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Economic growth under alternative monetary regimes: inflation targeting vs real exchange rate targeting

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The main features and implications of a monetary regime based on inflation targeting are examined and compared to a system based on real exchange rate targeting. The latter is very effective in stimulating economic growth, but the 'trilemma' reduces the effectiveness of stabilization based on open market operations. Inflation targeting is very effective in stabilizing prices but it hurts growth and employment. The dynamics of long-run equilibrium is also analyzed for both regimes.

Keywords: inflation targeting; monetary policy; trilemma; growth

JEL classifications: E12, E31, E58, O42

1. Introduction

Several models have been developed within the structuralist tradition in order to analyze growth and distribution in open economies. These works, however, do not always include the monetary sector, and when they do, they rarely establish the interaction between the latter and the balance of payments; they are not designed to examine the association between the monetary regime, and the foreign exchange rate system. This article attempts to fill that void by means of a framework that allows comparing two alternative monetary regimes: one resulting from inflation targeting, and another resulting from real exchange rate targeting.

The topic becomes relevant as several developing nations are deciding to adopt inflation targeting regimes, combined with flexible foreign exchange systems. This move has been encouraged by the International Monetary Fund (IMF), and especially recommended to those economies with difficulties in bringing their inflation rates down to the level of the more advanced countries. In various nations, however, this shift has been shown to cause unemployment, real exchange rate appreciation, lower output growth, and vulnerability to external shocks.

This article examines the two alternative monetary regimes by means of a formal model. In Section 2, the Central Bank adjusts the nominal exchange rate to hit a real exchange rate target, with inflation control playing an important but secondary role. Section 3 presents the inflation targeting scheme. For each of the models developed in Sections 2 and 3, the dynamic properties of the long-run equilibrium are also analyzed. Section 4 presents some concluding remarks.

2. A small-open economy with a real exchange rate target

In this economy the Central Bank adjusts the nominal exchange rate in order to bring the actual real exchange rate to a target level. With this control over the exchange rate and an open capital account, attempts to reduce the money supply with open market operations raise the nominal

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interest rate and lead to an increase in international monetary reserves; this, in turn, offsets the reduction in money supply that authorities were looking for. It is clear that this economy faces the difficulties arising from the 'trilemma.'

This situation leads to inflation rates that are higher than internationally accepted levels. It also allows the Central Bank to make the adjustments that are needed to maintain the competitiveness of exports and the rate of economic growth. These arguments are explored with the model presented below.

2.1. Assumptions of the model

Some assumptions below are rather general, but others reveal the structuralist approach that is followed in building the model.¹

- (1) The country produces a consumption good Q , which could be exported or consumed domestically.
- (2) The country imports a composite good that may be used for consumption or investment purposes. All capital used in the country is imported.
- (3) The small economy cannot affect the international price of its imports P^M , but it determines domestically the price of local production P^Q , part of which is exported. This assumption, in relation to the price of local production, allows analyzing the effect that internal prices have on the competitiveness of exports.
- (4) The price of imports, in terms of foreign currency is P^M , assumed exogenous for the small economy. In terms of local currency, the price of imports is: eP^M where e represents the nominal exchange rate (number of units of local currency that have to be paid for one unit of foreign currency).
- (5) There are two social classes: producers and workers. Workers spend all their wage income on consumption of both the local good and the imported good, while producers save a fixed portion s of their profit income and the rest they spend on consumption of both the domestic and imported goods.
- (6) Good Q is produced by means of a fixed-coefficient production function:

$$Q = \text{Min} \left[\frac{L}{a}, uK \right]$$

where L represents the labor input, a is a technical coefficient, K is capital and u represents the output/capital ratio. Capital does not depreciate, and firms are assumed to hold excess capacity so that u is a variable that moves up (down) when capacity utilization increases (decreases).

- (7) The interest rate is a policy variable fixed by the Central Bank for stabilization purposes.
- (8) The capital stock K and the labor force N are given in the short- and medium-run, but they may change in the long-run.
- (9) The nominal exchange rate e is a policy variable that remains fixed in the short- and medium-run, but is adjusted in the long-run by the Central Bank. The adjustment process follows a rule that allows hitting a real exchange target.
- (10) The real exchange rate, which determines the competitiveness of exports, is defined

$$\text{as: } h = \frac{eP^M}{P^Q}.$$

(11) The wage share is assumed given in the short- and medium-run, and is defined as

$$A = \frac{Wa}{P^Q} .$$

In the short-run W and the technical coefficient a are also fixed, but they

adjust in the long-run. The domestic price level P^Q is given in the short-run but may vary in the medium-run.

(12) The analysis is conducted in three stages: in the short-run, output adjusts while prices, the real exchange rate, and the distribution of income remain given; in the medium run inflation will move to clear the monetary market; and in the long-run the wage share and the real exchange rate are allowed to vary.

2.2. General overview

In this section we present the goods market, and define the conditions for macroeconomic equilibrium in the short-run. With the previous assumptions we can find equilibrium values for the rate of growth, the rate of profit, the output/capital ratio, and the employment rate; inflation only adjusts in the medium run, as seen below.

Within the foreign sector, in the short run, the given levels of the interest rate and real exchange rate help us determine the increase in international monetary reserves; this then enters into the determination of money supply growth. With the short-run variables already determined, the monetary sector clears in the medium-run through adjustments in the inflation rate. We will then see how the real exchange rate emerges as a leading character in the story.²

Equations of the model

Goods market:

$$g^s = sr + B \tag{1}$$

$$g^d = b_0 + b_1r - b_2i \tag{2}$$

$$r = \frac{u}{h}(1 - A) \tag{3}$$

$$P^Q = \bar{P}^Q \tag{4}$$

$$g^d = g^s \tag{5}$$

$$\frac{L}{N} = \frac{L}{Q} \frac{Q}{K} \frac{K}{N} = l = auk \tag{6}$$

Monetary market:

$$\hat{M}^d = \eta_1\pi + \eta_2u - \eta_3i - \eta_4\pi^E \tag{7}$$

$$\hat{M}^S = R + \tau_0 - \tau_1i \tag{8}$$

$$\hat{M}^S = \hat{M}^d \tag{9}$$

$$i = i_0 \quad (10)$$

Foreign sector:

$$B = F - R \quad (11)$$

$$B = B(h); \quad B_h < 0 \quad (12)$$

$$F = F(i); \quad F_i > 0 \quad (13)$$

$$\hat{e} = \Omega[h_T - h] \quad (14)$$

Several variables are measured as ratios over the value of the capital stock $eP^M K$: desired investment g^d , total saving g^s , the current account deficit B , capital inflows F , the increase in international monetary reserves R , and output u . The nominal interest rate i , the actual inflation rate π , the expected inflation rate π^E , and the rates of growth of money supply and money demand \hat{M}^s, \hat{M}^d , are written in percentage terms. The real exchange rate and the wage share are denoted by h and A , respectively, and the symbols $\eta_1, \eta_2, \eta_3, \eta_4, \tau_0, \tau_1, b_0, b_1, b_2$, all represent positive parameters.

Equation (1) defines total saving as domestic saving sr , plus foreign saving B . In (2) desired investment depends on the profit and interest rates. Then (3) shows the rate of profit in terms of the flexible output/capital ratio, the real exchange rate, and the wage share, and (4) indicates that prices remain fixed in the short-run. Goods market equilibrium is defined in (5), while (6) shows the employment rate (l) as a function of the output/capital ratio (for given k).

In the monetary market, equilibrium is attained when the rates of growth of money supply and money demand (in nominal terms) are equal. In (7) money demand is determined by inflation, the output/capital ratio, the interest rate and an exogenous expected inflation term. Inflation increases the demand for money as the public will attempt to replenish the value of their real balances whenever inflation goes up. Also people will try to get rid of (i.e. spend) their holdings of money if they expect inflation: the public will attempt to win the race against inflation.

The money supply in equation (8) grows with the accumulation of foreign exchange reserves, but decreases with the exogenous interest rate. This latter component attempts to formalize Central Bank policy-making: in order to reduce money growth, the bank conducts open market operations and drives interest rates up, and the opposite would happen if policy makers wished to increase money growth. The constant parameter τ_0 , captures the effect of monetary policy that is not related to open market operations.

Equation (9) presents money market equilibrium, and (10) presents the exogenous nominal interest rate. Inflation is here a monetary phenomenon: excess money supply leads to excess spending, and hence to higher inflation. Also, the lack of money supply results from high interest rates, which hurt employment and output growth. Thus, effective demand continues as a relevant determinant of economic activity. Here money is not neutral, so, unlike several versions of the 'new consensus' macroeconomics (Meyer 2001), money does matter. Our approach also differs from the Post Keynesian view of inflation as resulting from cost-push and social conflict (as presented for example in Arestis and Sawyer (2006)).

Ceteris paribus, the use of the interest rate to control inflation will only lead to a stable adjustment process if money supply is more sensitive to changes in the interest rate than money demand (i.e. τ_1 , is bigger than η_3). Only in this case will the higher interest rate lead to a reduction in the excess money supply, and to a lower inflation rate.³

The foreign sector is described in equations (11)–(14). In (11) the current account deficit is financed by capital inflows and depletion of international monetary reserves. The current account deficit depends negatively on the real exchange rate and net capital inflows depend positively on the interest rate. In (14) we see how, in the long-run, the monetary authority devalues the nominal exchange rate to bring the real rate to its target (h_7); Ω is a positive parameter.

2.3. Formal solution of the model

The process starts when the Central Bank defines the nominal interest rate and the target for the real exchange rate. These two policy variables are utilized, respectively, to control the money supply, and to maintain the competitiveness of net exports. The current account deficit and net capital inflows can then be determined, and with this we can solve for R in (11).

In the goods sector equations (1), (2), (12) and (5) determine the profit rate. In (3), given A and h , we find the output/capital ratio, and (6) then leads to the employment rate (l). As in other Keynesian models, employment is determined in the goods market (not in the labor market as monetarist and new classical approaches would suggest). The short-run solution for the goods sector is shown in Figure 1.

We may now move into the medium run and use (7)–(10) in the monetary sector to solve for inflation, as shown below:

$$\pi_0 = \frac{R_0 + \tau_0 + (-\tau_1 + \eta_3)i_0 - \eta_2 u_0 + \eta_4 \pi^E}{\eta_1} \tag{15}$$

where u_0 represents the level of the output/capital ratio that clears the goods market in the short-run, and i_0 denotes the interest rate fixed by the Central Bank. The relationship between the interest rate and inflation is shown in Figure 2.

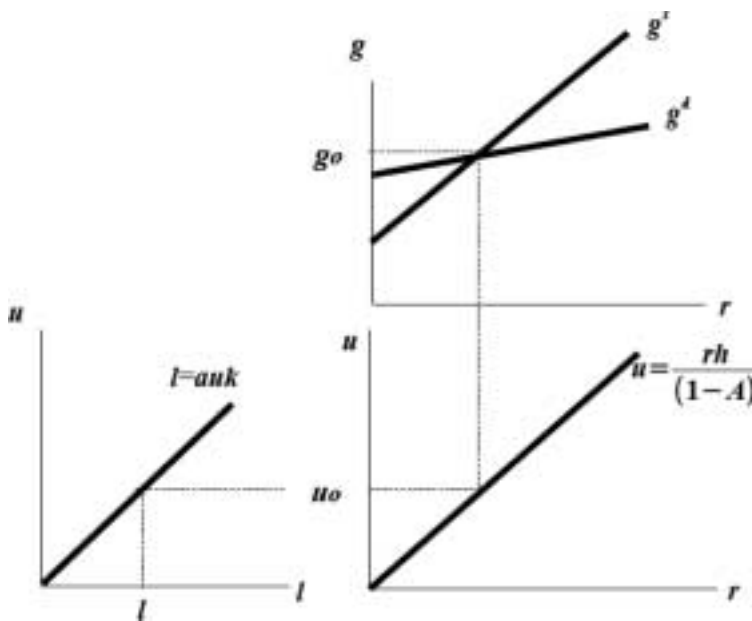


Figure 1. Goods market equilibrium in the short-run.

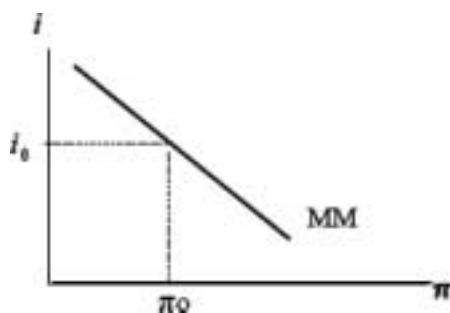


Figure 2. Money market equilibrium schedule.

The money market equilibrium schedule (MM line) in Figure 2 has a negative slope when the conditions specified in note 3 hold. This schedule provides the combinations of inflation and interest rate that are consistent with equilibrium in the monetary market. The Central Bank raises the interest rate to reduce money supply growth; and as the availability of money declines, aggregate spending decreases and inflation goes down (the economy moves to the left along the MM line).

In the foreign sector, a higher i will attract more capital flows, making international monetary reserves go up. The money supply will then increase (the MM line shifts out), compensating (at least partially) for the initial attempt to reduce inflation pressure. Thus, the monetary authorities cannot control both the exchange rate and interest rate (and the money supply) under an open capital account.

Second, in the goods market, as i goes up, investment demand goes down; the g^d line shifts down and the rate of growth, the rate of profit, the output/capital ratio and the employment rate decrease. Stabilization is not very successful and hurts economic activity.

Fortunately, the Central Bank can decide to increase the target level for h , which will cause foreign savings to go down. The g^s line in Figure 1 will shift to the right (down) leading to faster growth, higher profit rate, and higher output/capital ratio and employment rate.

We have thus confirmed the double edged character of the real exchange rate: it is to blame for the difficulties the Central Bank faces in controlling inflation; had it had more flexibility there would have been no accumulation of international reserves. However, the ability of the Central Bank to move the real exchange rate to a targeted level, provides the economy with the possibility to reach faster growth and higher employment rates. Arguments and evidence in favor of targeting the real exchange rate may be found in Frenkel (2004) and in Frenkel and Ros (2006).

Notice also that, in addition to open market operations, the Central Bank may use other policy instruments, like an increase in the legal reserve requirement.⁴ This would reduce τ_0 in equation (15) and the MM schedule would shift down in Figure 2. This would not have a direct impact on interest rates and the Central Bank may break in this way the ‘trilemma.’⁵ This is in line with the arguments in Frenkel (2004) and in Ffrench Davis (2003), who add that capital controls may also be utilized.

2.4. Long run dynamics

We follow Cordero (1995) in analyzing the interaction between the wage share A and the real exchange rate h , which were given in the short- and medium-run. We assume that in the long run the variables that adjusted in the short-run to clear the goods market (u, g, r, l), and in the medium-run to clear the monetary sector π , remain at their equilibrium levels.

The motion of A is given by

$$\hat{A} = \hat{W} + \hat{a} - \pi \tag{16}$$

where the hats denote rate of growth. The coefficient a was defined as L/Q so we can write that

$$y = \frac{Q}{L} = \frac{1}{a}$$

where y represents average labor productivity. As in Arrow (1962) labor productivity depends on learning, which is assumed to be positively related to production, and the latter is, in turn, associated with the investment rate g (Dutt 1994):

$$\hat{y} = -\hat{a} = Y(g - \gamma), \quad Y_g > 0 \tag{17}$$

with Y_g the partial derivative of productivity growth with respect to the investment rate, and γ is an arbitrary positive number.

We assume that workers try to increase their nominal wage whenever the actual wage share falls below the level workers desire (A^W , exogenous):

$$\hat{W} = \theta[A^W - A] \tag{18}$$

Finally, the inflation rate that clears the monetary market depends on the real exchange rate and the wage share:

$$\pi_0 = \pi(h, A); \quad \pi_h < 0; \quad \pi_A < 0 \tag{19}$$

where π_h, π_A denote partial derivatives of π with respect to h and A , respectively. The dependency of π_0 on h and A comes from the presence of the equilibrium output/capital ratio u_0 in equation (15); and from the fact that this u_0 was determined in the goods market (through the interaction between g^d and g^s for given h and A).

We may now put equations (17)–(19) in (16) to get a differential equation in h and A :

$$\hat{A} = \theta[A^W - A] - Y[g(h) - \gamma] - \pi[h, A] \tag{20}$$

Next, we note that the dynamic behavior of the real exchange rate is described by:

$$\hat{h} = \hat{e} - \pi \tag{21}$$

According to (14), the nominal exchange rate moves up when the actual the real exchange rate falls below the target chosen by the Central Bank. We can now use (19) and (14) in (21) to get

$$\hat{h} = \Omega[h_T - h] - \pi[h, A] \tag{22}$$

Equations (20) and (22) form a system of two differential equations in two state variables: h, A ; the stability of the system is analyzed by means of the Jacobian matrix:

$$\text{Det}(J) = \begin{bmatrix} \frac{\partial \hat{A}}{\partial A} & \frac{\partial \hat{A}}{\partial h} \\ \frac{\partial \hat{h}}{\partial A} & \frac{\partial \hat{h}}{\partial h} \end{bmatrix} = \begin{bmatrix} (-\theta - \pi_A) & (-Y_g g_h - \pi_h) \\ -\pi_A & (-\Omega - \pi_A) \end{bmatrix}$$

The determinant is:

$$\text{Det}(J) = (\theta + \pi_A)(\Omega + \pi_h) - \pi_A(Y_g g_h - \pi_h) = \theta[\Omega + \pi_h] + \pi_A[\Omega - Y_g g_h]$$

which will be positive if $\Omega > \pi_h$ and $\Omega > Y_g g_h$. In other words, $\text{Det}(J)$ will be positive if Ω is large. The trace is $\text{Tr}(J) = -\theta - \pi_A - \Omega - \pi_h$, which will be negative if θ and Ω are large. So the long-run equilibrium will be stable if wages are flexible and the Central Bank is very committed to maintaining the real exchange rate close to the chosen target.⁶

3. The small economy under an inflation targeting regime

3.1. The inflation targeting regime

The problems of the ‘trilemma’ have generated a strong tendency to move to an inflation targeting regime and turn the exchange rate system into a flexible one. This bias, according to Epstein (2007), is part of a global change in the practice of central banking, promoted mostly by institutions like the IMF: central banking practices must be based on independence, inflation as the goal of policy (including application of inflation targeting regimes), and the use of indirect methods of monetary policy (mostly open market operations). Arestis and Sawyer (2003) relate this bias to the ‘new consensus’ macroeconomics in which inflation targets become the focus of monetary policy. In this section of the article, we want to emphasize that once this approach is adopted everything in the economy will be tied to the inflation target; the result is great success in bringing inflation down, but a rather disappointing performance in terms of growth and employment.

According to Galindo and Ros (2008) this monetary regime leads to possible appreciation of the real exchange rate, and increased vulnerability to monetary shocks coming from the external sector. In the case of Mexico, these authors show that inflation targeting has led to an appreciation of the real exchange rate, which has had a negative impact on output growth.

Epstein (2002) reports that in South Africa, this monetary system led to high interest rates, accompanied by low employment and investment rates. His recommendation is that South Africa move to a scheme in which employment is targeted, but subject to an inflation goal. He also recommends the use of capital controls in order to better control the effect of the world economy on South Africa. Setterfield (2006) also argues that governments should pursue output and employment targets, in addition to inflation goals.

Other, more general cross-country studies have found that there is no reason to keep inflation below the 3–5% range, especially because in middle income economies higher single digit rates of inflation could stimulate economic growth (Pollin and Zhu 2005). Another study conducted by Ball and Sheridan (2003), concludes that inflation targeting has generated no major benefits in economic performance (other than a decline in inflation rates). In this section we explore the implications of inflation targeting with a formal model.

3.2. Revised equations

Money market:

$$i = \Gamma(\pi); \quad \Gamma_\pi < 0; \quad \pi = p(i), \quad p_i < 0 \tag{23}$$

$$\hat{M}^s = \tau_0 - \tau_1 i \tag{24}$$

$$\hat{M}^d = \eta_1 \pi + \eta_2 u - \eta_3 i \tag{25}$$

$$\pi = \pi_T \tag{26}$$

$$\hat{M}^s = \hat{M}^d \tag{27}$$

Foreign sector:

$$B = F \tag{28}$$

$$B = B(h); \quad B_h < 0 \tag{29}$$

$$F = F(i); \quad F_i > 0 \tag{30}$$

Goods sector:

$$g^d = g^d(r, i), \quad g_r^d > 0, \quad g_i^d < 0 \tag{31}$$

$$G = g^d(r, i) - B(h) \tag{32}$$

$$S = sr \tag{33}$$

$$G = S \tag{34}$$

$$PQ = \bar{P}Q \tag{4}$$

$$r = \frac{u}{h}(1 - A) \tag{3}$$

$$l = auk \tag{6}$$

The interest rate is the instrument the Central Bank uses to control inflation (equation 23). Once an inflation target is defined in (26), open market operations bring the interest rate to the level that is needed to hit such a target. Money demand (equation 25) is very similar to the one in Section 2. Finally, and in accordance with this monetary system, we assume that the Central Bank announces an inflation target with the understanding that this goal is prior to any other objective the bank might have.

In the foreign sector there is no accumulation of international monetary reserves and, as equation (28) shows, the trade deficit is financed by net capital inflows. This is made possible by allowing the real exchange rate to fluctuate as required to satisfy expression (28).⁷

In the goods sector, the specification looks a bit different from Section 2, but it still holds the same meaning: equation (32) defines demand injections, while (33) defines domestic savings. Equations (3), (4) and (6) are borrowed from the previous section to describe prices, the rate of profit, and the employment rate.

3.3. Solution of the model

In the short-run, prices remain fixed by equation (4), and will adjust only in the medium-run (the growth of prices in the medium-run is determined by the inflation target chosen by the Central Bank). In the short-run, the burden of adjustment falls on the output/capital ratio and the real exchange rate.

Once the inflation target and the nominal interest rate are known, in the foreign sector the real exchange rate adjusts to equilibrate the balance of payments and we get:

$$h = h[i], \quad h_i < 0 \tag{35}$$

With i and h known we move to the monetary sector: equations (24), (25) and (27) provide an expression for money market equilibrium:

$$\tau_0 - \tau_1 i - \eta_1 p(i) - \eta_2 u + \eta_3 i = 0 \tag{36}$$

This equation describes a relationship between the interest rate and the output/capital ratio, and the slope is given by

$$\frac{\partial u}{\partial i} = \frac{[-\tau_1 - \eta_1 p_i + \eta_3]}{\eta_2} < 0$$

The sign of this slope results from the conditions in note 3 (Figure 3 presents the corresponding graph) and we write that:

$$u = u[i], \quad u_i < 0 \tag{37}$$

We can plug the known interest rate i_0 in (36) to find the output/capital ratio u that clears the money market. This implies that, in order to derive u , it is not necessary that savings and investment be equal: the model is overdetermined.

In order to determine the rate of profit we use (3), (35) and (37) to get:

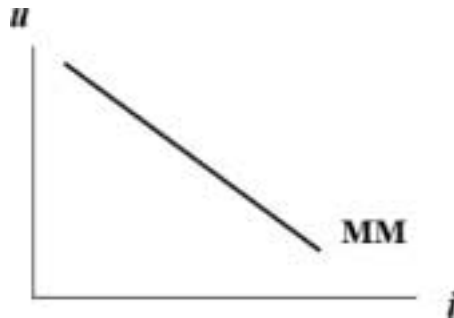


Figure 3. Money market equilibrium schedule under inflation targeting.

$$r = \frac{[u(i)]}{[h(i)]}(1 - A) \tag{38}$$

and the response of the rate of profit to changes in the interest rate is given by:

$$\frac{\partial r}{\partial i} = r_i = \frac{(1 - A)}{[h(i)]^2} [u_i h - u h_i] \tag{39}$$

We cannot define the sign of the term $[u_i h - u h_i]$, so we examine two possible cases:

$$r = r[i, (1 - A)], \quad r_i < 0, \quad r_A < 0 \tag{40a}$$

or

$$r = r[i, (1 - A)], \quad r_i > 0, \quad r_A < 0 \tag{40b}$$

Signing the derivatives of r with respect to i is very important as that will allow us to also sign the derivatives of demand injections G and domestic saving S with respect to i .

Case 1: $r_i < 0, r_A < 0$

From (32) and from (40a) we get:

$$G = g^d \{r[i, (1 - A)], i\} - B[h(i)] \tag{41}$$

and the slope of this line is

$$\frac{\partial G}{\partial i} = g_r^d r_i + g_i^d - B_h h_i < 0 \tag{42}$$

Next, from (33) and (40a) obtain:

$$S = sr[i, (1 - A)] \tag{43}$$

and the slope of the savings function is

$$\frac{\partial S}{\partial i} = sr_i < 0 \tag{44}$$

Just as in other Keynesian models, the slope of the S line has to be steeper than that of the G line in order to secure stability of equilibrium in the short run:

$$\left| \frac{\partial G}{\partial i} \right| < \left| \frac{\partial S}{\partial i} \right| \tag{45}$$

The graphical solution appears in Figure 4. In the first panel, the inflation target fixes the interest rate; then in the foreign sector (second panel) the known interest rate determines the real exchange rate. In the monetary sector (MM schedule), the interest rate determines the output/capital ratio. In the goods market, demand injections G and domestic saving S will meet at the given interest rate only by coincidence: overdetermination becomes clear here. If the interest rate is below the

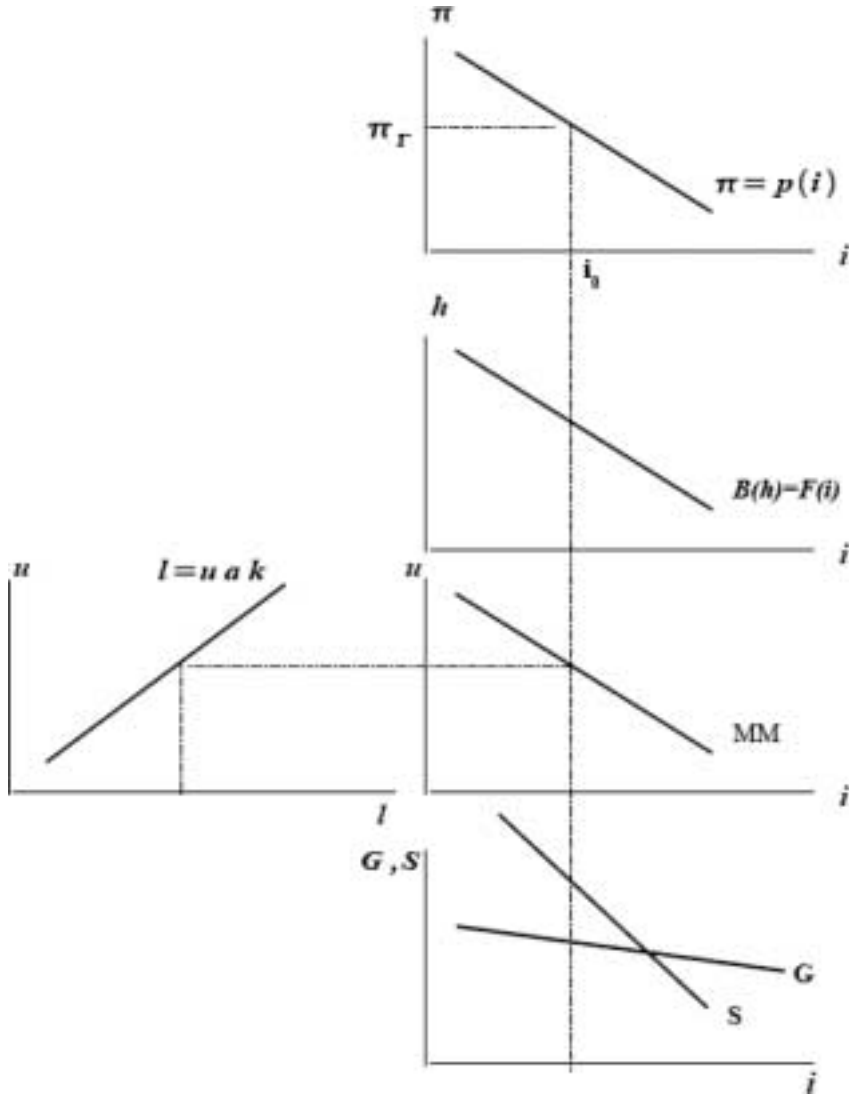


Figure 4. An open economy under inflation targeting and overdetermination in the goods sector.

one that brings G and S to equality, then the economy will be at a point on the G line. Any reduction in the inflation target (and thus increase in the interest rate) will lead to real appreciation, higher unemployment, and a lower rate of economic growth. A reduction of the inflation target will reduce the level of activity even if the interest rate is to the right of the one that makes G and S equal. As the nominal exchange rate is no longer a policy variable, the Central Bank cannot stimulate economic activity and reduce the inflation rate at the same time.

Case 2: $r_i > 0, r_A < 0$

Here the G function keeps the negative slope, but the S function will definitely have a positive slope, as shown in Figure 5.

With the interest rate at the level i_0 (which is, again, lower than the one that brings G and S to equality), the economy must be at a point on the S schedule (investors cannot satisfy their

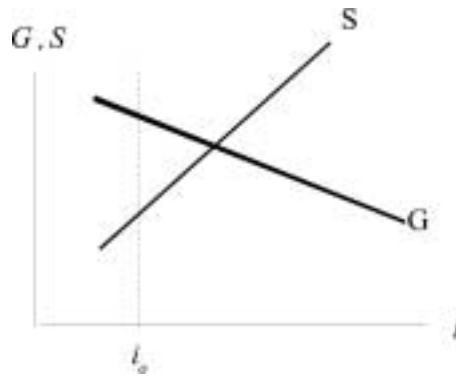


Figure 5. Overdetermination on the goods sector when savings slopes up.

desires). A reduction in the inflation target will require a rightward movement of the interest rate, with the economy moving along the domestic saving line towards the right and to a higher rate of growth. But investment desires will suffer a downward movement along the G schedule (and the G line shifts down as h falls). So as inflation falls, the investment drive also declines. Thus, in this case overdetermination causes a gap between actual and desired investment. When the given interest rate lies to the right of the level that brings domestic savings and demand injections to equality, the economy is positioned at a point on the G schedule; in this case stabilization policies lead to a lower rate of growth.

3.4. Long run dynamics

In the long run we analyze two state variables: the wage share A and the capital/labor force ratio k . The analysis is based on Cordero (2002).

The motion of A is again described by equation (16), and for the technical coefficient a we use again equation (17). For the growth of nominal wages we go back to expression (18), reproduced below

$$\hat{W} = \theta[A^W - A] \tag{18}$$

but the desired wage share now depends on the employment rate:

$$A^W = \alpha_0 + \alpha_1 \left(\frac{L}{N} \right) = \alpha_0 + \alpha_1 \left(\frac{L}{Q} \frac{Q}{K} \frac{K}{N} \right) = \alpha_0 + \alpha_1 (auk) \tag{46}$$

Finally, we recall that the local inflation rate was set by a target defined by the Central Bank, as indicated in equation (26). We may then use (17), (18), (46), (37) and (26) in (16) to get a differential equation for the evolution of A :

$$\hat{A} = \theta\alpha_0 + \theta\alpha_1 au[i]k - \theta A - Y[g - \gamma] - \pi_T \tag{47}$$

The motion of k is described by:

$$\hat{k} = \hat{K} - \hat{N}$$

where \hat{K} is the investment rate g , and \hat{N} is assumed fixed at a level denoted by n :

$$\hat{k} = g - n \tag{48}$$

In order to finish writing (47) and (48) in terms of A and k , we have to replace g with its short-run equilibrium value.⁸ Before we proceed we must generate expressions for the desired investment rate and total savings. The first of these is provided by equation (31), which, after using (40a), becomes equation (49). Next, notice that the total savings is defined as domestic savings sr plus foreign savings $[B(h)]$. This, along with (33) and (40a) leads to:

$$g^d = g^d\{r[i, (1 - A)], i\}, \quad g_r^d > 0, g_i^d < 0, r_i < 0, r_A < 0 \tag{49}$$

Total savings, however, is defined as domestic savings sr plus foreign savings $B[h]$. From (33), (40a) and our definition of foreign savings, we get

$$g^s = s\{r[i, (1 - A)]\} + B[h], \quad s > 0, \quad r_i < 0, \quad r_A < 0 \tag{50}$$

For the case depicted in Figure 4 the g level is determined by the corresponding value of g^d in equation (49).⁹

The system formed by (47) and (48) may be rewritten as:

$$\hat{A} = \theta\alpha_0 + \theta\alpha_1 au[i]k - \theta A - Y[g^d\{r[i, (1 - A)], i\} - \gamma] - \pi_T \tag{51}$$

$$\hat{k} = g^d\{r[i, (1 - A)], i\} - n \tag{52}$$

The stability of the system is analyzed by means of the Jacobian matrix:

$$\text{Det}(J) = \begin{bmatrix} \frac{\partial \hat{A}}{\partial A} & \frac{\partial \hat{A}}{\partial k} \\ \frac{\partial \hat{k}}{\partial A} & \frac{\partial \hat{k}}{\partial k} \end{bmatrix} = \begin{bmatrix} (-\theta - Y_g g_r^d r_A) & \theta\alpha_1 au[i] \\ g_r^d r_A & 0 \end{bmatrix}$$

We have:

$$\text{Det}(J) = -[g_r^d r_A][\theta\alpha_1 au[i]] > 0$$

and

$$\text{Tr}(J) = (-\theta - Y_g g_r^d r_A)$$

Since $r_A < 0$, the long-run equilibrium will be stable when nominal wage flexibility is important (θ large) compared to learning effects (Y_g). This does not mean that the economy has to stay away from productivity gains; it means instead that wage flexibility is necessary to accommodate productivity growth.

4. Concluding remarks

The most important result in this article is the recognition of the critical importance that the real exchange rate has on the determination of the rates of accumulation and employment of the small open economy. Countries that have already decided to embark on inflation targeting regimes should allow themselves to tolerate higher inflation goals to avoid excessive appreciation of the real exchange rate.

For countries which find themselves battling the difficulties of the 'trilemma' the recommendation would be to combine the use of open market operations with the legal reserve requirement or even with some control over the capital account of the balance of payments.

For the long-run, we found that, under real exchange rate targeting, equilibrium is stable if nominal wages are flexible and the Central Bank maintains a competitive real exchange rate. Under inflation targeting, the long-run equilibrium is stable if nominal wages are flexible enough to accommodate the productivity gains resulting from learning.

Notes

1. The structuralist approach is described in Taylor (1991) and in Dutt (1992).
2. In other structuralist models (Dutt 1984; Taylor 1985, for example), income distribution plays a critical role in economic growth. Blecker (1989) extended those models to examine how income distribution affects growth in an open economy. In this article, however, the investment function (our equation 2) looks more like the neo-Keynesian version used by Marglin (1984), and the flexible output/capital ratio has been taken out of the desired accumulation function. This modification prevents the wage share from having an effect on the rate of growth.
3. The adjustment mechanism may be described by: $\frac{\partial i}{\partial t} = \varphi(M^s - M^d)$, $\varphi > 0$; and this will be stable only if $\varphi(-\tau_1 + \eta_3) < 0$.
4. This was analyzed in Cordero (2005).
5. The mainstream view argues that higher levels of the reserve requirement cause higher administrative costs, and may lead to higher spreads for financial intermediation. But this is not necessarily true: in the case of Costa Rica, the reserve requirement fell from 15% in 1999 to 5% in 2002, but in the same period the spread between active and passive interest rates declined only 0.5%. Then, in 2003, when the reserve requirement jumped from 5% to 10%, the spread went up by only 1.5% (Cordero 2005).
6. The motion of k is given by: $\hat{k} = g - \hat{N}$. The short-run equilibrium level of g is: $g_0 = \bar{g}(h)$, $\bar{g}_h > 0$. Let $\hat{N} = n(k)$ with $n_k > 0$, and thus $\hat{k} = \bar{g}(h) - n(k)$. The system formed by (20) and (22) provides a solution for h , which we use to find the level of k required for $\hat{k} = 0$. The equilibrium is stable if $n_k > 0$.
7. With prices fixed in equation (4), h adjusts as a result of variations in the nominal exchange rate e .
8. Of course we also analyzed a second case which here would require that we plug (40b) in (31) for the g^d expression, and in (33) for the g^s equation. The long-run dynamics will be analogous to that of the first case, but will not be presented in the paper.
9. If the interest rate falls to the right of the level making G equal to S , then the g level is determined by the corresponding value of g^s in equation (50). Again, the dynamics of this case is analogous to the one resulting from Figure 4 and will not be analyzed here in detail.

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