CAPITAL MOBILITY, REAL EXCHANGE RATE APPRECIATION AND ASSET PRICE BUBBLES IN EMERGING ECONOMIES

A post Keynesian macroeconomic model for a small open economy *

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Abstract: The objective of this paper is to show that open economies that have (i) high degree of capital mobility, (ii) low degree of organization in financial markets, and (iii) high sensibility of net exports to changes in the level of economic activity may have *bubbles* in asset prices if there is an exogenous shock to these economies that produces a *real exchange rate appreciation*. These are common features of emerging/developing economies like Brazil or South Korea. In order to do that, we will present a post Keynesian macroeconomic model for small open economies that will take as a stating point the Taylor and O´ Connell 1985 QJE model. After discussing the shortcomings of the original version of that model as an analytical framework for emerging economies, we will present a more general and relevant model that (i) have a broader list of assets (9 assets) than the original model (3 assets); (ii) assumes the existence of trade between the domestic economy and the rest of the world in order to introduce the crucial variable for our analysis – the real exchange rate; (iii) have high (although) imperfect capital mobility – in the sense of Mundell and Fleming – so that interest rate differential is a major factor determining capital inflows to emerging countries.

January 2005

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* This article is a modified version of the paper delivered at *VI International Workshop in Post Keynesian Economics* held at University of Tennessee, Knoxville, from 22 to 28 of June 2000.

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*** The author would like to thank Gary Dymski, Steve Fazzari, Robert Blecker, Fernando Carvalho, Rogério Studart, Gilberto Tadeu Lima, Antônio Henrique Silveira, Antonio Luis Licha and an anonymous referee for their helpful comments. Financial support of the National Research Council is also gratefully acknowledged.

1. Introduction

One of the most far-reaching economic developments of the late decades is the explosive growth of international financial transactions and capital flows. Powerful forces have driven the rapid growth of international capital flows, like revolutionary changes in information and communications technologies in financial services industry worldwide and the trend in both industrial and developing countries toward economic liberalization and the globalization of trade.

The liberalization of capital account has contributed to higher investment in many countries and increases the volume and volatility of international capital flows. So financial liberalization has been associated with costly financial crises in several countries. The arguments about potential risks of open capital markets arise from problems of incomplete information and other distortions[1] [2]. They point out that there are information gaps in financial markets. Such imperfections give rise to several problems that have potential to lead to inefficient and unstable financial markets.

Critics of the "efficient markets" view argue that between several problems affect financial markets one of the most important is **herding behavior**. Herding can make sense when *the private return of adopting a particular course of action is an increasing function in the number of agents that adopt the same course of action*. Agents may try to follow the lead of someone they believe to be better informed (cf. Banerjee, 1992) or herding can occur when investor lack information about the quality of those who manage their funds (cf. Shaferstein & Stein, 1990). It is not difficult to see that in the presence of asymmetric or incomplete information, investor will quite sensibly take actions that can amplify price movements and precipitate sudden crises. In other words, herding behavior can lead to sharp investor reactions, and bubbles in financial markets.

Financial liberalization and herding behavior can promote bubbles in capital markets, and even financial crises with potentially damaging consequences. A consequence of this statement is that financial liberalization unambiguously reduces the efficiency of

[1] Eichengreen *et alii* (1998) examines several aspects of capital account liberalization.

resource allocation when it is not accompanied by policies to limit the instability of capital markets, especially herding behavior. This suggests that the theoretical presumption in favor of the liberalization of capital account, like propose the classic case for capital mobility, is not correct by the presence of incomplete information.

Developing countries have adopted policies to increase international capital flows. In particular, restrictions on capital account transactions began to decline in Latin America at the end of the 1980s when highly indebted countries put the worst aspect of the debt crisis behind them and the industrial countries evinced a renewed willingness to undertake lending to developing countries. Nevertheless, preexisting inefficiencies led to the emergence of financial instability unrelated to fundamentals[3] [4].

Financial markets of these countries, however, have some particular features that make then *more susceptible* to the occurrence of bubbles in asset prices than financial markets in developed countries in the face of financial liberalization. In fact, financial markets in emerging countries like Brazil or South Korea have *a low degree of organization*[5] [6] which produces a *great volatility* in asset prices when compared to the fluctuations in asset prices observed in the financial markets of developed countries. The low degree of organization that prevails in financial markets of emerging countries tends to increase the possibility of occurrence of herding behavior, *making asset demand more*

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[2] A Post Keynesian view about potential risks of volatile capital flows is presented by Davidson (1997).

[3] See Eichengreen *et alii* (1998).

[4] The existence of inefficiencies in Pareto sense is not fundamental for the results that will be presented in this article. As we will see later, asset price bubbles are *possible* in economies where financial markets have a low degree of organization (However, a low degree of organization in financial markets is not a necessary condition for asset price bubbles since they can also occur in developed countries). In this case, we say that financial markets in developing countries are not functional to economic development. The concept of "functionality" of financial system was developed by Studart (1995, 2000). According to Studart, a financial system is "functional" to economic development if it is able to supply the required amount of credit for a high growth path with the minimum level of financial fragility. If financial markets have a low degree of organization, however, the requirement of low financial fragility will not me met, and the financial system will not be "functional" to economic development.

[5] Carvalho (1992) defines an organized market as one in "*(...) which avoids excessive potentially disruptive fluctuations in the price of assets, avoiding thereby solvency crisis that could be threaten the performance of that market. To contain the fluctuations in asset prices is the function of market makers (...) residual buyers or sellers that absorb excess supplies or demands when they exceed some acceptable margin"*(p.87).

[6] Some indicators of financial market development in emerging and developed countries can be found in Demirguç-Kunt and Levine (1996) and Levine and Zervos (1996).

sensitive (more elastic) to changes in current conditions. This increased sensitivity in assets demand results in greater volatility of asset prices.

The objective of this paper is to show that open economies that (i) have (short-term) capital mobility and (ii) a low degree of organization in financial markets may have *bubbles* in asset prices – which are defined by Dymski (1998) *as cumulative increase in equity prices in relation to supply price of capital goods* - if there is an exogenous shock to these economies that produces a *real exchange rate appreciation*. In fact, almost all emerging countries have experienced a real exchange rate appreciation in the 1990´s (cf. Mishkin, 1999, p.11). This suggests that *exchange rate appreciation* can be the triggering event of asset price bubbles observed in some of these countries in the last decade.

The logic of the argument presented in this paper is the following. A real exchange rate appreciation[7] will reduce the price of domestic assets – mainly domestic equities – relative to the price of foreign assets. This will induce both domestic and foreign investors to substitute domestic assets for foreign assets in their portfolios. This change in investors´ portfolios will produce a great increase in prices of domestic equities, since financial markets in developing countries have a low degree of organization. The capital gains obtained in equities will induce a new change in investors´ portfolios. Encouraged by then, investors will reduce their demand for liquidity (namely their liquidity preference) in order to increase their holdings of domestic equities. This will result in a reduction of domestic interest rates and an increase in aggregate investment. The increase in investment will produce an increase in effective demand, which will result in an increase in the level of capacity utilization and, given the level of income distribution, an increase in the rate of profit. The combined result of these effects in the short run will be a sharp rise in the price of equities relative to the supply price of capital goods; i.e. a *bubble* in the price of equities.

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[7] Between 1994 and 1995 Brazil had experienced a sharp real exchange rate appreciation due to the tight monetary policy adopted in the beginning of the stabilization program of President Fernando Henrique Cardoso – the Real Plan - and to the liberalization of capital account, made in the beginning of the 1990´s by the former president Fernando Collor de Mello. For more details of real exchange rate problems in Brazil during the 1990´s see Paula & Alves Jr. (2000).

In the long run, the expected future profits increase as a reaction to the reduction in the current rate of interest. In fact, the initial reduction of the level of interest rates – due to the portfolio effects of real exchange rate appreciation – will make investors to expect a future increase in the rate of profit, since a decrease in the rate of interest has a positive influence over aggregate demand. This increase in the "state of long-term expectations" will induce investors to reduce their liquidity preference and increase their holdings of equities. As a result of this portfolio change, interest rates will be reduced again and aggregate demand will increase, producing a new increase in the level of capacity utilization and, given income distribution, in the rate of profits. These effects will result in n new increase in expected future profits, generating a cumulative increase in the price of equities.

The combination of real exchange rate appreciation and the increase in the rate of capacity utilization will produce a *deficit* in the balance of payments[8]. Supposing the existence of a fixed (nominal) exchange rate regime – as Brazil until January of 1999 – the deficit in balance of payments will result in a *monetary contraction*; i.e. a reduction in the stock of high powered money. This monetary contraction should produce, ceteris paribus, an increase in nominal interest rates. However, this effect will be countervailed – at least temporarily - by the reduction in liquidity preference due to the increase in expected future profits. As a result, interest rate will be kept at low levels, and capital account surpluses will be insufficient to pay for current account deficits. So the cumulative increase in the price of equities will be accompanied by an increasing balance of payments deficit. This process will continue until foreign reserves are exhausted or investors begin to expect a future devaluation of nominal exchange rate. This expectation will increase nominal interest rates, making investors to shift their portfolio preference toward domestic bonds. So the *bubble* bursts.

The formal model presented in the paper will take as a *starting point* the structure of Taylor and O´ Connell QJE model (cf. Taylor and O'Connell, 1985). On that model a

[8] For a different approach about the economic effects of bubbles in capitalist economies, see Eatweel (2004).

bubble may occur as a result of an exogenous increase in expected profits[9]. One assumption is crucial for their result: the existence of a high substitutability among assets in investors´ portfolios. In this setting an increase in expected profits will induce investors to shift portfolio preferences toward equities, reducing their holding of money and liquid assets. As a consequence of the reduction in the liquidity preference, interest rates go down, and aggregate investment increases. Due to the increase in investment spending, the current level of capacity utilization also increases, producing an increase in the profit rate, given the level of income distribution.

However, the process of increase in equities´ prices does not stop here. The reduction in nominal interest rates will produce an increase in the expected profits. As a result of the increase in expected profits, investors will increase their holding of equities, producing a new increase in their prices. Aggregate investment increases again, as the level of capacity utilization and profit rate. This process continues indefinitely.

The Taylor and O'Connell model has several major shortcomings[10] as an explanation for the occurrence of bubbles in developing countries. First of all, the assumption of high substitutability between equities and money in investors´ portfolios is equivalent to say that equities have a high liquidity premium as money has. Even if this assumption was a realistic description of financial markets in developed countries – which is not – for developing countries this hypothesis is completely unrealistic. The low degree of organization in the financial markets of developing countries make equities a poor substitute for money in investors portfolios. Second, *bubbles* in developing countries are usually associated with real exchange rate appreciation and capital inflows[11]. This makes a closed economy model – as the one presented by Taylor and O´Connell – a completely unsatisfactory framework to analyze the emergence of bubbles in these countries.

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[9] In the original article, Taylor and O'Connell analyze a negative bubble; i.e. a sharp decrease in the price of equities as a result of an exogenous decrease in expected profits. However, the model can easily be used to analyze the case of a positive bubble; i.e. a sharp increase in the price of equities.
[10] Other shortcomings of Taylor and O'Connell QJE model are listed by Nassica (2000, pp. 53-54).
[11] Rodrik and Velasco (1999) report the occurrence of a real exchange rate appreciation and a huge increase in short term external debt in South Korea in the period between 1995 and 1997; just before the East Asian Crisis.

Given the shortcomings of Taylor and O'Connell model we will develop a macroeconomic model that (i) have a broader list of assets (9 assets) than the original model (3 assets); (ii) have trade between the domestic economy and the rest of the world in order to introduce the crucial variable for our analysis – the real exchange rate; (iii) have imperfect capital mobility – in the sense of Mundell and Fleming – so that interest rate differential is a major factor determining capital inflows to emerging countries.

The present article is organized in 6 sections. Section 2, presents the basic structure of the economy under discussion. Section 3 shows the behavior of the economy in the short run, i.e. in the interval of (logical) time where asset stocks and expectations are held constant. Section 4 presents the behavior of our model economy in the long run, showing the existence of a *saddle-path* trajectory to the *steady-state* position of the model. Section 5, discusses the response of the economy to a particular exogenous shock: a real exchange rate appreciation. As a result of this shock, a bubble in asset prices may occur. Section 6 presents the conclusions of the article.

2- The Basic Building Blocks

Let us consider a small open economy that produces a single good with the assistance of labor and an imported input. The technology employed by firms of this economy is *leontieff type*, that is technical coefficients of production – i.e. labor-output ratio and imports-output ratio – are constant. We will also suppose that price of the single good produced in this economy is determined by a fixed *mark-up* over unit costs. In this case, price determination can be represented by the following equation:

$$p = (1+\tau)[wb + ep^{*}{}_{0}a_{0}] \qquad (1)$$

Where: p is the money price of the single domestic good, w is the money wage rate, e is the nominal exchange rate, $p^{*}{}_{0}$ is the price of the imported input in foreign currency, b is the labor-output ratio and a_0 is the import input-output ratio.

Since the *mark-up* is constant then all variations in the rate of profit come from variations in the degree of capacity utilization. The rate of profit can be expressed by the following equation:

$$r = \frac{\tau}{1+\tau} u \quad (2)$$

Where: $u = \frac{X}{K}$ is defined as the current level of capacity utilization.

In the demand side of the economy, we will suppose, like Kalecki, that workers spend all their income in consumption goods and that capitalists save a constant fraction of profits. In this case, the consumption in nominal terms can be expressed by the following equation:

$$pC = wbX + (1-s)rpK \qquad (3)$$

Where: C is the real consumption expenditure, X is the quantity of output produced in the economy, s is the propensity to save out of profits, K is the capital stock in real terms.

The goods market will be in equilibrium if and only if the following condition is met:

$$pC + pI + p\,(G\text{-}T) + p\,E = p\,X \quad (4)$$

Where: I is the real investment spending, G-T is the real fiscal deficit and E is the real net exports.

Using (3) in (4) we found after all algebraic manipulations that:

$$g - sr + \gamma + \varepsilon - \phi\tau^{-1} r = 0 \qquad (5)$$

where:

$$g \equiv \frac{\dot{I}}{K}; \gamma = \frac{G-T}{K}; \quad \varepsilon = \frac{E}{K}; \quad \phi = \frac{ep^{*}{}_{0}a_{0}}{wb + ep^{*}{}_{0}a_{0}}$$

In equation (5), g is the growth rate of the capital stock desired by entrepreneurs, γ is the fiscal deficit as a proportion of the economy's capital stock, ε is the net exports of final goods as a proportion of capital stock and ϕ is the fraction of imported input costs in unit costs.

In order to determine the equilibrium *loci* of the goods market, we will suppose first that the rate of growth of the capital stock that is desired by the entrepreneurs is given by the following equation:

$$g = g_0 + h(r + \rho - i) \quad (6)$$

Where: ρ is the expected future rate of profit; i is the current rate of interest; h is the "propensity to invest", that is the sensibility of the growth rate of capital stock to the difference between expected (and current) profit rate and the current rate of interest.

Equation (6) establishes that growth rate of capital stock is a function of the difference between expected rate of profit (ρ) and the current rate of interest (i). This is a simple formalization of the theory of investment behavior that Keynes presented in chapter eleven of the *General Theory*. The *state of long-term expectations* whose, according to Keynes, is a major determinant of investment spending, is represented by ρ in equation (6). The current rate of profit - r - is also added to the investment equation in order to represent the influence of *changes in the level of capacity utilization* on investment demand. More precisely, we are supposing that an increase in the degree of capacity utilization, *ceteris paribus*, will increase investment spending.

We will also consider that ε is determined by the following equation:

$$\varepsilon = \varepsilon_0 + \varepsilon_1 q + \varepsilon_2 u \quad ; \quad \varepsilon_0, \varepsilon_1 > 0; \quad \varepsilon_2 < 0 \quad (7)$$

$$q = \frac{ep^*}{p}$$

Where: q is the price of foreign goods and services in terms of domestic currency relative to the price of domestic goods and services expressed in domestic currency – i.e. is the "real exchange rate"; e is the price of foreign currency relative to domestic currency – i.e. is the "nominal exchange rate"; p^* is the price of foreign goods and services in foreign currency; u is the actual level of capacity utilization.

In equation (7), net exports as a fraction of economy's capital stock is a positive function of real exchange rate (q). In other words, we are supposing that *Marshall-Lerner* condition is being fulfilled. The nominal exchange rate (e) is fixed, that is, monetary authorities – the Central Bank – employ the stock of foreign reserves to sustain a fixed parity with foreign currencies. In this setting, all variations in real exchange rate come from changes in domestic price level or in foreign prices. Finally, we are supposing that net exports of final goods are a negative function of current degree of capacity utilization. This hypothesis is done in order to formalize the idea the income effects are important in the determination of real-world trade fluctuations[12].

Using (6) and (7) in (5), we obtain the *loci* of combinations between the current rate of profit and the current rate of interest for which the goods market is in equilibrium, i.e. aggregate demand is equal to aggregate supply. So we have the following equation:

$$r = \frac{g_0 + \varepsilon_0 + \varepsilon_1 q + h(\rho - i)}{s + \phi\tau^{-1} - h - \varepsilon_2 \tau^{-1}(1+\tau)} \quad (8)$$

In equation (8) we are supposing that $s + \phi\tau^{-1} > h + \varepsilon_2 \tau^{-1}(1+\tau)$ in order to guarantee a positive sign for the equilibrium value of r.

In order to determine the slope of the *loci* of goods market equilibrium – which will be labeled as GG′ *loci* – let us take the total derivative of (8). After all mathematical manipulations we have:

$$\frac{\partial r}{\partial i} = -\frac{h}{s + \phi\tau^{-1} - h - \varepsilon_2 \tau^{-1}(1+\tau)} \quad (8a)$$

Equation (8^a) shows that in order to the GG′ *loci* to be downward sloping is necessary that [$s + \phi\tau^{-1} - \varepsilon_2\tau^{-1}(1+\tau) - h$] be positive, that is the *sum* of propensity to save out of profits [s] and propensity to import - the sum of two terms: $\phi\tau^{-1}$ *and* [$- \varepsilon_2\tau^{-1}(1+\tau)$] - be bigger than the propensity to invest [h]. This condition is, in general, assumed by all

[12] This important remark is due to the helpful comment of an anonymous referee.

Keynesian macroeconomic models, so there is no loss of generality if we also assume this hypothesis in the present model.

The GG´ *locus is* shown in figure 1.

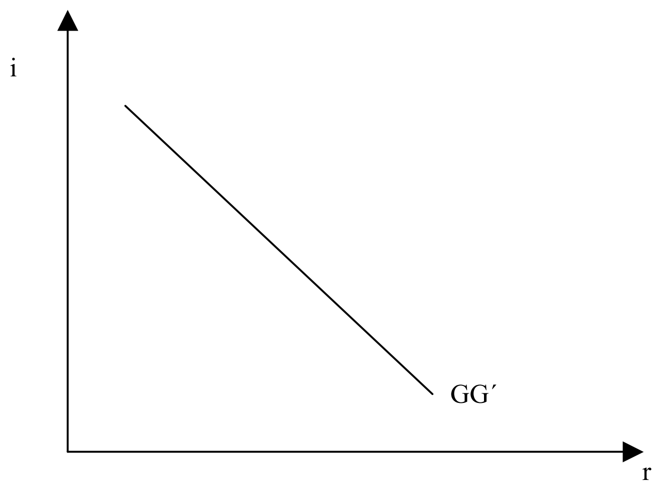

Figure 1

The next step is to consider the asset markets and the financial sector of this economy. We will suppose that there is 9 different assets in the economy: foreign reserves (eR), domestic bonds (B), foreign bonds (B^*), equities (P_eE), loans (L), bank reserves (H), demand deposits (D), capital goods (P_kK) and securities (F). These assets are hold by four different agents: Central Bank, commercial banks, firms and *rentiers*.

Equations (9)-(12) describe the balance sheets of all agents of this economy:

$F + eR = H$ (9)

$H + L = D$ (10)

$P_kK = L + P_eE + N$ (11)

$D + eB^* + B + P_e E = W$ (12)

Where: *P_k is the demand price of capital goods, P_e is the price of equities, N is firm's net worth, and W is rentiers´ total wealth.*

For simplicity, we will assume that commercial banks are forced by law or convention to hold a constant fraction of demand deposits in the form of bank reserves, that is:

$$H = \theta D \quad ; \quad 0 < \theta < 1 \qquad (13)$$

We will also suppose that rentiers decide about what proportion of their financial wealth that will be hold in demand deposits, domestic and foreign bonds and equities. These assets are supposed to be ***imperfect substitutes*** so that demand for each asset is influenced not only by its own rate of return but also by the rate of return of other assets. The same assumption is also employed by Tobin (1969) and Taylor and O'Connell (1985).

In this setting, rentiers´s portfolio decision is described by the following system of equations:

$$\mu\left(i, i^* + d^e, r + \rho\right)W = D \qquad (14)$$
$$\beta\left(i, i^* + d^e, r + \rho\right)W = B \qquad (15)$$
$$\beta^*\left(i, i^* + d^e, r + \rho\right)W = B^*\overline{e} \qquad (16)$$
$$\zeta\left(i, i^* + d^e, r + \rho\right)W = P_e E \qquad (17)$$

$$s.t: W = D + B + B^*\overline{e} + P_e E \qquad (18)$$

Equations (14)-(17) describe the demand of each kind of asset by rentiers. As we can see, the fraction of wealth that rentiers wish to hold in each of the four possible assets is a function of three variables: domestic interest rate, foreign interest rate *plus* expected devaluation of domestic currency and current rate of profit *plus* expected rate of profit. The first variable can be thought as the rate of return on domestic bonds while the second is clearly the rate of return on foreign bonds calculated in terms of domestic currency. Finally, the third variable is a (poor) proxy for the rate of return on equities.

Equation (18) is the (stock) budget constraint of rentiers. It shows that total demand of assets cannot be larger than total wealth. But it is necessary to observe that, while total wealth is a *datum* in almost all IS-LM type macroeconomic models, in the present model total wealth is an endogenous variable (cf. Taylor and O'Connell, 1985, p.871). In fact, total wealth is a positive function of equity prices whose, in turn, are endogenously determined.

In fact, using (14), (15) and (17) in (18) it can be shown that:

$$W = \frac{B^{*}\overline{e}}{1-\mu(.)-\beta(.)-\zeta(.)} \qquad (19)$$

Equation (19) determines the value of (rentiers) total wealth as a function of (i) the stock of foreign bonds evaluated in terms of domestic currency, (ii) the domestic rate of interest; (ii) the foreign rate of interest *plus* the expected rate of depreciation in domestic currency and (iv) the current and expected rate of profit.

Using (13) and (19) in (14), it can also be shown that:

$$\mu\left(i,i^{*}+d^{e},r+\rho\right)=\theta^{-1}\alpha\left[1-\mu\left(i,i^{*}+d^{e},r+\rho\right)-\beta\left(i,i^{*}+d^{e},r+\rho\right)-\zeta\left(i,i^{*}+d^{e},r+\rho\right)\right] (20)$$

Equation (20) can be thought as the equilibrium *loci* of financial markets. Such *loci* will be labeled as *loci FF´*. In order to determine the slope of *FF´ loci*, it is necessary to make some assumptions about the sign of partial derivatives in the system presented by equations (14)-(17). More specifically, we will suppose that:

$$\mu_1 < 0; \mu_2 < 0, \mu_3 > 0 \qquad (21a)$$
$$\beta_1 > 0, \beta_2 < 0, \beta_3 < 0 \qquad (21b)$$
$$\zeta_1 < 0, \zeta_2 < 0, \zeta_3 > 0 \qquad (21c)$$

Given the conditions stated in (21^a) to (21c), we can be shown that:

$$\frac{\partial i}{\partial r} = -\left\{\frac{(1+\alpha')\mu_3+\alpha'\beta_3+\alpha'\zeta_3}{(1+\alpha')\mu_1+\alpha'\beta_1+\alpha'\zeta_1}\right\} \quad (22) \quad ; \quad \alpha'=\alpha\theta^{-1}$$

In equation (22), both numerator and denominator have ambiguous sign. In order to solve this ambiguity, it is necessary to impose additional restrictions to the parameters of (22). For such, we will first calculate the effect of an increase in international rate of interest over domestic rate of interest. It is a stylized fact about macroeconomic performance of small open economies under fixed exchange-rate regime that an increase in foreign rate of interest will produce a sharp increase in domestic rates. So we can analyze what restrictions should be imposed to the parameters of the model in order to reproduce this stylized fact.

Thus we obtain the following expression:

$$\frac{\partial i}{\partial\left(i+d^{e}\right)}=-\left\{\frac{(1+\alpha')\mu_2+\alpha'\beta_2+\alpha'\zeta_2}{(1+\alpha')\mu_1+\alpha'\beta_1+\alpha'\zeta_1}\right\} \quad (23)$$

In order to the sign of (23) be ***positive***, denominator must have a ***positive*** sign. But the denominator in (23) is equal to the denominator in (22), so this one has also a positive sign.

What about the sign of numerator in (22)? In order to determine its sign, we have to impose additional restrictions to the relation between μ_3, β_3 and ζ_3. It is a stylized fact about financial markets in emerging economies like Brazil or South Korea that stock markets have a low degree of organization, i.e. they have low liquidity and show wide fluctuations in equity prices[13]. These special features of stock markets in emerging economies imply that demand elasticity of equities in relation to its own rate of return is very high. On the other hand, it can be easily demonstrated that a high elasticity of demand for equities can result from a positive sign in the numerator of (22)[14]. Under these assumptions, the FF′ *loci* will be downward sloping (see figure 2).

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[13] See footnote 5, page 2.
[14] See appendix 1 for a formal proof of this statement.

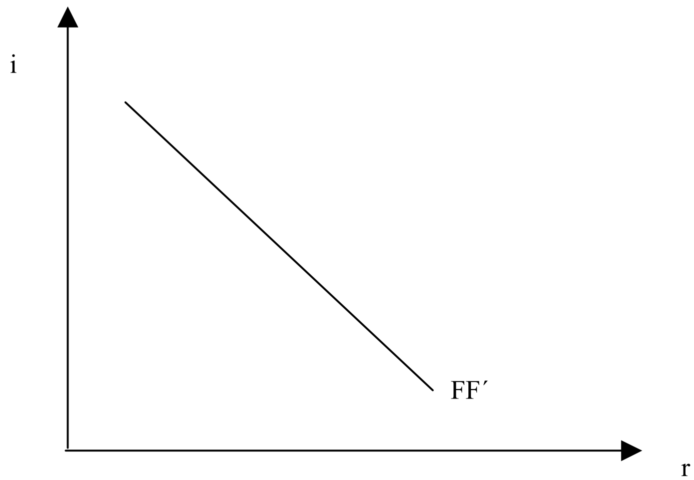

Figure 2

3 – Short Run Equilibrium and Comparative Statics.

We are now able to analyze the short run equilibrium of this economy; that is the simultaneous equilibrium of all markets when asset stocks and expectations about future profitability of capital goods are kept constant.

From (8) and (20), we know that:

$$r = r(i, q, \gamma, \rho) \quad ; \quad r_1 < 0, r_2 > 0, r_3 > 0, r_4 > 0 \qquad (24)$$

$$i = i(r, d^e, \rho, \alpha) \quad ; \quad i_r < 0, i_2 > 0, i_3 > 0, i_4 > 0 \qquad (25)$$

Equations (24) and (25) are simple representations of the GG′ and FF′ *loci*, respectively.

General equilibrium of goods and financial markets requires a pair of values for *r* and *i* such that equations (24) and (25) are solved simultaneously. This will happen in the point where GG′ curve intercept FF′ curve, as shown by figures 3^a and 3^b.

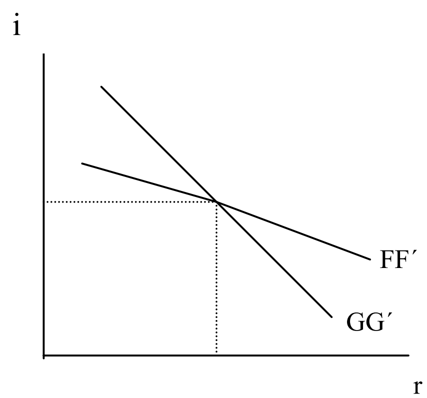

Figure 3a

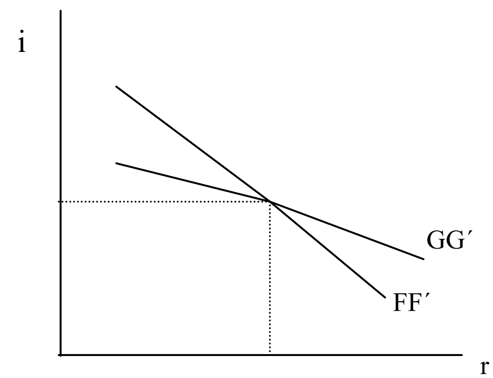

Figure 3b

Figures 3[a] and 3[b] show two possible short run equilibrium configurations. In the first one – shown by figure 3[a] – FF´ curve is less inclined than GG´ curve. In the second – represented by figure 3[b] – GG´ curve is less inclined than FF´ curve.

For short run analysis we will not consider the issue of equilibrium stability; in other words, we will suppose that the economy is always in short run equilibrium. In this case, the relative inclinations of GG´ and FF´ curves are important only for comparative statics.

For analysis of comparative statics, we will suppose that FF´ is steeper than GG´ curve; i.e. $1 - r_1 i_1 < 0$. So, using (25) in (24) and taking total derivative of the resulting equation, we can easily demonstrate that:

$$dr = \left[\frac{r_1 i_2}{1 - r_1 i_1}\right] dd^e + \left[\frac{r_1 i_3 + r_4}{1 - r_1 i_1}\right] d\rho + \left[\frac{r_1 i_4}{1 - r_1 i_1}\right] d\alpha + \left[\frac{r_2}{1 - r_1 i_1}\right] dq + \left[\frac{r_3}{1 - r_1 i_1}\right] d\gamma \quad (26)$$

$$di = \left\{ i_2 + i_1 \left[\frac{r_1 i_2}{1 - r_1 i_1} \right] \right\} dd^e + \left\{ i_3 + i_1 \left[\frac{r_1 i_3 + r_4}{1 - r_1 i_1} \right] \right\} d\rho + \left\{ i_4 + i_1 \left[\frac{r_1 i_4}{1 - r_1 i_1} \right] \right\} d\alpha + \left\{ \frac{i_1 r_2}{1 - r_1 i_1} \right\} dq + \left\{ \frac{i_1 r_3}{1 - r_1 i_1} \right\} d\gamma \qquad (27)$$

Expressions (26) and (27) summarizes the effects of changes in (i) expected devaluation of domestic currency, (ii) expected rate of profit, (iii) real exchange rate, (iv) fiscal deficit as a fraction of economy's capital stock and (v) ratio of bank reserves and foreign bonds evaluated in terms of domestic currency over equilibrium levels of current rates of interest and profit. These results allow us to write the following equations[15]:

$$r = r(d^e, \rho, \alpha, q, \gamma) \qquad (28)$$

$$i = i(d^e, \rho, \alpha, q, \gamma) \qquad (29)$$

The most important result of this exercise for the argument of the paper is the signal of $\frac{\partial r}{\partial q}$. As we can see in expression (26), if an FF´ locus is steeper than GG´ locus – that is $(1-i_1 r_1 < 0)$ – than a real exchange rate appreciation will produce an increase of profit rate (and capacity utilization, given income distribution) in the short run. This result is at odds with the traditional open-economy macroeconomics (as it is present in standard textbooks); but is fully compatible with the experience of emerging economies – like Brazil – during the 1990´s[16]. This result can be seen in Figure 3(c).

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[15] From equations (26) and (27) we can easily conclude that: $\frac{\partial r}{\partial q} < 0; \frac{\partial r}{\partial \alpha} > 0; \frac{\partial r}{\partial d^e} > 0; \frac{\partial r}{\partial \gamma} < 0; \frac{\partial i}{\partial q} > 0; \frac{\partial i}{\partial \gamma} > 0$. The other partial derivatives have ambiguous signs. In order to solve this ambiguity we will suppose that the structural parameters of the model are such that $\frac{\partial i}{\partial \rho} < 0; \frac{\partial i}{\partial \alpha} > 0; \frac{\partial i}{\partial d^e} > 0$.

[16] Brazil, for example, had experienced a sharp appreciation of real exchange rate in 1994 relative to 1993 (more or less 30%), and an increase in the rate of economic growth from 4.92 % in 1993 to 5.85% in 1994 (source: www.ipeadata.gov.br).

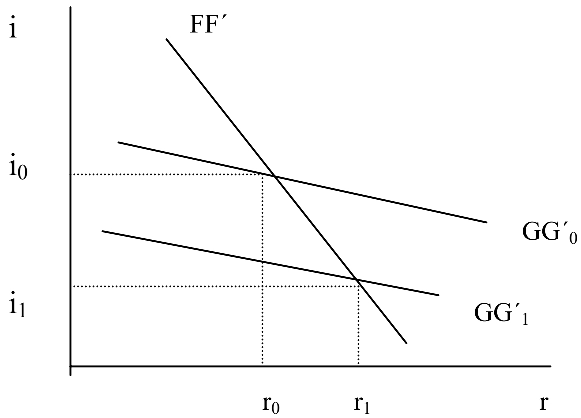

Figure 3 c

4 – Long Run Equilibrium and Dynamics

Now we must turn our attention to the behavior of the system in the long run. As already been told, in the long run asset stocks and expectations will be changing as a result of the endogenous operation of the economy. In particular, monetary base – which, in the present model, is equal to bank reserves – may change as a result of balance of payments deficits or surpluses, and expected rate of profit may change as a result of changes in the current situation of the economy.

Taking the first derivative of α in relation to time, we obtain the following expression:

$$\hat{\alpha} = \frac{\dot{\alpha}}{\alpha} = \left[\frac{\dot{H}}{H} - \frac{\dot{B}^*}{B^*} \right] \qquad (30)$$

Equation (30) shows that rate of growth of the ratio between monetary base and foreign bonds is equal to the difference between the rate of growth of monetary base and the rate of growth of the stock of foreign bonds. For simplicity, we will assume that stock of foreign bonds is kept constant through time, so all changes in α comes from changes in monetary base.

In the absence of *sterilization*, changes in the stock of high-powered money will be equal to changes in foreign reserves. Since there is a fixed exchange rate regime, all variations in the stock of foreign reserves come from surpluses or deficits in the balance of payments.

We will suppose that balance of payments deficits or surpluses are determined by the following equation[17] [18]:

$$BPA = \left[\varepsilon_0 + \varepsilon_1 q + \tau^{-1}\left(\varepsilon_2\left(1+\tau\right) - \phi\right) r\right] K + \varphi\left(i - i^* + d^e\right) K \qquad ;0 < \varphi < \infty \quad (31)$$

$$where: \quad \left(\varepsilon_2 (1+\tau) - \phi\right) < 0 \quad since \quad \varepsilon_2 < 0$$

The first term in (31) is the current account surplus, which is a positive function of real exchange rate – i.e. *Marshall-Lerner* condition is satisfied – and a negative function of current rate of profit. The second term is the capital account surplus, which is a positive function of the difference between domestic rate of interest and international rate of interest *plus* expected rate of devaluation in domestic currency. The coefficient φ represents the sensitivity of capital account surpluses to the difference between domestic and international rate of interest. Since $\varphi < \infty$, this economy is not under a system of perfect capital mobility. More precisely, we are supposing, like Mundell (1962, 1963) and Fleming (1962), that there is *imperfect capital mobility* between countries. This imperfection on mobility of capital can, in turn, be the result of governmental restrictions on capital movements, like those that prevailed in most countries during the post war period.

Dividing both sides of (31) by K, and remembering that BPA is equal to time derivative of monetary base, we obtain the following expression:

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[17] The term $\tau^{-1}\phi r$ represents the imports of *intermediate* goods that are used by domestic firms in the production of *final* goods.

[18] For an econometric analysis of the determinants of balance of payments of the Brazilian economy see Bértola, Higachi and Porcile (2002).

$$\frac{\dot{H}}{H} = h^{-1}\left[\varepsilon_0 + \varepsilon_1 q + \tau^{-1}\left(\varepsilon_2 (1+\tau) - \phi\right) r + \varphi\left(i - i^* + d^e\right)\right] \quad ; h = \frac{H}{K} \quad (32)$$

Using (32) in (30), we have the following differential equation:

$$\hat{\alpha} = h^{-1}\left[\varepsilon_0 + \varepsilon_1 q + \tau^{-1}\left(\varepsilon_2 (1+\tau) - \phi\right) r(\rho,\alpha) + \varphi\left(i(\rho,\alpha) - i^* + d^e\right)\right] \qquad (33)$$

From (33) we can obtain the *loci* of all combinations in ρ and α for which the ratio between monetary base and the stock of foreign bonds is kept constant through time. The slope of this *locus* is given by:

$$\left(\frac{\partial \rho}{\partial \alpha}\right)_{|\dot{\alpha}=0\rangle} = \frac{\left(\phi - \varepsilon_2 (1+\tau)\right)\tau^{-1} r_\alpha - \varphi i_\alpha}{\varphi i_\rho - \tau^{-1}\left(\phi - \varepsilon_2 (1+\tau)\right) r_\rho} \qquad (34)$$

$$\textit{where}:$$
$$r_\alpha = \frac{\partial r}{\partial \alpha}; \quad r_\rho = \frac{\partial r}{\partial \rho}; \quad i_\rho = \frac{\partial i}{\partial \rho}; \quad i_\alpha = \frac{\partial i}{\partial \alpha}$$

The signal of equation (34) can be either positive or negative depending on the value of the parameter φ. For a positive sign the following condition must be met: $\varphi > \frac{\left[\phi - \varepsilon_2 (1+\tau)\right]\tau^{-1} r_\alpha}{i_\alpha} = \varphi^c$; that is, the sensibility of capital account to the difference between domestic and foreign interest rates must be higher than a critical value, φ^c. In economic terms this means that this economy must have a substantial degree of capital mobility[19].

Now we must turn our attention to the evolution of expected rate of profit through time. We will suppose that:

$$\dot{\rho} = \psi\left[i(\rho,\alpha) - \bar{i}\right] \quad ; \quad \psi < 0 \quad (35)$$

Where:

$\bar{i}$ Is the "normal rate of interest".

Equation (35) establishes that if current rate of interest is bigger than normal rate of interest than there will be a *continuous* decrease in expected rate of profit. This hypothesis is the same employed by Taylor and O'Connell on their original model. Despite the criticism made by Nassica (2000, p.53), it seems a reasonable hypothesis due to the inverse relation between the current level of interest rate and the rate of profit. In fact, an increase in the current level of interest rate must be followed by a reduction in the rate of profit – due to its negative effect over aggregate demand – and to the extent that investor's expectations about future profits are formed according to Keynesian rules[20], than expected profits must also decrease.

From (35) we can obtain the *loci* of all combinations in ρ and α for which expected rate of profit is constant through time. The slope of this *locus* is given by:

$$\left(\frac{\partial \rho}{\partial \alpha}\right)_{|\dot{\rho}=0\rangle} = -\frac{i_{\alpha}}{i_{\rho}} > 0 \quad (36)$$

This economy will be in *steady-state* when values of ρ and α are such that (33) and (34) are both set equal to zero. Graphically, this will occur in the point where curve $\dot{\alpha} = 0$

[19] As we will see in the following pages this condition will also assure the existence of a saddle-path equilibrium position.

[20] In Keynes words: "*It would be foolish, in forming our expectations, to attach great weight to matters which are very uncertain. It is reasonable, therefore, to be guided to a considerable degree by the facts about which we feel somewhat confident, even though they may be less decisively relevant to the issue than other facts about which our knowledge is vague and scanty. For this reason the facts of existing situation enter, in a sense disproportionately, into the formation of our long-term expectations; our usual practice being to take the existing situation and to project it into the future, modified only to the extent that we have more or less definite reasons for expecting a change"* (1973, p.148).

intercepts the curve $\dot{\rho} = 0$. A possible *steady-state* configuration[21] of this economy is represented in Figure 4.

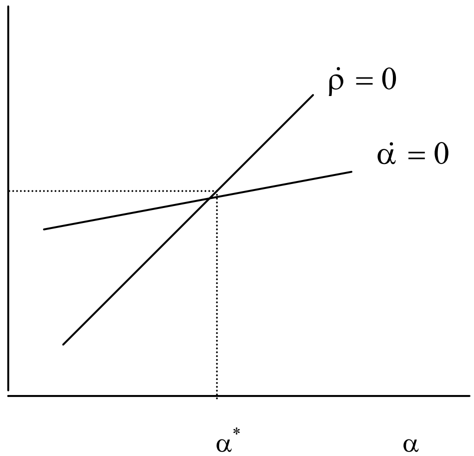

Figure 4

Where: ρ^* and α^* are the *steady-state* values of ρ and α.

Now we have to analyze the stability of *steady-state* equilibrium. In order to do that, is necessary to calculate the matrix M of partial derivatives of the dynamic system composed by equations (33) and (35) [cf. Lima and Meirelles, 2004]. The elements of this matrix are given by:

$$M_{11} = h^{-1}\left\{\tau^{-1}\left(\varepsilon_2(1+\tau) - \phi\right)r_p + \varphi i_\rho\right\} < 0 \qquad (36a)$$

$$M_{12} = h^{-1}\left\{\tau^{-1}\left(\varepsilon_2(1+\tau) - \phi\right)r_\alpha + \varphi i_\alpha\right\} \qquad (36b)$$

$$M_{21} = \psi i_p > 0 \qquad (36c)$$

$$M_{22} = \psi i_\alpha < 0 \qquad (36d)$$

---

[21] This is the long-run equilibrium configuration for which a saddle path trajectory exists.

This economy will have a *saddle-path* if and only if the determinant of matrix M is negative (Takayama, 1993, p. 408). The determinant of matrix M is given by:

$$M_{11}M_{22} - M_{21}M_{12} \qquad (38)$$

For a negative determinant is necessary – although not sufficient[22] – that M_{12} be positive. That is the following condition must be satisfied:

$$\varphi > \frac{\left[\phi - \varepsilon_2 (1+\tau)\pi^{-1} r_\alpha\right]}{i_\alpha} = \varphi^c \qquad (38a)$$

As we can see this is the same condition as the one necessary to assure a positive signal for expression (34).

5 – Real exchange rate appreciation and dynamics of growth and equity prices: *booms* and *bubbles*.

Now, we will turn our attention to the long-run effects of real exchange rate appreciation over a set of variables, in particular: (i) the current rate of profit, (ii) the current rate of interest, (iii) equity prices; (iv) expected profits and (iv) monetary base.

First of all, we will analyze the effect of real exchange rate appreciation over $\dot{\rho} = 0$ curve. Setting (35) equal to zero, and taking the total derivative of the resulting equation, we obtain the following expression:

$$\left(\frac{\partial \rho}{\partial q}\right)_{|\dot{\rho}=0} = -\frac{i_q}{i_\alpha} > 0 \qquad (39)$$

Expression (39) states that a reduction in real exchange rate – i.e. an increase in the relative price of domestic goods (that is a real exchange rate appreciation) – will produce a decrease in expected rate of profits in steady-state. Graphically, this effect is represented by a leftward shift in $\dot{\rho} = 0$ curve, as it is shown in figure 5.

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[22] A sufficient condition is that $\dot{\rho} = 0$ curve will be steeper than $\dot{\alpha} = 0$ curve.

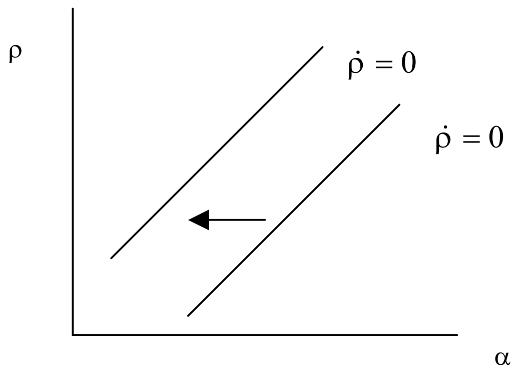

Figure 5

In order to determine the effect of a real exchange rate appreciation over $\dot{\alpha} = 0$ curve, we have to set (33) equal to zero and take total derivative of the resulting equation. After all necessary algebraic manipulations, we arrive at the following expression:

$$\left(\frac{\partial \rho}{\partial \alpha}\right)_{|\dot{\alpha}=0} = -\frac{\left[\varepsilon_1 + \tau^{-1}\left(\varepsilon_2(1+\tau) - \phi\right) r_q + \varphi i_q\right]}{\left[\tau^{-1}\left(\varepsilon_2(1+\tau) - \phi\right) + \varphi i_\rho\right]} \qquad (40)$$

Expression (40) has an ambiguous sign because it is not possible to determine the sign of numerator. However, if sensitivity of net exports of final goods to changes in current degree of capacity utilization - ε_2 - is high enough than the sign of numerator will be negative. In this case, the sign of (40) will also be negative, meaning that real exchange rate appreciation will produce an increase in expected rate of profit over the $\dot{\alpha} = 0$ loci [23]. This effect is represented graphically by a rightward shift in $\dot{\alpha} = 0$ curve, as shown in figure 6.

[23] Even if ε_1 is near zero; i.e. sensibility of net exports to variations in real exchange rate is very small, the signal of the numerator in (40) will still be ambiguous. For a negative signal, it is necessary a high sensibility of net exports to variations in the degree of capacity utilization.

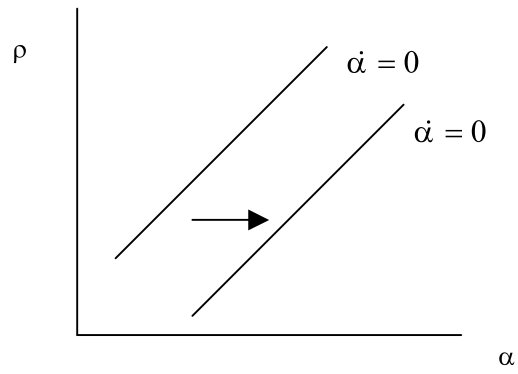

Figure 6

The final effect of a real exchange rate appreciation over *steady-state* values of α and ρ will depend on the relative shift of both curves. The steady-state value of α and ρ will certainly decrease, producing an ambiguous effect over the steady-state values of *r*, *i* and P^e. However, as we can see in figure 7, the new steady-state equilibrium will be located below and at the left of the original steady-state equilibrium. This information will be very important for the dynamic analysis of the effects of a real exchange rate appreciation.

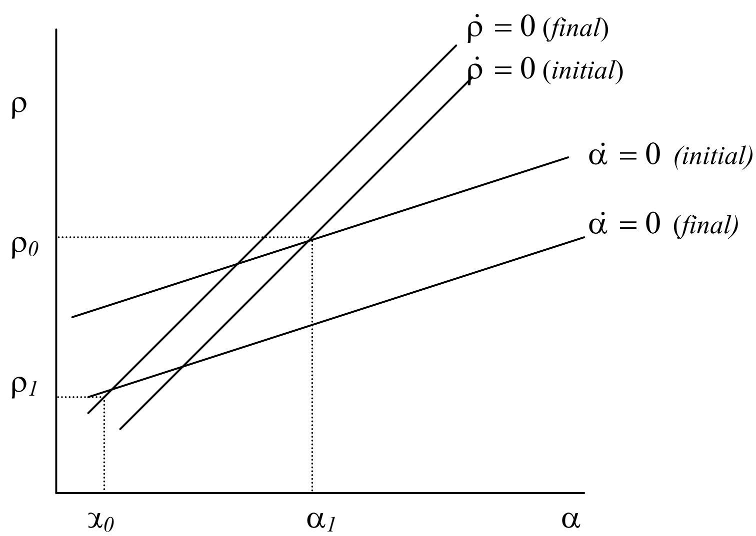

Figure 7

Table I summarizes the effects of a real exchange rate appreciation over *steady-state* values of α, ρ, *r, i* and P_e.

Table I

	ρ	α	***r***	***i***	P_e
Real exchange rate appreciation	*decrease*	*decrease*	*ambiguous*	*ambiguous*	*ambiguous*

So far we have only analyzed the effects of real exchange rate appreciation over *steady-state* values of α and ρ. However, out of steady-state dynamics is much more interesting.

In fact, let us consider the situation displayed in Figure 8. This figure presents an unstable (saddle-path) steady-state equilibrium. Line SS represents the saddle-path trajectory; Point *A* represents the initial *steady-state* position of the economy, i.e. before the occurrence of a shock over real exchange rate and point B represents the final *steady-state* position. After the appreciation in real exchange rate, economy starts to move in *DD* path. As we can see, from point A to point C there is (i) a continuous reduction in the value of α; and (ii) a continuous increase in ρ.

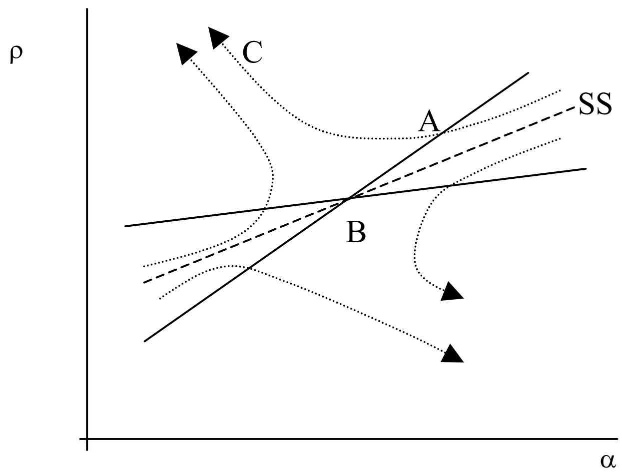

Figure 8

The behavior of α and ρ from A to B produces the following effects:

1. First of all, since *r* is a positive function of ρ and a negative function of α there will be a cumulative increase in the current rate of profit. This increase is accompanied by a reduction in the rate of interest, since it is a negative function of ρ and a positive function of α. The combined effect of (i) increase in current and expected rate of profit; and (ii) reduction in the rate of interest will result in an increase in the desired rate of capital accumulation, i.e. an increase in the rate of growth of capital stock.

2. Since economy is under a fixed (nominal) exchange-rate regime, a continuous reduction in the ratio between bank reserves and foreign bonds is followed, under no-sterilization assumption, by a continuous reduction in the stock of foreign reserves.

3. As a result of the continuous increase in current and expected rates of profit, there is a cumulative increase in price of equities as soon as *rentiers* substitute domestic bonds for equities in their portfolios. In other words, a *bubble* in equity prices – defined as a cumulative increase in asset prices relative to prices of capital goods - is produced as a result of the dynamic path of α and ρ.

4. Since the degree of capacity utilization is increasing over time, there will be a continuous increase in imports of raw materials and an outflow of capital. In other words, this economy will have a current account and a capital account deficit, which will be financed by a continuous loss of foreign reserves.

The main reason for the occurrence of a bubble in asset prices is that in emerging markets a real exchange rate appreciation will produce an increase – not a decrease – in current rate of profit and capacity utilization[24]. In fact, an increase in real exchange rate will produce a reduction in net exports but – due to the low degree of organization in financial markets of these countries – will also produce a sharp decrease in interest rates and an expansion in aggregate demand and capacity utilization. The corresponding increase in current rate of profit will produce an increase in entrepreneur's optimism and, consequently, in expected future profits. Since demand for equities is a positive function of expected rate of profit, there will be an increase in price of equities. The increase in entrepreneurs´ optimism will also produce an increase in the desired rate of growth of the capital stock (I/K) and a new increase in aggregate demand and capacity utilization.

Our analysis finishes at point C, where it is supposed that either foreign reserves falls down to zero or investors begin to expect a strong devaluation of nominal exchange rates. As we can be observed in expression (27)[25], if investors expect a devaluation of domestic currency than nominal interest rates goes up and, consequently, profit rate and capacity utilization goes down. In this case the bubble will certainly burst, and the economy may start a process of asset-price deflation as the one described by Minsky (1975).

6 – Conclusion

Through out this article, we have shown that a asset price bubble – defined as a cumulative increase in asset prices relative to prices of capital goods – can result from a *real exchange rate* appreciation in economies that have (i) high (although imperfect) capital

[24] This result is similar to Taylor (1991, Chapter 7) where devaluation in real exchange rate will produce a reduction in aggregate demand and capacity utilization.
[25] See footnote 14.

mobility; (ii) a low degree of organization in financial markets and (iii) a high sensibility of net exports to variations in the degree of capacity utilization. These are common features of emerging countries like Brazil or South Korea, so that the possibility of occurrence of asset price bubbles in these economies is not small.

Appendix 1: The Slope of FF´ locus and demand elasticity of equities.

If the numerator in (22) is positive then:

$$\beta_3 > -\frac{(1+\alpha')}{\alpha'}\mu_3 - \varepsilon_3 \qquad (A1)$$

Multiplying both sides of (A1) *by [(r+*ρ*)/*ε*W]* , we have:

$$\frac{\beta_3(r+\rho)}{\varepsilon W} > -\frac{(1+\alpha')}{\alpha'}\frac{\mu_3(r+\rho)}{\varepsilon W} - \frac{\varepsilon_3(r+\rho)}{\varepsilon W} \quad (A2)$$

But the last term in (A2) is the elasticity of equities demand in relation to the expected rate of profit, which we will define as $\eta_{\varepsilon,\, r+\rho}$. It is easy to show that:

$$\frac{\beta}{\varepsilon}\eta_{\beta,r+\rho} > -\left(\frac{1+\alpha'}{\alpha'}\right)\eta_{m,r+\rho}\frac{\mu}{\varepsilon} - \eta_{\varepsilon,r+\rho}\,(A3)$$

Where: $\eta_{\beta,\, r+\rho}$ is the demand elasticity of domestic bonds in relation to expected rate of profit and $\eta_{\mu,\, r+\rho}$ is the demand elasticity of “money” in relation to expected rate of profit.

Manipulating (A3) we arrive at the following expression:

$$\eta_{\varepsilon,r+\rho} > -\left[\frac{\beta}{\varepsilon}\eta_{\beta,r+p} + \left(\frac{1+\alpha'}{\alpha'}\right)\eta_{\mu,r+\rho}\right] = \eta^*_{\varepsilon,r+\rho} \quad (A4)$$

Expression (A4) shows that numerator in (22) will be positive **if and only if** demand elasticity of equities in relation to expected rate of profit is bigger than some *critical value* $\eta^*_{\varepsilon,\, r+\rho}$.

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