REAL WAGES, TECHNOLOGY AND ECONOMIC GROWTH

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ABSTRACT

The model formalizes the idea that learning is hampered when workers face poor health conditions and have no access to education. This reduces the rate of productivity growth and the learning process in the firm, and to the extent that international competitiveness increasingly relies on the diffusion of technology, it also reduces the rate of economic growth consistent with Balance-of-Payments equilibrium. This in turn renders compatible (within a certain range of values of the real wage) growth and income distribution, even in the context of external openness and intense international competition.

Key words: Economic growth; international competitiveness; technology and international trade.

INTRODUCTION

The debate on growth and distribution in the Kaleckian tradition suggests that in a closed economy a higher real wage fosters effective demand, the utilization rate of the stock of capital, the rate of investment and economic growth (Dutt, 1984). On the other hand, in an open economy, this positive association cannot be taken for granted, to the extent that growth could be constrained by Balance-of-Payments disequilibrium. Therefore, it is necessary to analyze the problem taking into account the effect of real wages on trade. The literature on Balance-of-Payments-constrained growth models is particularly useful to discuss this type of problems.

Lets first briefly review the insights provided by these models. In a nutshell, they suggest that a country´s long run rate of growth consistent with external equilibrium depends on international competitiveness, which shapes the rate of growth of the demand for exports and imports. When purchasing power parity (PPP) is assumed, *i.e.* when the real exchange rate is constant, international competitiveness will be solely related to non-price competitiveness, defined by the ratio between the income elasticity of exports and the income elasticity of imports (McCombie and Thirlwall, 1994). Blecker (1989) shows that if one removes the PPP assumption, a fall in the target mark-up set by the firms (and the ensuing increase in the real wage) may lead to a higher rate of growth, when the income elasticity of the demand for imports is small compared to the price elasticity of the demand for exports and imports.

There is another road by which a higher real wage may lead to higher growth, even when PPP holds. In developing countries a higher real wage could bring about benefits that are not considered in models in which technology is exogenous. First, a worker´s productivity is positively related to his or her level of consumption, especially at low levels of consumption (Basu, 1984, p.96; Bliss and Stern, 1978). Secondly, higher real wages imply better access to education and cultural goods, which have a direct effect upon the workers´ ability to learn (Reinert and Stewart, 2002). This effect might be present even at relatively high levels of consumption. Finally, the literature on efficiency wages suggests that higher real wages imply more motivation and elicit a higher effort at work, and therefore more learning and higher rates of productivity growth (Shapiro and Stiglitz, 1989; Ros, 2000, p.320). To the extent that the ability to compete in the international markets

increasingly depends on the firms´ ability to learn and improve on foreign technology (Cimoli, 1988; Mytelka, 1999), higher real wages may lead to a higher rate of growth with external equilibrium. In this case, as the effect of learning largely takes place through an increase in non-price competitiveness, its positive effect on growth will hold even when PPP is fully in place.

This paper formally explores the idea that an increase in real wages could foster international competitiveness and economic growth in an open economy. Section I presents the basic model, where international competitiveness depends on the relative rates of innovation in the North and imitation in the South. Following the literature on catching-up in technology, it is assumed that the rate of technological diffusion in the South is a positive function of the North-South technology-gap. In addition, it is also assumed that technological diffusion increases in the South as a function of the increase in the real wage, up to a certain critical real wage, after which further real wage increases have no effect on learning. In sum, it is proposed a growth model in which Keynesian growth-led demand is combined with Schumpeterian technology-driven international competitiveness. In this model, the real wage, technology and productivity growth are endogenous variables in the South.

Section II analyzes the dynamics of the model and the stability of equilibria. Multiple stable equilibria are possible, suggesting that policy may make a difference in choosing which equilibrium is eventually reached by the economy. In particular, the model suggests that a dynamic poverty trap is possible, featuring low levels of both, real wage and economic growth. Policy implications are addressed in section III and the main results of the paper are summarized in a concluding section.

2. THE MODEL

(a) Growth and Competitiveness

A useful starting point is Amable (1994), who includes the variable quality within the argument of a conventional constant-elasticity-of-demand function for exports. This renders the following equations of demand for exports and imports:

$$M = A(\frac{P^*}{P}E)^y Y^p \quad (1)$$

$$X = B(\frac{P}{P^*E})^h Z^e \Omega^l \ (2),$$

where M are Southern real imports, X are Southern real exports, Z is the real income of the international economy, Y is Southern real income, P is the price level in the South (expressed in the Southern currency), P* is the price level in the North (expressed in the Northern currency), E is the nominal exchange rate (value of the Northern currency in terms of the Southern currency), Ω is an index of the quality of exports, ψ is the price elasticity of imports, π is the income elasticity of imports, η is the price elasticity of exports, ε is the income elasticity of exports, λ is the quality elasticity of exports, and A and B are positive constants. As usual, price elasticities are negative and income elasticities are positive. The South is a small country and therefore its own growth does not affect the rate of growth of the international economy. The variable quality, along with the income elasticity of the demand for exports and imports, contributes to shape non-price competitiveness.

Current account equilibrium requires that

$$EP^*M = PX \quad (3),$$

and substituting from (1) and (2) into (3) yields:

$$EP^*A(\frac{P^*}{P}E)^y Y^p = PB(\frac{P}{P^*E})^h Z^e \Omega^l \quad (4)$$

Taking logs in (4) and differentiating with respect to time gives (5):

$$e + p^* + y(p^* + e - p) + py = h(p - p^* - e) + p + eZ + lw \quad (5),$$

Small letters represent proportional rates of growth (*vg* $p = \frac{dP/dt}{P}$ is the domestic inflation rate). It is straightforward that:

$$y = \frac{1}{p}((h + y + 1)(p - p^* - e) + ez + lw) \qquad (6)$$

Equation (6) shows that the long run rate of growth, consistent with balance-of-Payments equilibrium, is given by the rate of change of the real exchange rate, the rate of economic growth in the North and the rate of growth of the quality index of exports – the result usually known as Thirlwall´s law, with the addition of a new variable, the evolution of the quality of exports, suggested by Amable.

A set of additional assumptions will be made to render the model easier to handle. The first assumption (frequent in this type of models) is that PPP applies in the long run and hence $p - p^* - e = 0$. The second assumption is that the nominal exchange rate is fixed at a certain value, so that $e = 0$. By combining the two previous assumptions, it is easy to conclude that the domestic rate of inflation and the international rate of inflation fully converge, $p = p^*$.

The next step is to make the evolution of the quality index an endogenous variable. The critical assumption is that the existence of a technology gap directly impinges on the relative ability of the South (as compared to the North) to improve the quality of the goods it produces. Thus, the rate of change of the quality index is a linear function of the inverse of the North-South technology gap, defined as $S = (Ts/Tn)$, where *Ts* is the technological capability of the South and *Tn* is that of the North. Formally:

$$w = vS = v\left(\frac{T_S}{T_N}\right) \qquad (7)$$

where $v \quad 0$. Substituting (7) into (6), assuming (with no loss of generality) that $v = 1$, and assuming that that PPP holds, one gets:

$$y = \frac{1}{p}(\varepsilon z + \lambda w) = \frac{1}{p}(\varepsilon z + \lambda S) \qquad (8)$$

Thus, the rate of growth of the South with external equilibrium increases with the rate of growth of the international economy (z), the inverse of the technology gap (S), the income elasticity of the demand for exports (ε), the quality elasticity of the demand for exports (λ), and falls with the income elasticity of the demand for imports (π).

How does S evolve? Drawing from the Schumpeterian literature, it will be assumed that the technology gap shapes the potential technological spillovers from the North and the opportunities for imitation in the South. The higher the initial technology gap, the faster will be the process of learning in the South. In addition, it is assumed that higher real wages encourages learning in the South by shaping the capabilities and motivation of workers to learn. Both topics are formally addressed in the following section.

(b) Learning

As mentioned, S depends on the technology gap and on real wages in the South. This paper follows Fagerberg (1988, 1995), assuming that the relationship between the technology gap and learning in the South is linear – the higher the technology gap, the faster is the process of learning[1]. As regards the influence of the real wage, it is assumed that a higher real wage favors learning (due to its positive effects on health, education and motivation), but just up to a certain critical point, Wc. When the real wage surpasses this critical value ($W > Wc$), it ceases to affect the learning process[2]. Formally:

$$\begin{cases} s = a_0 + a_1 W - a_2 S & para\ W \le Wc \\ s = a_0 + a_1 Wc - a_2 S & para\ W > Wc \end{cases} \qquad (9)$$

[1] The empirical evidence suggests that it would be more realistic to assume that the relationship between the technology gap and the rate of technological diffusion is nonlinear (Verspagen, 1993). But this not a key point in this paper (whose focus is on real wages and learning), and linearity helps to keep the model simple. Therefore, Fagerberg´s equation for technological catching-up will be retained here.

[2] It could even be assumed that after this critical real wage, motivation and learning falls, as workers may decide to work fewer hours and spend more time on leisure. This possibility, however, is not considered in the model.

where W is the real wage in the South, S the inverse of the technology gap, and s the rate of change of the inverse of the technology gap. All parameters are positive: a_1 gives the impact of an increase of the real wage on the learning process and a_2 gives the impact on learning of the reduction of the technology gap. It is clear from (9) that a higher a_2 implies a lower rate of learning for any give value of the technology gap[3].

So far little has been said about how the real wage is determined in the South. This topic is addressed in the following section, which focus on the labor market.

(c) The Labor Market

The rate of change of the real wage in the South is a function of (i) the difference between the rate of growth of the demand and the supply of labor and (ii) the relative bargaining power of capitalists and workers in the labor market.

The growth of labor demand depends on the rate of growth of the economy and hence on its non-price competitiveness (see equation (8)). Assuming that the rate of growth of the labor force is given and constant, the higher the rate of growth of labor demand, the higher the rate of growth of the real wage. Still, the level of the real wage matters as well. When the real wage is high, capitalists will be more resistant give in to labor demands (Carlin, 1990, pp.140-43). As a result, the variation of the real wage through time ($w = (dW/dt$) will increase not only along with the reduction of the technology gap, but also with the reduction of the real wage level. Formally,

$$w = b_o - b_1 W + b_2 S, \quad (10)$$

where b_1 is a measure of the ability of the firms to avoid cuts on their mark-up as wages increase[4], while b_2 is a measure of the positive impact of increasing competitiveness on the demand for workers.

II. EQUILIBRIA AND DYNAMICS

[3] The value of this parameter will depend on the nature of the National System of Innovation of the South (Nelson, 1988). a_2 will be higher in countries where this system is weaker.

[4] Such an ability will depend on institutional forces, like the degree of organization of workers and capitalists, and the labor and social legislation.

(a) Equilibria

In the preceding section it was suggested that the dynamics of the economy could be described by a system of two differential equations, one of which was related to the dynamics of the labor market, and the other one to the dynamics of non-price competitiveness (which, as mentioned, evolves with the technology gap). Thus,

$$\begin{cases} w = b_0 - b_1 W + b_2 S \\ s = a_0 + a_1 W - a_2 S \quad para\, W \le Wc \\ s = a_0 + a_1 Wc - a_2 S \quad para\, W > Wc \end{cases} \qquad (11)$$

This can be seen more clearly by dividing (11) in two 2x2 systems:

$W=[0, Wc)$

$$\begin{cases} w = b_0 - b_1 W + b_2 S \\ s = a_0 + a_1 W - a_2 S \end{cases} \qquad (12)$$

$W=[Wc, \infty)$

$$\begin{cases} w = b_0 - b_1 W + b_2 S \\ s = a_0 + a_1 Wc - a_2 S \end{cases} \qquad (13)$$

In equilibrium, $S(t) = S^*$, $W(t) = W^*$ and $s = w = 0$, and therefore:

$W=[0, Wc)$

$$\begin{cases} +b_1 W - b_2 S = b_0 \\ -a_1 W + a_2 S = a_0 \end{cases} \qquad (14)$$

$W=[Wc, \infty)$

$$\begin{cases} +b_1 W - b_2 S = b_0 \\ +a_2 S = a_0 + a_1 Wc \end{cases} \qquad (15)$$

And it is also true that:

$$W^* = \frac{a_2 b_0 + b_2 a_0}{b_1 a_2 - b_2 a_1} \text{ and } S^* = \frac{a_1 b_0 + b_1 a_0}{b_1 a_2 - b_2 a_1} \text{ for } W^* \pounds Wc ;$$

$$W^* = \frac{b_0}{b_1} + \frac{b_2 (a_0 + a_1 Wc)}{b_1 a_2} \text{ and } S^* = \frac{(a_0 + a_1 Wc)}{a_2} \text{ for } W^* > Wc.$$

It is necessary to impose some additional constraints on the system to avoid scenarios that make no sense from an economic point of view. First, the South could not overcome the North in the technology race, *i.e.* there should always exist a positive technology gap:

$$S = T_S / T_N \leq 1 \quad (16)$$

In addition, the profit rate could not be negative at any moment, neither in equilibrium nor during the transitional dynamics. This constraint can be stated by simply requiring that the real wage should always be lower than, or equal to the real product of the economy.

$$WL < Y \qquad (17),$$

where W is the real wage and L is the total number of employed workers. If labor productivity, defined as $A = Y / L$, increases linearly with the inverse of the technology gap, then

$$A = KS \quad (18)$$

and (17) can be written as:

$$W < KS \qquad (19)$$

This equation is immediately intuitive, as it just states that the real wage cannot exceed labor productivity[5]. The diagrams 1A and 1B show the two possible equlibria of the system. The shaded areas are those inconsistent with either (16) or (19).

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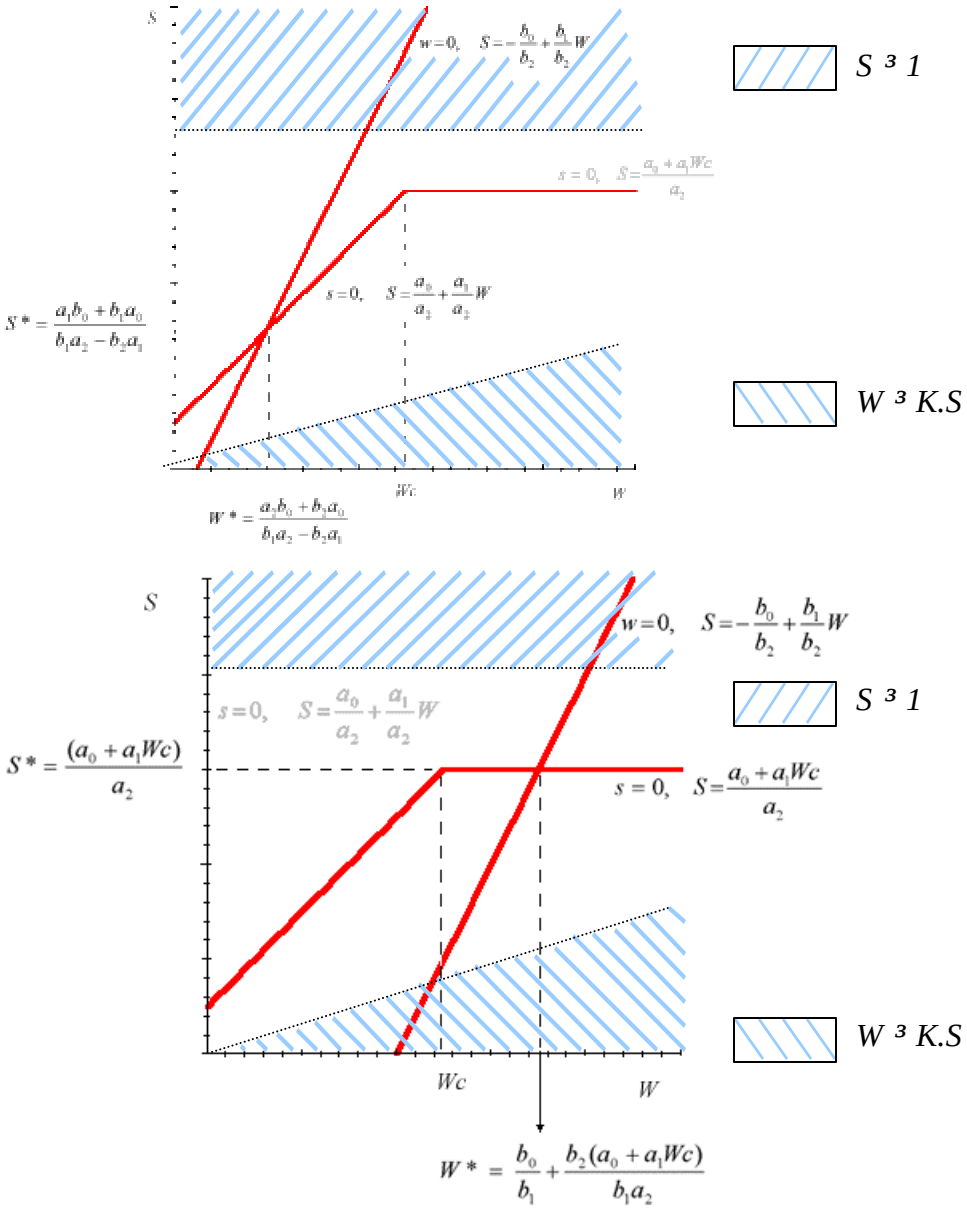
[5] The rate of growth of employment ($l = (dL/dt)/L$) will therefore be $l = y - s$, as it is clear from (18) that the rate of growth of labor productivity equals the rate at which the technology gap closes through time (s). It is also clear that in equilibrium $s = 0$ and $l = y$. An implicit assumption in the model is that there is no labor shortage in the economy so that growth could not be supply-side constrained at any moment. This assumption is fairly reasonable in developing countries, where there is usually an "excess" of labor.

FIGURES 1A AND 1B: EQUILIBRIA.



(b) Stability

In this section the stability of the equilibria is analyzed using the Jacobian matrixes of the systems represented by equations (12) and (13). The system can be written as:

$$\begin{bmatrix} w \\ s \end{bmatrix} = \begin{bmatrix} -b_1 & b_2 \\ a_1 & -a_2 \end{bmatrix} \begin{bmatrix} W \\ S \end{bmatrix} + \begin{bmatrix} b_0 \\ a_0 \end{bmatrix} \quad (20)$$

$$\begin{bmatrix} w \\ s \end{bmatrix} = \begin{bmatrix} -b_1 & b_2 \\ 0 & -a_2 \end{bmatrix} \begin{bmatrix} W \\ S \end{bmatrix} + \begin{bmatrix} b_0 \\ a_0 + a_1 Wc \end{bmatrix} \quad (21)$$

where the Jacobians are:

$$J_{W£Wc} = \begin{bmatrix} -b_1 & b_2 \\ a_1 & -a_2 \end{bmatrix} \quad (22) \text{ e } J_{W>Wc} = \begin{bmatrix} -b_1 & b_2 \\ 0 & -a_2 \end{bmatrix} \quad (23)$$

Lets first take the case in which $W^* \leq Wc$. The trace and the determinant of the first matrix are as follows:

$$tr\ J = -b_1 - a_2 \quad (24), \qquad |J| = b_1 a_2 - b_2 a_1 \quad (25)$$

Since all the parameters a_i and b_i are positive, it can be concluded that if $W^*£Wc$, then $tr\ J < 0$. The signal of the determinant is not so clear-cut, however. But there are some conditions that must be satisfied for the curves $s = o$ and $w = 0$ to intersect at $W^*£Wc$, and these conditions are useful to find out more about the signal of the determinant. The equation that describes the evolution of competitiveness as a function of the real wage for $w = 0$ has a positive linear coefficient equal to b_0/b_2. In turn, the isocline $s = 0$ has a positive linear coefficient equal to a_0/a_2. Therefore, for the two lines to intercept at $W^*£Wc$ will be necessary that:

$$a_1/a_2 < b_1/b_2 \quad (26)$$

If this condition is satisfied, then $b_1a_2 > b_2a_1$ and $|J| > 0$. It follows that if $(tr\ J)^2 \geq 4\ |J|$, the equilibrium will be a stable node, and if $(tr\ J)^2 < 4\ |J|$, the equilibrium will be stable focus. When W* >Wc, the trace and the determinant of the Jacobian matrix will be:

$tr\ J = - b_1 - a_2$ (27), $\qquad |J| = b_1a_2$ (28)

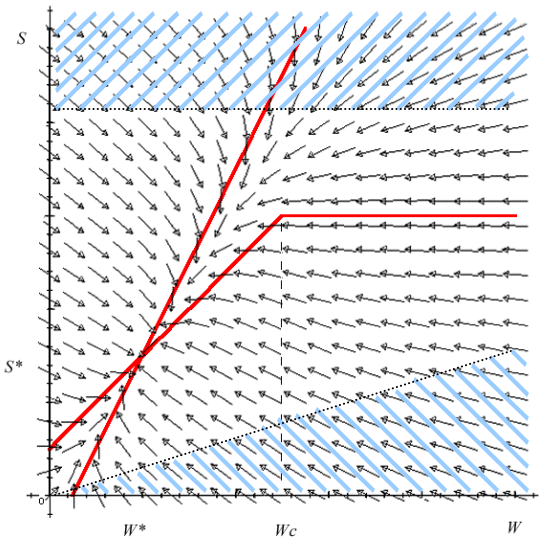
In this case, the trace and the determinant will be negative and positive, respectively, for all positive values of the parameters b_1 and a_2. As in the previous case, the equilibrium point will be either a stable node or a stable focus.

In sum, both fixed points are stable (though may be subject to dampen fluctuations). Figures 2A and 2B shows the direction fields of the system, drawn from the equations $s = s(S, W)$ and $w = w(S, W)$.

FIGURES 2 A AND 2B. DIRECTION FIELDS

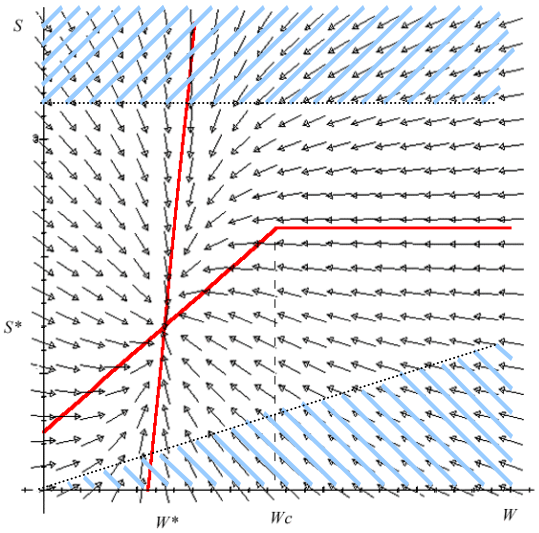
1o. caso: $W^* \leqslant Wc$

$tr\,J < 0$, $|J| > 0$



$(tr\,J)^2 > 4\,|J|$

nó estável

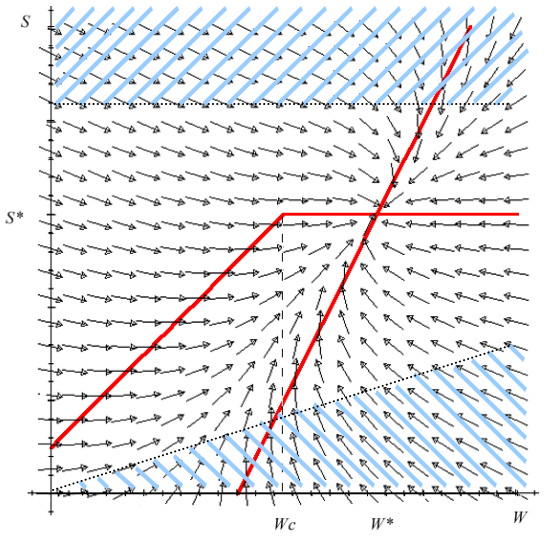


$(tr\,J)^2 < 4\,|J|$

foco estável

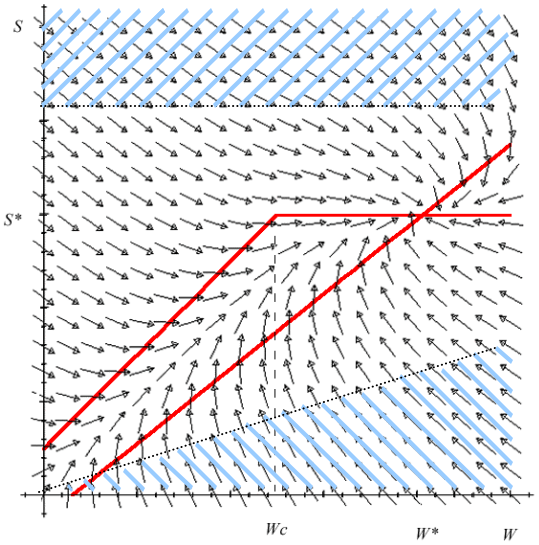
2o. caso: $W^* > Wc$

$tr\,J < 0$, $|J| > 0$



$(tr\,J)^2 > 4\,|J|$

nó estável



$(tr\,J)^2 < 4\,|J|$

foco estável

III. POLICY IMPLICATIONS

Some useful results can be drawn from the model. First, there exists the possibility that the economy could reach a stable equilibrium that is clearly inefficient. In effect, any pair of equilibrium values (W^*,S^*) in which $W^* < Wc$ implies that the economy will grow at a lower rate and will pay a lower real wage than in any alternative configuration in which $W^* > Wc$ In other words, the economy could get trapped in an equilibrium featuring both sluggish growth and low wages – a kind of vicious circle of poverty which is ultimately explained by the failure of the economy to fully develop the learning potentialities of its workers. The room for having complementary growth and real wages increases will not be exhausted until the real wage in the economy surpasses Wc.

How could this inefficiency be avoided or corrected? For having an equilibrium with $W > Wc$, it is a necessary condition (but not a sufficient one) that $b_1a_2 < b_2a_1$ (as can be easily seen from equation 11). This demands that the positive interaction between wages and competitiveness overcomes the negative forces stemming from less technological spillovers (as S increases) and a stronger conflict between capital and labor (as W increases). In this case (*i.e.*, when $W < Wc$), policies oriented to strengthen the bargaining position of workers and to foster their learning capabilities could be helpful to take the economy out of its poverty trap. The first type of policy (as well as income policies aimed at fostering real wages) will lead to a fall in b_1, while the second type of policy will increase b_2. [6]

The reinforcing mechanism proposed in the model between growth and a real wages is complementary to that suggested by Blecker (1998). This author, using an open economy growth model with a Kaleckian structure (featuring an independent investment function with the utilization rate in the argument), shows that a lower mark-up (and a higher real wage) may be associated with an increase in price competitiveness. This in turn may give rise to a higher rate of growth. This result, however, only holds under certain conditions, namely when the price elasticity of the demand for exports and imports is high, the income

[6] This result of the model is generally convergent with recent economic history research on growth and income distribution: countries that feature a more unequal pattern of income distribution show as well a lower rate of innovation, productivity growth and economic growth ((Engerman e Sokoloff, 1994; Aghion e Williamson, 2000).

elasticity of the demand for imports is low and the initial import / GDP ratio is small (Blecker, 1989, p.403). The model presented in this paper suggests that competitiveness and real wages mat be positively related even when the PPP assumption is kept, though a positive effect of real wages on learning and non-price competitiveness.

The situation is of course very different if $W^* > Wc$. In this case policies aimed at strengthening workers´ bargaining power might lead to a scenario of profit-squeeze (a scenario ruled out by assumption from the model). On the other hand, policies aimed at maximizing the rate of imitation of technology (reducing a_2) could increase both W* and S*. In this case, the focus should be on industrial and technological policies aimed at fostering the diffusion of technology.

Finally, it is interesting to note that the higher is *Wc* the larger is the scope for matching growth and distribution. In this model it was assumed that *Wc* is a constant, but a reasonable guess is that *Wc* increases *pari passu* with the degree of diversification and technological complexity of the economy. A country that produces rather simple commodities (say, shoes for the lower end of the international market) would probably have a low *Wc*, but a country that exports high-tech goods and services (say, computers and airplanes) would have a much higher *Wc*. The very transformation of the economic structure redefines the concept of a fully motivated, capable worker. In other words, *Wc* may well be an endogenous variable that moves upward as the technology gap closes. It would be more like a moving target than a parameter, which should be aimed at by using different combinations of income and technological policies.

CONCLUDING REMARKS

The model formalizes the idea that the level of human development is positively associated with economic growth. In a Balance-of-Payments-constrained growth model, it is assumed that international competitiveness depends on the ability of the South to reduce the technology gap. This in turn is stimulated by a higher real wage (up to a certain critical point), to the extent that there exists a favorable effect on learning of higher levels of consumption in developing countries. As a result, under certain conditions, higher real wages can go hand by hand with economic growth, even in the context of an open economy with a constant real exchange rate. The model also allows for the possibility of a stable

equilibrium that represents a dynamic poverty trap, in which the opportunities for having both more growth and a higher real wage are not fully exploited.

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