting external debt, such positive effects dissipate and are rapidly substituted by uncertainty, falling investment and foreign exchange speculation (Ffrench-Davis, 1999; Stallings and Peres, 2000, pp. 58-65).

Moreover, the processes of trade liberalization and closer integration to world markets that most Latin American countries went through in the nineties made them more sensitive to changes in the real exchange rate. When Latin America was insulated by high tariff and non-tariff barriers, these changes had their impact mitigated by protection. When Latin American countries became more open to international trade, however, the real exchange rate turned to be an important determinant of decisions of production and investment. Indeed, the debate on the possibility that the rapid expansion of the demand for natural resources in recent years may lead to an overvalued currency and to the "dutch disease" in several developing countries (particularly in Latin America) reflects this renewed concern over the influence of the exchange rate on international competitiveness and growth (Palma, 2005; UNCTAD, 2005b).

The real exchange rate is also a critical component of the trade-off between growth and income distribution. As shown by Blecker (1989), this trade-off reappears in open-economy Keynesian models, as a better income distribution is related to a lower real exchange rate and thereby to lower international competitiveness. Conflict over income distribution boosts inflation and depresses the real exchange rate (Pugno, 1996). The intensity of the class conflict around the real exchange rate may be acute. This problem deeply concerned many Latin American economists in the sixties and seventies, as it hampered growth and weakened political democracy in the region (O'Donnell, 1978; Prebisch, 1981; Rodríguez, 1980). The real exchange rate became a central variable in the dispute between unions and capitalists, especially those related to the export sector.

Last but not least, the real exchange rate is related to the elasticity of labor supply. The elasticity of labor supply has been a central theme in the literature on economic development, revisited and extended by Ros (2000).[4] The higher this elasticity is, the weaker will be the bargaining position of labor in the labor market and the higher will be the real exchange rate in equilibrium. In this paper this topic is addressed in a BOP-constrained macrodynamic model, it being suggested that the elasticity of labor supply not only has a direct influence on growth performance, but it as well shapes the effectiveness of the industrial and technological policies to foster growth in developing countries.

Arguably, the role of the elasticity of labor supply is not solely confined to its effects on the labor market. It is reasonable to assume that it also affects the rates of learning and productivity growth in the modern sector. Productivity growth depends, on the one hand, on the Kaldor-Verdoor Law, related to the presence of different forms of increasing returns, which implies that

[4] The classical contributions are Lewis (1954) and Prebisch (1950).

productivity is procyclical. On the other hand, in a developing economy with significant migration of workers from the subsistence to the modern sector, new entrants in the labor market will not have the same productivity as those already employed in the modern sector. The need to train and educate the new entrants may lessen the virtuous circle of the Kaldor-Verdoor Law. In the compass of this paper these distinct effects of the elasticity of labor supply on growth (through the labor market and the growth of productivity) are taken into account in a model with endogenous technical change.

Hence, this paper is intended to contribute to the literature on BOP-constrained macrodynamics in several ways. Firstly, it presents a model in which the equilibrium level of the real exchange rate affects the long run rate of growth of a developing economy by means of its effects on the rate of investment. Secondly, it offers a formal representation of some of the key insights set forth by the late Raul Prebisch and other structuralist economists about the determinants of the intensity of the interclass conflict in Latin America.[5] Thirdly, it discusses how the equilibrium level of the real exchange rate varies with the elasticity of labor supply, which plays a critical role in shaping the relative bargaining power of labor unions in the labor market. Last but not least, it allows for the possibility that the elasticity of labor supply affects both the dynamics of the labor market and the rate of productivity growth in the modern sector in a model with endogenous technical change.

The paper is organized in four sections in addition to this introduction and the conclusions. Section I presents the model without technical change, focusing on the relationship between income distribution and growth in a context in which investment is constrained by the availability of foreign exchange. Both the labor and goods markets are assumed to operate under imperfect competition and the dynamics of the conflict between capital and labor shapes the equilibrium exchange rate. Section II addresses the influence of the elasticity of labor supply on the behavior of the labor market and income distribution. In turn, Section III allows for endogenous technical progress, related to both the Kaldor-Verdoor Law and the need to train the new workers drawn from the subsistence sector.

I. The Model

The labor market, real wages and the real exchange rate

The economy produces only one good that can be exported or consumed domestically. The market is imperfectly competitive and firms set prices by adding a constant mark-up over unit variable costs (Dutt, 1990; Carlin and Soskice, 1990):

$$P = \frac{1}{1-m}\left(\frac{W}{a} + \frac{P^{*}e}{b}\right) \tag{1}$$

where P is the domestic price, $1/(1-m)$ is the mark-up, W is the nominal wage, a is labor productivity, b is the productivity of imported intermediate goods, e the nominal exchange rate

[5] See Prebisch (1981), pp. 75-84. Although clearly the richness of Prebisch's vision could not be fully captured by a simple model, the latter may help to identify more clearly some of the mechanisms that produce the trade-off between growth and distribution.

(measured in units of the local currency per unit of the foreign currency) and P^* is the foreign price. P, P^*, e, a and b are all positive, and $0 < m \leq 1$. There is no technical change and therefore a and b are constants – an assumption that will be removed later. The mark-up is also assumed to remain constant. Under these conditions, the observed real wage can be obtained by rearranging equation (1):

$$(2) \qquad \frac{W}{P} = w = (1-m)a - q\frac{a}{b}$$

where w is the real wage that comes out firms' price-setting behavior and $q = eP^*/P$ is the real exchange rate. The real wage in the modern sector w is constrained to be positive and cannot be lower than the real wage in the subsistence sector ($\overline{w}$). This implies that q is constrained so that $0 < q \leq \frac{[(1-m)-\overline{w}]b}{a}$ is always satisfied.

The bargaining process between unions and capitalists can be represented in terms of the union's demands for a desired level of income distribution. If the productivity of labor is constant, there is no difference between demanding a desired real wage and demanding a desired functional distribution. Hence, in the next section, which assumes away technical change, the bargaining process will be modeled as a negotiation over a desired real wage. In section III, in which the model is extended to include endogenous technical change, this assumption will be removed. Negotiations between unions and capitalists will then be aimed at attaining a desired functional distribution rather than a desired real wage.

The real wage derived from (2) may not coincide with the real wage unions believe they could obtain from the bargaining process with the firms. The real wage that workers demand, w_d, is a function of: (i) the real wage in the informal and subsistence sectors, which sets a floor for that in the modern sector and (ii) the employment rate in the modern sector of the economy, which shapes workers' perceptions regarding their bargaining power. The higher the employment rate is, the higher the real wage unions will demand:

$$(3) \qquad \frac{W_d}{P} = w_d = \overline{w} + fE$$

where w_d is the demanded real wage, $\overline{w}$ is the wage of the subsistence sector (either urban and rural), f is a positive parameter and E ($0 \leq E \leq 1$) is the employment rate, which is defined as $E = N/L$, where N is the number of employed workers and L is total labor supply to the modern sector.

Workers' demands are expressed in terms of nominal wages. Whenever workers believe that the observed real wage is lower than the real wage they could obtain at the current employment rate, they will demand a rise in nominal wages according to the following equation (Carlin and Soskice, 1990):

$$(4) \qquad \hat{W} = \hat{P}^E + \frac{w_d - w}{w} = \hat{P} + \frac{w_d - w}{w}$$

where $\hat{W}$ is the growth rate of the nominal wage, $\hat{P}^E$ is the expected inflation rate (which is assumed to equal the actual inflation rate, $\hat{P}$) and ($w_d - w$) is the difference between the price-

settled real wage and the demanded real wage. Domestic inflation can be obtained by taking logarithms in equation (1) and differentiating with respect to time:

(5) $$\hat{P} = \alpha\hat{W} + (1-\alpha)(\hat{P}^* + \hat{e})$$

where $\alpha = \dfrac{W/a}{W/a + P^* e/b}$ is the share of wages in total unit variable costs. Clearly, α is not constant, though it is approximately so when wages represent a large share of total variable costs and when nominal wages vary moderately over time. For simplicity, this assumption is made in what follows.

Note that $\hat{q} = \hat{P}^* + \hat{e} - \hat{P}$ and $\hat{P} = \alpha\hat{W} + (1-\alpha)(\hat{q} + \hat{P})$. Assuming a fixed exchange rate regime ($\hat{e} = 0$), and using (4) in (5), we get:

(6) $$\hat{q} = \frac{\alpha}{1-\alpha}\left(\frac{w - w_d}{w}\right)$$

Using (2) and (3) in (6), we obtain:

(7) $$\hat{q} = \frac{\alpha}{1-\alpha}\left[1 - \frac{\overline{w} + fE}{(1-m)a - \dfrac{aq}{b}}\right]$$

This equation gives the dynamics of the real exchange rate as a result of the bargaining process in the labor market and the behavior of firms under imperfect competition. Whenever workers believe their real wage is below the level they could obtain for a given level of employment, they will demand – and obtain – higher nominal wages. The rise in nominal wages equals the expected inflation rate plus the difference between the effective and the demanded real wage. The ensuing inflationary process will lead to a fall in the real exchange rate, and thereby a fall in the cost of intermediate inputs in terms of the domestic currency, and this mechanism makes workers' demands compatible with the constant mark-up. Indeed, it is as if the conflict between labor and capital could be passed onto the price of imported inputs by means of an appreciation of the local currency – a fall in q.

However, this is not the whole story. A fall in the real exchange rate implies a deterioration of the international price competitiveness of the country, leading to a current account deficit. The real exchange rate that stabilizes the labor market may be unsustainable from the point of view of the external sector. It is then necessary to look at how growth and employment rates react to the disequilibrium in the current account.

Production function and labor supply

The production function is one of fixed coefficients in which labor, intermediate imported inputs and capital goods are perfectly complementary:

(8) $$Y = \min(aEL, bM_i, vK)$$

where *Mi* are total imported inputs, *K* total capital, and *a*, *b* and *v* are labor productivity, the productivity of imported inputs and the productivity of capital, respectively. Total imports consist of imported inputs and foreign capital goods:

$$M = I_f + M_i = I_f + \frac{Y}{b} \tag{9}$$

Foreign capital goods and domestic capital goods are combined in a fixed proportion, κ, so that $I_n = \kappa I_f$. Following Basu (1984), this implies that investment is given by:

$$I = \dot{K} = (1+\kappa)\, I_f, \tag{10}$$

If the binding constraint is the capacity to import the foreign capital goods required to sustain investment, equation (10) can be used in equation (8) to obtain:

$$\dot{Y} = v\dot{K} = vI = v(\mathbf{1}+\kappa)\, I_f \tag{11}$$

This assumption is actually congenial with the view that growth is constrained by the availability of foreign exchange, as in BOP-constrained macromodels and in the ECLAC tradition in Latin America (Prebisch, 1950; Rodríguez, 1980). Developing countries show a strong dependency on imports of foreign capital goods. The real exchange rate contributes to determine the total foreign exchange available in these countries, which ECLAC calls the total capacity to import. Foreign exchange has to be allocated either to import consumer goods, to import raw materials or to import foreign capital goods. There may be some substitution between imports and domestic goods in the case of consumer goods, but raw materials and capital goods, especially those that are technologically more sophisticated, cannot be easily substituted by domestic production. Foreign and domestic capital goods are thus complementary rather than substitutes in total investment. As a result, investment may be halted when the lack of foreign exchange compromises imports of capital goods. The fall in investment and capital accumulation in turn compromises economic growth.[6]

Substitution of equation (9) in (11) yields:

$$\dot{Y} = vI = v(1+\kappa)\left(M - \frac{Y}{b}\right) \tag{12}$$

Hence, the capacity to import equals total exports as there is no capital inflows in the form of foreign lending or foreign direct investment. All the foreign exchange the developing country earns is used to pay for imported inputs and foreign capital goods (there is neither accumulation of reserves nor exports of foreign exchange from the developing economy). Equilibrium in the current account requires that $PX = eP^*M$, so that:

[6] This description of the limits to growth in a developing, technologically-backward economy, strongly dependent from abroad for the supply of complementary capital goods, can be found in many accounts of why Latin America lagged behind in the post World War II period. In the "easy" phase of import-substituting industrialization, when many Latin American economies gradually mastered the production of simpler, low-tech industrial goods, it was possible for them to redirect imports away from consumer goods towards capital goods. But when import-substitution became more difficult, with the domestic production of capital goods requiring increasingly higher amounts of capital and technology, both investment and growth were harmed (Rodríguez, 1980, pp. 59-64).

(13) $X/q=M$

Now it is necessary to specify the behavior of exports. In equation (14) the ratio of exports to output is defined as a function of the non-price competitiveness (the term $x \geq 0$) and the real exchange rate (the term cq, $c \geq 0$), so that:

(14) $M = (x + cq)Y$

Substitution of (14) in (12) yields:

(15) $$\frac{\dot{Y}}{Y} = \hat{Y} = v(1+\kappa)\left(x + cq - \frac{1}{b}\right)$$

Equation (15) represents the rate of growth as a function of the real exchange rate. It is convenient to express (15) in terms of the employment rate (E) and the real exchange rate, and recalling that $Y = aEL$ (where $E=N/L$) and $\hat{Y} = \hat{L} \dot{+} \hat{E}$, we obtain:

(16) $$\hat{E} = v(1+\kappa)\left(x + cq - \frac{1}{b}\right) - \hat{L}$$

where $\hat{L}$ is the rate of growth of labor supply to the modern sector, which is assumed to be given by:

(17) $\hat{L} = n + \sigma(w - \overline{w})$

where n is an autonomous component of the growth of labor supply (for instance, due to population growth), w is the real wage in the modern sector, $\overline{w}$ is the exogenous real wage in the subsistence sector[7] and σ is the sensitivity of the labor supply (which can take any value from zero to plus infinity) to differences in real wages between the subsistence and the modern sectors. Substitution of (17) in (16) yields:

(18) $$\hat{E} = v(1+\kappa)\left(x + cq - \frac{1}{b}\right) - n - \sigma(w - \overline{w})$$

Equation (2) implies that the price-settled real wage depends on the real exchange rate, $w = (1-m)a - \frac{a}{b}q$, and using this result in equation (18) we obtain:

(19) $$\hat{E} = v(1+\kappa)(x - 1/b) - n - \sigma\left[(1-m)a - \overline{w}\right] + \left[\sigma\frac{a}{b} + vc(1+\kappa)\right]q$$

Equations (19) and (7) form a 2x2 system of differential equations in which E and q are endogenously determined. Steady state equilibrium, $\hat{q} = \hat{E} = 0$, yields $q = q^*$ and $E = E^*$, and the stability of the system can be analyzed via the Jacobian matrix of partial derivatives computed at the equilibrium values:

[7] Recall that subsistence sector is a label that includes the informal sector, the subsistence sector and other regions or countries in which real wages are lower than in the modern sector.

$$(20) \qquad J(q^*, E^*) = \begin{pmatrix} -\frac{a\alpha}{(1-\alpha)b}\left[\frac{(\bar{w}+fE^*)}{(\phi(q^*))^2}\right] & \frac{\alpha}{(1-\alpha)}\left[\frac{f\phi(q^*)}{(\phi(q^*))^2}\right] \\ \frac{a\sigma}{b}+vc(1+\kappa) & 0 \end{pmatrix}$$

where $\phi(q^*) = (1-m)a - \frac{a}{b}q^* = w$. Given our restrictions on the variables and parameters, the trace is negative, the determinant is positive and therefore the equilibrium is stable. We now turn to the implications of the model for growth and income distribution.

II. Elasticity of Labor Supply, Real Wages, Income Distribution and Growth

Growth and the elasticity of labor supply

The equilibrium value of the real exchange rate is given by:

$$(21) \qquad q^* = -\left(\frac{v(1+\kappa)(x-1/b) - n - \sigma\left[(1-m)a - \bar{w}\right)\right]}{\sigma\frac{a}{b} + vc(1+\kappa)}\right)$$

It is instructive to analyze how the real exchange rate varies with the elasticity of labor supply. Let us first assumed that labor supply is perfectly inelastic, $\sigma = 0$. It follows that the real exchange rate is given by:

$$(22) \qquad q^* = -\left(\frac{v(1+\kappa)(x-1/b) - n}{vc(1+\kappa)}\right)$$

Plugging (22) in equation (15), which represents the growth rate, we obtain $\hat{Y} = n$. Hence, when labor supply is perfectly inelastic the growth rate is given by the autonomous, exogenous growth of labor supply. This is not surprising, however, since a binding supply-side constraint has been imposed. Any attempt to raise growth above *n* will increase the level of employment *E* and foster labor unions' demands for higher real wages. This will in turn depress the real exchange rate, reduce price competitiveness, reduce growth – a back to *n* – and lead the economy back towards its previous level of employment. This situation is pictured in Figure 1, in which an initially too high employment level (point X in quadrant B) produces a fall in the real exchange rate. When the economy reaches quadrant C, the rate of growth is not high enough to employ all the new workers that join the labor market and *E* begins to fall. As *E* falls, real wage demands recede, inflation falls and the real exchange rate moves upward again. Real wages demands are then gradually placed in line with the price-settled real wage. Since the economy now grows at the rate *n*, *E* does not change, the labor market is in equilibrium, domestic inflation equals foreign inflation and both the real wage and the real exchange rate are stable.

Hence, it takes an extremely restrictive assumption, namely zero elasticity of labor supply, for the natural rate of growth (with no technical change) to obtain. Yet, there is considerable evidence that labor does respond to wage differentials across sectors, regions and countries. Although this was especially true for the period between the end of the nineteenth century and

the 1930s (Williamson, 2000), internal and international migration is still a significant force that cannot be ignored. Indeed, León-Ledesma & Thirlwall (2000, 2002) estimated the sensitivity of the natural rate of growth (with technical change) to the actual rate of growth for 15 OECD countries over the period 1961 to 1995 and found that both components of the natural rate (labor force growth and labor productivity growth) are endogenous to output growth. In their view, there are several ways, well documented, through which the growth of labor inputs increases when output growth is buoyant: hours worked increase; participation rates increase, particularly among females; reallocation of labor from low to high productivity sectors take place, which is a very important factor in the early stages of industrialization; and immigration may also occur.

Though in the specific case in which $\sigma = 0$ growth does not depend on the BOP constraint, real wages do. In equilibrium the real wage depends on the parameters that define the external competitiveness (c, κ and x), along with the productivity parameters (b, a and v), the mark-up (m) and the exogenous rate of growth of labor supply (n). Since real wages are defined by firms at the very moment they set their mark-up, labor unions will only have a say on nominal wages and the employment rate. But they are unable to determine the real wage.

What happens in the opposite case, when $\sigma \to \infty$? In this case the labor market works as in the Lewis model (Lewis, 1954), while economic growth is BOP constrained as in Prebisch-Thirlwall. Using L'Hopital in equation (22), we obtain:

$$\lim_{\sigma \to \infty} q^* = \frac{b\left[(1-m)a - \overline{w}\right]}{a} \tag{23}$$

This exchange rate is entirely given by the productivity parameters (b and a), the mark-up and the real wage in the subsistence sector. While in the previous case unions could have at least a temporary influence on real wages, now this is no longer possible. If real wages increase slightly over the subsistence level, the labor market will be flooded with new workers and the wage gap will be immediately closed (and hence q will always be at its equilibrium level). In fact, the labor market is no longer segmented and it can be considered that firms draw labor from a single pool of labor supply. To the extent that now N tends to infinity, then E will tend to zero at any moment – recall that $E = L/N$. Since $E = 0$, it follows from equation (3) that $w = \overline{w}$. In this case the rate of growth depends solely on the BOP constraint, it being given by:

$$\hat{Y} = v(1+\kappa)\left(x + c\left[b(1-m) - \frac{\overline{w}}{a} \right] - \frac{1}{b} \right) \tag{24}$$

Finally, when σ assumes values between zero and infinity, the growth rate is given by:

$$\hat{Y}^* = n + \sigma\left[(1-m)a - \frac{a}{b} q^* - \overline{w} \right] \tag{25}$$

If we replace q for the equilibrium value found in (21), the growth rate can be expressed in terms of an implicit function of a set of exogenous parameters (the signs over the variables corresponds to partial derivatives):

$$\hat{Y}^* = f(\overset{+}{a}, \overset{+}{b}, \overset{+}{c}, \overset{+}{v}, \overset{+}{\kappa}, \overset{+}{x}, \overset{-}{m}, \overset{+}{n}, \overset{-}{\overline{w}}, \overset{+}{\sigma}) \tag{25'}$$

Equation (25') describes economic growth in a manner which seems fairly reasonable for the experience of Latin America: economic growth depends on the capacity to domestically produce complementary capital goods (κ), non-price competitiveness, the productivity of labor, capital and foreign intermediate goods, the subsistence wage and the elasticity of labor supply.

It is worth analyzing more carefully the implications of the value of σ. Figure 2 shows the evolution of the equilibrium rate of growth when σ varies. When σ =0, the rate of growth is given by the exogenous growth of labor supply. As σ increases, then the economy is able to attract workers from the subsistence to the modern sector. For each level of σ (for instance, σ_1), the economy attracts workers at a rate $\sigma_1(w-\overline{w})$. As a result, the economy can grow at a rate which is higher than *n*, since the arrival of these new workers avoids a rise in *E* that would in turn lead to higher inflation and a falling real exchange rate. It is the attraction of new workers that makes it possible to raise the rate of growth without a subsequent increase in *E*. As σ tends to infinity, the rate of growth converges asymptotically towards the BOP-constrained growth rate. Labor supply responds so quickly to the wage gap that *E* remains constant and so does domestic inflation – which is equal to foreign inflation.

What would happen if non-price competitiveness increased (a rise in *x*)? This question is interesting because *x* represents non-price competitiveness, a variable that could be raised through more active industrial and technological policies. For instance, investing in R&D and human capital fosters *x* (Lall, 1997; Pugno, 1998). This is indeed a key topic in the Latin American debate as about how to achieve rates of growth higher than those recorded in the past two decades without compromising income distribution (ECLAC, 2000; Fajnzylber, 1990). Formally:

$$\frac{\delta q^*}{\delta x} = \frac{-b}{bv(1+\kappa)c+\sigma a} v(1+\kappa) < 0 \qquad (26)$$

$$\frac{\delta \hat{Y}}{\delta x} = \sigma \frac{a}{b}\left[\frac{bv(1+\kappa)}{bv(1+\kappa)c+\sigma a}\right] > 0 \qquad (27)$$

Equation (26) shows that an increase in *x* will lead to a fall in the real exchange rate and then to higher real wages in the modern sector. At the same time, from equation (27) it can be seen that the rate of growth will rise as well. In other words, the increase in non-price competitiveness allows the economy to achieve both a higher real wage and a higher rate of growth. Besides, the higher the value of σ, the more intense will be the response in terms of growth. Equations (26) and (27) show that when σ is zero there will be no change in growth in case *x* increases, all the impact being absorbed by a falling real exchange rate. Inversely, if σ is infinite, the full effect of a rise in *x* will be translated into higher growth, while the real exchange rate and real wages will remain unaffected in this case.

It is interesting to note that in a Solow-type model of growth with infinite elasticity of labor supply, growth can be sustained at higher rates than the natural rate thanks to the attraction of workers from the subsistence sector (Ros, 2000). The role played by the steady inflow of workers in sustaining growth in such a Solow model is to keep the capital/labor ratio (*k*) constant in the modern sector, so that capital accumulation avoids decreasing returns and the

economy is able to keep growing at a constant rate. It is only when the labor force in the subsistence sector is fully absorbed that the capital/labor ratio begins to rise and decreasing returns to capital set in. The growth rate is thereafter doomed to fall as the now mature economy accumulates capital at slower rates. In the structuralist-Keynesian model of this paper, labor coming from the subsistence sector plays a different role. Migration sustains economic growth not by ensuring a constant capital-labor ratio, but by ensuring a constant employment rate. By avoiding an increase in E when $\hat{Y} > n$, an infinitely elastic labor supply checks any upsurge in inflation that would lead to a fall in q. Hence, the economy is able to sustain both international competitiveness and growth.

Income distribution

The share of wages in the income of the modern sector, D, is given by:

$$D = \frac{wN}{Y} = \frac{w}{a} = \frac{(1-m)a - aq/b}{a} = (1-m) - q/b \tag{28}$$

which shows that the wage share falls monotonically with the real exchange rate. Recalling from equation (15) that the growth rate rises monotonically with the real exchange rate, it follows that there is a trade-off between growth and income distribution as regards to a change in the real exchange rate. The real exchange rate being given, income distribution can be altered in favor of workers by means of either a fall in the mark-up, m, or a rise in the productivity of imported inputs, b. In Latin America the industrial sector was concentrated and heavily protected from foreign competition, and thus a fall in m was an unlikely move. A fall in b, in turn, could be achieved either by improving the productivity of imported inputs or by substituting part of these inputs by domestic production. In the absence of an efficient industrial and trade policy aimed at faster technological learning, the scope for reducing b is likely to be rapidly exhausted. As suggested by Fajnzylber (1990) and Rodrik (1992), industrial and technology policy should be taken seriously, otherwise economic growth will depend almost entirely on the real exchange rate which is the focal point of class conflict. This could produce an impasse in which neither growth nor a better income distribution becomes possible. Indeed, such a situation most seriously concerned Raul Prebisch and other Latin American structuralists in the early sixties (Furtado, 1969; Pinto, 1965; Prebisch, 1963 and 1981). Prebisch (1981) argued that in these conditions the resumption of growth depended almost entirely on a reduction in the intensity of the class conflict, something that actually put enormous pressure on the political system of the Latin American countries.[8]

The same is true, *mutatis mutandis*, with respect to policies that could have raised growth for a given level of income distribution, such as a larger participation of domestic capital goods in total investment (κ) or higher levels of non-price competitiveness (x). In all these cases the focus on human capital and technological learning is critical, but Latin America clearly lost ground in these areas as compared to more successful Asian countries. Import substitution allowed for a

[8] In Prebisch's view, the fact that in the seventies many countries in the region were under military rule reflected precisely the intensity of the previous class conflict and the decision of solving it by the use of force. "*One of the main objectives of the use of force is to fight inflation, which would allow for resuming the dynamics of the continuous increase in the surplus"* required to sustain economic growth (Prebisch, 1981, p. 144).

decrease in κ in the largest countries of Latin America, but to the extent that this was based more on protection than on learning, it compromised economic efficiency, productivity growth and exports. This explains not only why growth was slower in the region, but also why since the late sixties it was rapidly engulfed by the escalation of the distributive conflict. Indeed, the limits of the Latin American pattern of growth would eventually culminate with the debt crisis of 1982 followed by untamed inflation throughout the eighties.

III. Endogenous Technological Change

So far it was assumed that there was no technical progress, which implied that labor productivity and the productivity of imported inputs remained constant. In this section it will be assumed the occurrence of endogenous technological change that increases labor productivity, while *b* remains constant.

The rate of technical change is affected by two variables. First, it depends positively on the rate of economic growth, which fosters learning in the economy by the various mechanisms related to Verdoorn's Law which are amply supported by empirical evidence: learning by doing, learning by investing and a faster substitution of old vintages of capital goods by improved new vintages (Kaldor, 1957; Ros, 2000). Secondly, it depends negatively on the rate at which new workers arrive at the labor market coming from the subsistence sectors. This second effect is related to the fact that new workers need to be (re)trained in order to attain the same levels of productivity of experienced workers. It is reasonable to expect that on average people coming from abroad, from rural areas, or who have remained in the urban informal sector for long a period would not be as productive as those that have been continuously trained on the job.

Since labor productivity changes over time, we now assume that workers' demands are aimed at a desired level of income distribution in the modern sector rather than at a desired real wage. The observed participation of wages in the income of the modern sector, *D*, is that defined in equation (28). In turn, the desired participation of wages in income depends on the level of employment in the modern sector:

(29) $$D_d = h + fE$$

where *h* represents a minimum level of income distribution acceptable for the unions in the modern sector. This value is exogenously given and it depends on social and historical conditions that are specific to each country. Hence, the rate of change of nominal wages is given by:

(30) $$\hat{W} = \hat{P} + \hat{a} + D_d - D$$

Equation (30) has two components. The first one, ($\hat{P} + \hat{a}$), keeps income distribution constant. Recalling that income distribution is given by $D = w/a = (W/P)/a$, it follows that:

(31) $$\hat{D} = \hat{W} - \hat{P} - \hat{a}$$

Therefore, for *D* to remain constant it is necessary that nominal wages rise *pari passu* with the rate of inflation plus the rate of growth of productivity. In turn, the second component, $(D_d - D)$, represents the change in income distribution demanded by workers, which varies positively with the employment rate.

As in the previous model, the inflation rate can be obtained by taking derivatives with respect to time of equation (1). For the sake of simplicity, it is assumed that foreign inflation is zero. As in the previous section, the nominal exchange rate (e) and the productivity of imported inputs (b) are assumed to remain constant, while labor productivity now changes over time. Formally:

(32) $$\hat{P} = \alpha(\hat{W} - \hat{a})$$

Substitution of (29), (30) and (31) in (32) yields:

(33) $$\hat{P} = \frac{\alpha}{1-\alpha}\left(fE + q/b - j\right)$$

where $j = (1 - m - h)$. Since $\hat{P} = -\hat{q}$, the rate of change of the real exchange rate can be obtained from equation (33) as:

(34) $$\hat{q} = \frac{\alpha}{1-\alpha}\left(j - fE - q/b\right)$$

In the model of the previous section, in which technical change was absent, the rate of change of the employment rate ($E = N/L$) was given by equation (16). To take into account the impact of technical change, this equation is modified in two ways. First, it includes the effect of the increase in labor productivity on the demand for labor by the modern sector. Second, the extent to which labor is supposed to be attracted to the modern sector depends on the difference between the effective income distribution that prevails in the modern sector and the base income distribution accepted by unions (the parameter h). Formally:

(35) $$\hat{E} = v(1+\kappa)\left(x + cq - \frac{1}{b}\right) - \hat{a} - n - \sigma(D - h)$$

Substitution of D in (35) by the result obtained in (29) yields:

(36) $$\hat{E} = v(1+\kappa)\left(x + cq - \frac{1}{b}\right) - \hat{a} - n - \sigma(j - q/b)$$

Finally, the growth of labor productivity is modeled as a function of the Verdoorn Law and the rate of arrival of new workers to the modern sector:

(37) $$\hat{a} = s\hat{Y} - u\sigma\left(j - q/b\right) = sv\left(x + cq - \frac{1}{b}\right) - u\sigma\left(j - \frac{q}{b}\right)$$

where $0 < s < 1$ and $0 < u < 1$ are positive parameters. By substituting (37) in (36) and rearranging the resulting expression, the rate of growth of the employment rate can be expressed as a function of the real exchange rate:

(38) $$\hat{E} = v(1+\kappa)(1-s)\left(x - \frac{1}{b}\right) - \sigma(1-u)j + \left[v(1+\kappa)(1-s)c + \frac{\sigma(1-u)}{b}\right]q$$

Equations (34) and (38) form another 2x2 system of differential equations in which q and E are endogenously determined. Steady state equilibrium, $\hat{q} = \hat{E} = 0$, yields $q = q^*$ and $E = E^*$, and

the stability of the system can be analyzed via the Jacobian matrix of partial derivatives computed at the equilibrium values:

$$J(q^*, E^*) = \begin{pmatrix} -\dfrac{\alpha}{(1-\alpha)b} & -\dfrac{\alpha f}{(1-\alpha)} \\ v(1+\kappa)(1-s)c + \dfrac{\sigma(1-u)}{b} & 0 \end{pmatrix} \tag{39}$$

Given our restrictions on the variables and parameters, the trace is negative, the determinant is positive and therefore the equilibrium is stable. What are the economic implications of the model from the point of view of growth, real wages and income distribution? Some of them can be summarized as follows:

(i) The equilibrium wage share falls monotonically with the real exchange rate, q. Since the growth rate rises with q, the trade-off between growth and functional distribution persists in the model with endogenous technical change.

(ii) Real wages rise with labor productivity, which in turn rises with the real exchange rate. This happens because a higher real exchange rate increases productivity growth in two ways. Firstly, by fostering economic growth and increasing returns related to the Kaldor-Verdoorn Law. Secondly, by reducing the rate of migration of lower-productivity workers from the informal to the modern sector.

(iii) Results (i) and (ii) allow us to address the potential for class conflict in the economy from a different perspective. A high equilibrium exchange rate may imply a more unequal pattern of income distribution. But to the extent that it also implies higher rates of growth of both productivity and real wages, its effects on workers welfare will be preferable as compared to an equilibrium featuring a lower real exchange rate. Indeed, countries which show a stable pattern of income distribution combined with fast productivity growth will show much more political stability and a milder conflict over income distribution than countries in which labor productivity grows slowly. The first pattern corresponds to the Asian countries, while the second pattern corresponds to the Latin American countries, where sluggish productivity growth goes hand by hand with a worsening of income distribution. Actually, while in the Asian countries real wages and productivity tend to co-evolve, this is not true in Latina America, where real wages have fallen behind productivity growth, especially since the beginning of the nineties.

Concluding remarks

The growth experience of many developing countries in the post-war period suggests that the level of the real exchange rate exerts an important influence on the relative performance of these countries. Particularly in Latin America, the undervaluation of the exchange rate for long periods (as observed in the second half of the seventies and nineties) led to subsequent external crisis that compromised growth. The exchange rate has also figured high in the agenda of the international political economy in recent years. The prospects for continuous growth in the world economy seem to rely on some kind of agreement between the principal economic actors, aimed at readjusting their exchange rates and correcting accumulated disequilibria.

In this context, this paper modifies a structuralist-Keynesian BOP-constrained macrodynamic model by allowing the equilibrium real exchange rate to have an influence on the rate of economic growth. The model takes as a starting point the notion that foreign and domestic capital goods are complementary and are combined in fixed proportions. The availability of foreign currency, which depends on both the real exchange rate and non-price competitiveness, determines the investment rate and hence the rate of capital accumulation and output growth.

A higher real exchange rate has a positive effect on economic growth by fostering exports, but at the same time worsens income distribution. It therefore becomes a focal point in the trade-off between growth and distribution, responding to the dynamics of inflation and to the intensity of the conflict between labor and capital. The model shows that this conflict is less intense (i) at the initial stages of import-substitution, when it is easy to reduce the imported content of domestic production; (ii) when non-price competitiveness is high, encouraging exports for a given the real exchange rate; (iii) when the growth of labor productivity and real wages is high, with a stable income distribution. The model with endogenous technical change illustrates the latter condition in a clear way, changing the focus of the analysis from income distribution to the evolution of labor productivity. Indeed, labor productivity growth can have a much larger impact on real wages than a once-and-for-all improvement in income distribution.

The aforementioned conditions are necessary to lessen the intensity of class conflict in an open developing economy. But to achieve conditions (i), (ii) and especially (iii) it is required a policy of investments in human capital and technological capabilities that was absent in most Latin American countries. This heightened the intensity of political conflict and instability, a problem that deeply concerned Raul Prebisch and many other structuralist writers from the late sixties onwards.

The elasticity of labor supply with respect to the real wage gap between the modern and the subsistence sectors is critical in defining the long run rate of growth. On the one hand, this elasticity affects positively the equilibrium real exchange rate and hence the rate of growth. On the other hand, a higher elasticity of labor supply implies that people move from the rural sector to the urban sector at a higher rate. Since the employment rate is constant, the economy must grow faster to absorb the flow the people coming from the rural sector. In the extreme case in which this elasticity is zero, growth would be constrained by the exogenous rate of growth of labor supply, which is the natural rate of growth with no technological change. When the elasticity of labor supply is infinite, the result is a Lewis-Prebisch model in which growth is solely determined by the parameters of international competitiveness. In addition, the BOP constraint is relevant even when the elasticity of labor supply is equal to zero, since it defines the equilibrium real wage and the employment rate. As it turns out, a public policy aimed at enhancing non-price competitiveness – such as a public policy directed to foster technological capabilities, financing exports and entering foreign markets – will have its greatest impact on growth when the elasticity of labor supply is infinite, while it will only change the real wage in case this elasticity is equal to zero.

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Figure 1: Dynamics with zero elasticity of labor supply

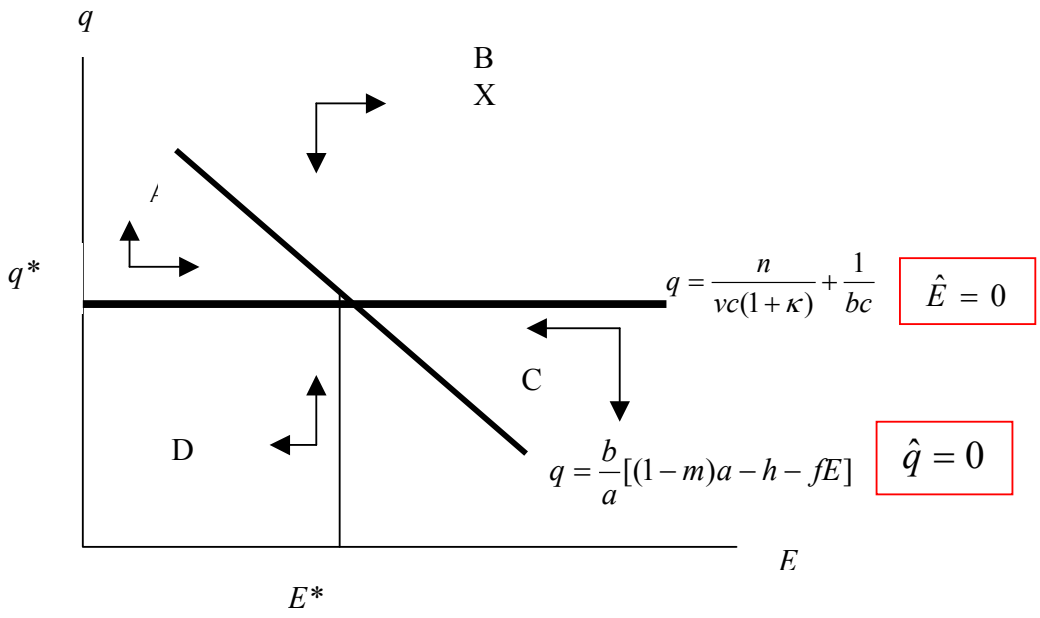

Figure 2: Economic growth and the elasticity of labor supply