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THE DYNAMIC ADJUSTMENT  
OF A TRANSITION ECONOMY  
IN THE EARLY STAGES  
OF TRANSFORMATION

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# **THE DYNAMIC ADJUSTMENT OF A TRANSITION ECONOMY IN THE EARLY STAGES OF TRANSFORMATION**

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## **ABSTRACT**

This paper develops a model of a representative transition economy to explain the stylised facts of output declines and real exchange rate appreciation in the early stages of transformation. These facts can be explained by supply-side shocks, interest rate liberalisation or a reduction in core inflation. The policy implication is that price liberalisation in advance of financial liberalization and structural reform, including widespread privatisation of the production process, necessarily results in some temporary loss of output.

*Keywords:* Transition dynamics, overshooting, competitiveness, output decline.  
*JEL Classification:* F41

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## 1. Introduction

There are three stylized facts that characterize transition economies in the early years of liberalization: a fall in output, a sudden sharp rise in inflation and a depreciation of the real exchange rate followed by a slower, steady appreciation. Table 1 shows these stylized facts for a number of Central and Eastern European transition economies in the early 1990s. The fall in output has been attributed to negative supply shocks (Borensztein, Demekas and Ostry 1993); a credit crunch (Calvo and Coricelli 1992), whereby high real interest rates were imposed on enterprises, which responded by reducing their demand for credit and production levels; a statistical exaggeration due to under-reporting of the activity of the private sector (Berg and Sachs, 1994); and the limited mobility of resources (Gomulka, 1998). The rise in inflation is usually attributed to the early liberalization of goods market prices, which rise in line with world prices following administered repression, but where output is slow to respond to the price signals, due to the slowness of the privatization process and the lack of market-oriented institutions. For example, according to the EBRD (1999), of their sample of 13 transition economies, there were only two that had not liberalized the majority of goods market prices by 1992 (Romania and Ukraine), whereas only five had liberalized their financial sectors by 1995 (Czech Republic, Hungary, Poland, Slovakia and Slovenia). The depreciation and subsequent appreciation of the real exchange rate during transition is similarly explained by Halpern and Wyplosz (1997) as due to the initial inflation shock followed by a gradual rise in productivity. This pattern is less clear from Table 1, partly due to currency changes, which make consistent data difficult to obtain in the initial transition phase, but also due to sharp changes in exchange rate policy<sup>1</sup> and the different speeds of transition. For countries such as the Czech Republic, Poland, Romania and Slovakia, however, the depreciation-appreciation pattern is apparent in Table 1.

This paper attempts to provide a theoretical rationale for these stylized facts by setting out an aggregate model of a representative transitional economy. The model is

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<sup>1</sup> The principal transition economies initially operating a flexible exchange rate policy included: Bulgaria, Lithuania, Moldova, Romania, Russia, Slovakia, Slovenia, Ukraine, with Hungary and Poland having crawling pegs. However, the Czech Republic switched from a pegged rate to a managed float in 1997, Lithuania and Bulgaria switched to a currency board in 1994 and 1997 respectively and Poland moved to a flexible rate in 2000.

characterized by flexible goods prices, together with sticky money wages and unemployment so an upward-sloping aggregate supply curve is maintained. Moreover, the model has an underdeveloped financial sector in which the central bank sets the short-term interest rate and there are few private capital inflows, which although not necessarily legally restricted, are limited by fragile and thin financial markets, which carry a high-risk premium for international investors. Domestic residents can, however, use foreign money for domestic transactions as a means of hedging against high inflation as well as the economic instability and uncertainty that are characteristic of the early stages of the transition process. This approach follows Calvo and Rodriguez (1977), Frenkel and Rodriguez (1982) and more recently, Calvo and Frenkel (1991), in that the emphasis is on the thinness of capital markets and currency substitution as the most appropriate features of the financial markets.

This model enables the dynamic effects of three specific ‘liberalization shocks’ to be considered by examining the effects of once-and-for-all changes in three exogenous variables. The ERBD (2001) shows that banking sector reform has taken place since the mid-1990s. This is captured in the model by a rise in the nominal interest rate, reflecting the liberalization of the financial sector as financial repression is eased (see McKinnon, 1973). The EBRD (2001) also shows a gradual increase in small and large-scale privatizations, which we capture by considering a rise in the real wage rate, indicative of a more flexible supply-side. The third shock that we consider is a reduction in core inflation, which has been a common aim of macroeconomic policy in the transition economies since the high rates of inflation in the early 1990s and is consistent with the inflation record of these economies shown in Table 1.

The rest of the paper is set out as follows. The model is set out in Section 2, followed by the general solution to the model (Section 3). Section 4 examines the dynamics of the three liberalization shocks noted above and Section 5 offers a brief conclusion.

## **2. The Model**

The analysis relies on a dynamic macroeconomic model, which attempts to capture some of the basic characteristics of a typical transition economy in the early stages of transformation. In particular, by allowing the use of foreign currency holdings for domestic transactions - some currency substitution is permitted, while

interest rates are still set by the state. In the real sector, the analysis assumes the price of domestic output to adjust much faster to any excess demand than output. This assumption turns out to be important for the dynamics of the system. It relies on the empirical observation that while price liberalization occurred almost immediately in most economies, structural change proceeded gradually, reflecting the nature of such processes, as well as limiting the flexibility of product and labor markets and thus constraining the response of the real sector to relative price changes<sup>2</sup>. Finally, the economy is assumed to operate below full employment.

In the goods market, real demand for domestic output depends directly upon the level of real income, the real interest rate and the real exchange rate. That is,

$$z = \mathbf{g}y - \mathbf{s}(\bar{r} - \mathbf{p}) + \mathbf{q}c \quad (1)$$

where the variables of the model are expressed in logarithmic form and

$z$  = real aggregate demand,

$y$  = the real volume of domestic output,

$\bar{r}$  = the short-term, nominal interest rate (not in logs), taken to be fixed,

$c = p^* + e - p$  = the relative price of foreign to domestic goods,

$p$  = the price of domestic output,

$e$  = the current exchange rate, measured in units of domestic currency per unit of foreign currency,

$p^*$  = the foreign price level,

$\mathbf{p} \equiv \dot{p}$  = the rate of inflation of  $p$ .

The nominal, short-term interest rate is assumed to be largely determined by the central bank, reflecting the fact that the financial system is not yet fully liberalized and that market-forces play little role in determining nominal interest rates. It is therefore assumed that the long and the short rate can be treated as identical due to the underdeveloped capital markets and financial sector. Thus there is no term structure of interest rates and the same interest rate enters the aggregate demand for goods function as the money-demand functions.

The financial sector consists of two liquid assets - domestic money,  $h$  and foreign money,  $h^*$ . Domestic residents are assumed to hold both assets. The demand for

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<sup>2</sup> As a matter of fact the limited resource mobility to massive changes in relative prices constituted one of the reasons for the slow output recovery according to Gomulka (1998).

domestic money depends positively on real income,  $y$ , and the domestic cost of living,  $q$ , and inversely on the expected depreciation of the local currency,  $E\dot{e}$ , and the nominal interest rate,  $\bar{r}$ . In this model the expected depreciation of the home currency in the demand for money function reflects the fact that domestic residents may also hold foreign currency for transactions or precautionary purposes in the presence of domestic inflation. Thus domestic money market equilibrium is given by:

$$h = q + \mathbf{a}'y - \mathbf{b}'E\dot{e} - \mathbf{d}'\bar{r} \quad (2a)$$

where  $E\dot{e}$  is the expected rate of exchange depreciation and  $q = sp + (1-s)(p^* + e)$  the domestic cost of living, where  $s$  is the share of domestic production in total demand.

The domestic demand for foreign currency (measured in terms of home currency) is assumed to depend directly on the domestic cost of living, real income, the expected depreciation of the home currency and the nominal interest rate that is

$$(e + h^*) = q + \mathbf{a}^*y + \mathbf{b}^*E\dot{e} - \mathbf{d}^*\bar{r} \quad (2b)$$

Combining (2a) and (2b), and assuming perfect foresight, such that  $E\dot{e} = \mathbf{e}$ , where  $\mathbf{e}$  is the actual rate of depreciation, we obtain:

$$(h - h^* - e) = \mathbf{a}y - \mathbf{b}\mathbf{e} - \mathbf{d}'\bar{r} \quad \mathbf{a} > 0, \mathbf{b} > 0, \mathbf{d} > 0 \quad (2)$$

defining  $\mathbf{a} = \mathbf{a}' - \mathbf{a}^*$ ,  $\mathbf{b} = \mathbf{b}' + \mathbf{b}^*$  and  $\mathbf{d} = \mathbf{d}' - \mathbf{d}^*$ . The fact that,  $\mathbf{a} > 0$  and  $\mathbf{d} > 0$  implies that the income and interest elasticities of the demand for domestic money exceed the corresponding elasticities for the domestic demand for foreign money<sup>3</sup>. Equation (2) indicates that asset holders are willing to absorb a higher ratio of domestic to foreign currency holdings, if real domestic income rises, if the expected rate of depreciation falls or if the nominal interest rate falls. Equation (2) is the relation for financial market equilibrium, with  $\mathbf{b}$  indicating the degree of currency substitution, which closely resembles the specification used by Calvo and Frenkel (1991)<sup>4</sup>.

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<sup>3</sup> The interest rate elasticity is likely to be positive since the preferred-habitat hypothesis suggests that domestic assets are more responsive to domestic yields than foreign assets. Note, however, that this is primarily an empirical matter. There is very little empirical evidence appertaining to the likely values of these elasticities in transitional economies. If industrial countries can be used as a guide, then Bordo and Choudhri (1982) find that for Canada  $\mathbf{a}$  lies between 0.5 and 0.7 and  $\mathbf{d}$  between 10.5 and 11.5. Lahiri (1992) finds  $\mathbf{a} > 0$  for Yugoslavia, all of which confirm the signs postulated in this paper.

<sup>4</sup> According to Sahay and Vegh (1996), currency substitution captures the use of a foreign currency as a means of exchange relative to domestic currency and in that sense is measured by the opportunity cost of both currencies. Uribe (1997) and Mongardini and Mueller (2000) emphasise the importance of ratchet effects in currency substitution. These effects are not included here for tractability.

On the supply-side of the economy, it is assumed that money wages are set exogenously, but that on the demand-side labor is employed until the marginal revenue product is equal to the money wage rate. Thus the supply of output depends inversely on the real wage rate. That is,

$$y = -\mathbf{n}(w - p) \quad (3a)$$

where,  $w$  = nominal wage. By adding and subtracting the cost of living,  $q$ , equation (3a) can be expressed as,

$$y = -\mathbf{n}\bar{w} - \mathbf{t}c \quad (3)$$

where,  $\bar{w} \equiv w - q$  is the real consumption wage and  $\mathbf{t} \equiv \mathbf{n}(1 - s) > 0$ . In the analysis that follows we assume that the real consumption wage is fixed, implying that the nominal wage is set in such a way as to keep the real wage constant.

The last static equation represents the determinants of expected inflation in  $p$ . Expected inflation is assumed to be the same as actual inflation,  $\mathbf{p}$ , by perfect foresight expectations, and directly related to excess demand in the goods market plus some exogenous rate of core inflation,  $\bar{\mathbf{p}}$ , hence

$$\mathbf{p} = \mathbf{f}(z - y) + \bar{\mathbf{p}} \quad (4)$$

where  $\mathbf{f} \geq 0$  denotes the speed of adjustment of inflation expectations to excess demand in the goods market<sup>5</sup>.

The dynamic part of the model consists of three equations:

$$\dot{c} = \mathbf{p}^* + \mathbf{e} - \mathbf{p} \quad (5a)$$

$$\dot{h} = \mathbf{m} \quad (5b)$$

$$\dot{h}^* = \mathbf{h}(y - z) \quad (5c)$$

Equation (5a) describes the evolution of the relative price,  $c$ . Equation (5b) states that the rate of growth of the domestic money supply is fixed and equal to  $\mathbf{m}$ . Finally, Equation (5c) states that the rate of accumulation of foreign money reflects the extent of excess supply in the goods market. That is, the current account surplus reflects the increase in the foreign currency holdings of the public, i.e. the capital account deficit (see, for example, Wilson, 1992).

By specifying the ratio of domestic to foreign money as,  $m \equiv h - h^* - e$ , the model consisting of equations (1), (2), (3), (4) and (5), can be summarized as,

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<sup>5</sup> A better specification for expected inflation should refer to the cost of living. This, however, would complicate the analysis without altering the results in any essential way.

$$z = \mathbf{g}y - \mathbf{s}(\bar{r} - \mathbf{p}) + \mathbf{q}c \quad (6a)$$

$$m = \mathbf{a}y - \mathbf{b}e - d\bar{r} \quad (6b)$$

$$y = -n\bar{w} - tc \quad (6c)$$

$$\mathbf{p} = \mathbf{f}(z - y) + \bar{\mathbf{p}} \quad (6d)$$

$$\dot{c} = \mathbf{p}^* + \mathbf{e} - \mathbf{p} \quad (6e)$$

$$\dot{m} = \mathbf{m} - \mathbf{h}(y - z) - \mathbf{e} \quad (6f)$$

Equation (6f) is obtained by taking the time derivative of the definition of  $m$  and then substituting from (5b) and (5c). Turning to the evolution of the system, we assume that at all points other than those where the exchange rate undergoes jumps in response to unanticipated disturbances, the real exchange rate and the ratio of domestic to foreign money evolve continuously and can be taken as predetermined. The four equations (6a)-(6d) yield the short-run solutions for the four variables  $z, y, \mathbf{e}, \mathbf{p}$  in terms of  $c$  and  $m$ . Substituting these solutions into (6e) and (6f), the dynamic adjustment of the system is determined.

The steady-state equilibrium, denoted by tildes, is reached by setting  $\dot{c} = \dot{h} = \dot{h}^* = 0$ , implying

$$\tilde{y} = \tilde{z} \quad (7a)$$

$$\mathbf{m} = \tilde{\mathbf{e}} = \tilde{\mathbf{p}} = \bar{\mathbf{p}} \quad (7b)$$

Note from equation (7b), that core inflation reflects the long-run rate of growth in the money supply. More specifically, the long-run equilibrium values for  $\tilde{c}, \tilde{m}$  and  $\tilde{y}$  are:

$$\tilde{y} = -\frac{nq}{J}\bar{w} + \frac{ts}{J}\bar{\mathbf{p}} - \frac{ts}{J}\bar{r} \quad (8a)$$

$$\tilde{c} = -\frac{n(1-g)}{J}\bar{w} - \frac{s}{J}\bar{\mathbf{p}} + \frac{s}{J}\bar{r} \quad (8b)$$

$$\tilde{m} = -\frac{naq}{J}\bar{w} - \left(d + \frac{tas}{J}\right)\bar{r} - \left(b - \frac{tas}{J}\right)\bar{\mathbf{p}} \quad (8c)$$

where,  $J = t(1-g) + q > 0$ .

### 3. The General Solution of the System

In order to determine the evolution of the economy over time, we must first solve the static equations (6a)-(6d) for the short-run solutions of  $z, y, \mathbf{e}$  and  $\mathbf{p}$ . These solutions are given by the following expressions:

$$z = \frac{[q - t(g - sf)]}{\Delta} c - \frac{n(g - sf)}{\Delta} \bar{w} - \frac{s}{\Delta} \bar{r} + \frac{s}{\Delta} \bar{p} \quad (9a)$$

$$e = -\frac{ta}{b} c - \frac{na}{b} \bar{w} - \frac{1}{b} m - \frac{d}{b} \bar{r} \quad (9b)$$

$$p = \frac{f[q + t(1 - g)]}{\Delta} c + \frac{nf(1 - g)}{\Delta} \bar{w} - \frac{sf}{\Delta} \bar{r} + \frac{1}{\Delta} \bar{p} \quad (9c)$$

$$y = -tc - n\bar{w} \quad (9d)$$

where  $\Delta \equiv (1 - sf)$ , which is taken to be positive. Substituting (9a)-(9d) into (6e) and (6f), the dynamics of the economy are derived. In particular, the two roots are,

$$I_1 = -(f - h)[t(1 - g) + q]/\Delta < 0, \text{ and } I_2 = \frac{1}{b} > 0 \text{ which means that the equilibrium}$$

is a saddlepoint<sup>6</sup>. For  $I_1 < 0$ , the speed of the response of product market prices is greater than the response of the money supply to any excess demand. Note that the gradual response of the money supply is the result of the slow adjustment of the output market. The stable locus, which is derived using the stable root, is negatively sloped and represented by the line SL in Figure 1.

For the system to remain stable,  $m$  and  $c$  must always be on the stable arm. Any disturbance that causes the line SL to shift also leads to instantaneous jumps in  $m$  and  $c$  that allow the system to move to the new equilibrium. These jumps are due to a discontinuous adjustment in the exchange rate since prices are assumed to adjust sluggishly to clear the goods market. According to the definitions of  $m$  and  $c$ , the jumps in these variables are described by,

$$dc = de \quad (10a)$$

$$dm = -de \quad (10b)$$

from which it follows that,  $dm/dc = -1$ . This equation captures the direction along which the instantaneous jump from one stable locus to another takes place. It is illustrated by the negatively sloped line XX in Figure 1. Note that the slope of the stable locus, as shown in Figure 1, SL, is flatter than the XX line.

From the stable locus and the definitions in (10a) and (10b) we can derive an equation connecting changes in the exchange rate to changes in  $\bar{w}$ ,  $\bar{r}$  and  $\bar{p}$ , which represent the three disturbances under consideration, that is:

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<sup>6</sup> The detailed derivations are available from the authors on request.

$$de = \frac{1}{I_2} \left( \left\{ \frac{g_{21}n(1-g)}{J(1-bI_1)} + \frac{naq}{bJ} \right\} d\bar{w} - \left\{ \frac{s}{J} \left( I_1 + \frac{fJ}{\Delta} \right) - \frac{d}{b} \right\} d\bar{r} + \left\{ 1 + \frac{s}{J} \left( I_1 + \frac{fJ}{\Delta} \right) \right\} d\bar{p} \right) \quad (11)$$

where  $g_{21} = (ta/b) + (h(t(1-g) + q))/\Delta > 0$ .

Equation (11), together with the relations (10a) and (10b) and the short-run solutions given by (9a)-(9d), form the basis for our analysis regarding the impact of the three disturbances.

## 4. Disturbances

There are three disturbances to consider: a rise in the real wage, characteristic of price liberalisation and increased privatisation of the productive sector; a rise in the short term rate of interest, characteristic of financial sector liberalisation; and a reduction in the core rate of inflation, brought about by a fall in the rate of monetary growth, characteristic of a stability-oriented monetary policy<sup>7</sup>.

### 4.1 An increase in the real wage

A supply shock can be represented by a change in the real consumption wage,  $\bar{w}$ . A rise in the real wage rate, relative to the marginal product of labour, will lower competitiveness, output and the money stock. From equations (8a)-(8c), the increase in the real wage reduces domestic output which, in turn, requires a real exchange rate appreciation to equilibrate the product market. Furthermore, the output decline generates an excess supply in the money market, which requires a fall in the domestic to foreign money ratio.

The initial effect of the rise in the real wage will be to cause an immediate depreciation of the exchange rate, since from (11),  $(de_0/d\bar{w}) > 0$  where the subscript 0 refers to the initial impact effect. This, in turn, from (10a) and (10b), implies

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<sup>7</sup> The effect of changing the currency substitution parameter,  $b$ , because it affects the slope of the stable locus, may alter the impact on the model of each of the three disturbances. The results derived, however, do not give unambiguous results, making the impact of a higher  $b$  minimal. For example, consider the effect of a fall in  $m$  on  $c$  (the real exchange rate) under the assumption of a larger  $b$ . The fall in  $m$  generates an excess demand for money, which with a higher value of  $b$  means a smaller increase in the rate of depreciation needed to clear the money market. At the same time, the rise in domestic inflation will also be less since output does not have to fall by as much, because the rise in the rate of depreciation absorbs most of the excess demand in the money market. Thus these two forces work in opposite directions making the impact of a larger  $b$  on the slope of the stable locus qualitatively ambiguous and probably minimal.

$$\frac{dc_0}{d\bar{w}} = -\frac{dm_0}{d\bar{w}} = \frac{de_0}{d\bar{w}} > 0 \quad (12)$$

which means that there is an improvement in competitiveness and a fall in the domestic to foreign money ratio. The initial jumps in  $c$  and  $m$  affect the short-run equilibrium variables of the system  $z, y, e$  and  $p$ . Thus, by taking the differentials of (9a)-(9d) and using (12), we obtain

$$\frac{dy_0}{d\bar{w}} = -\mathbf{n} - \mathbf{t} \frac{de_0}{d\bar{w}} < 0 \quad (13a)$$

$$\frac{dz_0}{d\bar{w}} = -\frac{\mathbf{n}(\mathbf{g} - \mathbf{s}\mathbf{f})}{\Delta} + \frac{[\mathbf{q} - \mathbf{t}(\mathbf{g} - \mathbf{s}\mathbf{f})]}{\Delta} \frac{de_0}{d\bar{w}} \quad (13b)$$

$$\frac{de_0}{d\bar{w}} = -\frac{\mathbf{n}\mathbf{a}}{\mathbf{b}} + \frac{(1 - \mathbf{t}\mathbf{a})}{\mathbf{b}} \frac{de_0}{d\bar{w}} \quad (13c)$$

$$\frac{dp_0}{d\bar{w}} = \frac{\mathbf{n}\mathbf{f}(1 - \mathbf{g})}{\Delta} + \frac{\mathbf{f}\mathbf{J}}{\Delta} \frac{de_0}{d\bar{w}} > 0 \quad (13d)$$

The impact of the rise in the real wage is illustrated in Figure 1. The effect of the initial depreciation in the exchange rate is to shift the stable locus down to  $SL_1$ . The system moves from the initial steady state at point A, along the XX line to B, which corresponds to the new short-run equilibrium, where according to (12)  $m$  is lower and  $c$  is higher at  $m_1$  and  $c_1$  respectively. Then, from point B,  $c$  falls and  $m$  increases as the system converges along the  $SL_1$  locus to the new steady state equilibrium at C.

In the short-run, the direct effect of an increase in the real wage is to reduce domestic output. At the same time, the fall in the demand for domestic goods, due to the fall in real income, leads to a real depreciation and with the price of domestic output given instantaneously, this is achieved through an immediate depreciation of the nominal exchange rate. This relative price effect, on the one hand, tends to offset the impact of a lower output on aggregate demand, while on the other hand, by enhancing the output fall, indirectly affects aggregate demand inversely. The fall in output leads to higher inflation through the Phillips curve and this has a positive impact on aggregate demand through a lower real interest rate. Thus, it appears that, while in the short-run the output fall is in excess of the long-run decline, due to real depreciation, the overall impact on aggregate demand is ambiguous. As a result, a short-run excess demand for domestic output is generated, which corresponds to a current account deficit. In the money market, the decline in output lowers demand while the exchange rate depreciation, by reducing the ratio of domestic to foreign

money, decreases supply. This, in turn, means that the rate of exchange depreciation may or may not increase in order to secure equilibrium in the money market.

The adjustment period is associated with rising prices and expanding domestic to foreign money ratio, both reflecting the excess demand for domestic output. The fact that prices respond faster than the money supply to excess demand contributes to real appreciation of the exchange rate during adjustment. The fall in competitiveness leads to output recovery while simultaneously reducing demand. The adjustment process continues until the current account deficit is eliminated and the new long-run equilibrium is achieved, with lower levels for output and competitiveness.

#### 4.2 An increase in the interest rate

The increase in the short-term interest rate, as seen from (8a)-(8c), lowers money demand leading to a fall in the domestic to foreign currency ratio. It also leads to a fall in the demand for domestic output and as a result equilibrium in the goods market requires an improvement in competitiveness.

In the short run, a rise in the interest rate leads to an immediate depreciation of the exchange rate overshooting its long-run equilibrium. From equation (11) it follows that  $(de_0/d\bar{r}) > 0$  where, as before, the subscript 0 refers to the initial impact effect. Then, from (10a) and (10b) it follows that

$$\frac{dc_0}{d\bar{r}} = -\frac{dm_0}{d\bar{r}} = \frac{de_0}{d\bar{r}} > 0, \quad (14)$$

which means that the rise in the interest rate also leads to an improvement in competitiveness and to a decrease in the domestic to foreign money ratio.

Then, by taking the differentials of (9a)-(9d) and using (14), we deduce the following effects on the short-run equilibrium variables of the system

$$\frac{dy_0}{d\bar{r}} = -t \frac{de_0}{d\bar{r}} < 0 \quad (15a)$$

$$\frac{dz_0}{d\bar{r}} = -\frac{s}{\Delta} + \frac{[q - t(g - sf)]}{\Delta} \frac{de_0}{d\bar{r}} \quad (15b)$$

$$\frac{de_0}{d\bar{r}} = -\frac{d}{b} + \frac{(1 - ta)}{b} \frac{de_0}{d\bar{r}} \quad (15c)$$

$$\frac{dp_0}{d\bar{r}} = -\frac{sf}{\Delta} + \frac{fJ}{\Delta} \frac{de_0}{d\bar{r}}. \quad (15d)$$

The impact of the rise in the rate of interest is also illustrated in Figure 1. The effect of the initial depreciation in the exchange rate is to again shift the stable locus down to position  $SL_1$ . The system moves from the initial steady state at point A, along the XX line to point B, which is the new short-run equilibrium. Then, during the adjustment process  $c$  begins to fall and  $m$  to increase as the system moves towards the new steady-state equilibrium at point D.

In the short-run, the rise in the interest rate reduces the demand for domestic money and domestic output. The fall in aggregate demand causes an immediate depreciation of the exchange rate which, given the slow adjustment in the price of domestic output, corresponds to a real depreciation. The real depreciation, in turn, leads to a fall in domestic output. Thus, while output falls, the impact on aggregate demand appears ambiguous. We postulate, however, that a short-run excess demand for domestic output is the more likely outcome leading also to higher inflation. Turning to the financial sector, the depreciation of the exchange rate, by lowering the domestic to foreign currency ratio, is more likely to generate an excess demand, which means that it more than offsets the impact of a higher interest rate and lower output. As a result, the expected depreciation of the exchange rate will increase in order to restore equilibrium.

Both the price level and the domestic to foreign currency ratio are rising during the adjustment process. The increase in the price of domestic output leads to lower competitiveness, which, by stimulating output and reducing demand, starts eliminating the current account deficit. As a result, the rate of inflation and the rate of exchange depreciation begin falling until they become equal to the core inflation, which reflects the rate of the exogenously given rate of monetary expansion. The adjustment continues until the system converges to the new long-run equilibrium at point D in Figure 1.

### *4.3 A decrease in core inflation*

A decrease in the core rate of inflation reflects a decline in the rate of growth of the money supply, which is representative of macroeconomic stabilisation. In the long run, according to (8a)-(8b), the decline in the core inflation lowers demand for domestic output, which means that an improvement in competitiveness is required to restore equilibrium. The real depreciation, in turn, reduces domestic output. Thus, a

policy to reduce the rate of core inflation will again have a deleterious effect on output, although the economy will become more competitive. In the money market, according to equation (7b), the fall in core inflation leads to an equivalent decline in the rate of depreciation. This increases demand while the fall in output has the opposite effect. We postulate, however, that the former impact prevails and thus the domestic to foreign currency ratio rises.

The decline in core inflation leads to instantaneous appreciation of the exchange rate. Again, using equation (11), we see that  $(de_0/d\bar{p}) > 0$  and then, from (10a) and (10b) we obtain

$$\frac{dc_0}{d\bar{p}} = -\frac{dm_0}{d\bar{p}} = \frac{de_0}{d\bar{p}} > 0 \quad (16)$$

which reflects lower competitiveness and a higher domestic to foreign money ratio. Now, for the short-run equilibrium variables of the system, by taking the differentials of (9a)-(9d) and using (16), we derive

$$\frac{dy_0}{d\bar{p}} = -t \frac{de_0}{d\bar{p}} < 0 \quad (17a)$$

$$\frac{dz_0}{d\bar{p}} = \frac{s}{\Delta} + \frac{[q - t(g - sf)]}{\Delta} \frac{de_0}{d\bar{p}} > 0 \quad (17b)$$

$$\frac{de_0}{d\bar{p}} = \frac{(1 - ta)}{b} \frac{de_0}{d\bar{p}} > 0 \quad (17c)$$

$$\frac{dp_0}{d\bar{p}} = \frac{1}{\Delta} + \frac{fJ}{\Delta} \frac{de_0}{d\bar{p}} > 0 . \quad (17d)$$

As illustrated in Figure 2, the initial appreciation in the exchange rate shifts the stable locus to the right to  $SL_1$ . The system moves from the initial steady state at point A, along the XX line to the short-run equilibrium at B. Then,  $c$  starts depreciating and  $m$  falling so that new steady state equilibrium is reached at point C.

In the short-run, a fall in core inflation, brought about by a lower rate of growth of the money supply, leads to an immediate appreciation of the exchange rate. This corresponds to lower competitiveness since the price of domestic output adjusts sluggishly. The decline in relative prices leads to an increase in domestic output. The demand for domestic output, however, falls due to the higher real interest rate and lower competitiveness, although the increase in output works in the opposite direction. As a result, the fall in core inflation generates an excess supply in the domestic output market. In the money market, the exchange rate appreciation

increases supply, while the higher output raises demand. We postulate that the former effect prevails and thus the rate of exchange depreciation must decrease in order to restore equilibrium.

The excess supply in the market for domestic output brings about a fall in the price of domestic output as well as in the domestic to foreign money ratio during the adjustment period. The depreciation in the real exchange rate that follows removes the current account surplus. The new long-run equilibrium at point C in Figure 2 corresponds to a situation of lower output and improved competitiveness.

## **5. Conclusions**

In this paper we have used an aggregate dynamic macroeconomic model in order to explain some of the stylized facts that have characterized transition economies in the early stages of the transformation process. The analysis has incorporated some of the basic features of the particular economies such as the potential existence of currency substitution as well as the rapid price liberalization, as compared to the slower pace of financial and industrial sector reforms. Thus the liberalization of interest rates, the reduction of core inflation and the rise in real wages all serve to reduce output in the early stages of the transition process. The reason for this initial fall in output is an assumed lack of long-term inward investment and the slowness of the supply-side reforms - due to the need for the creation of market-orientated institutions - to bring about productivity gains to raise output.

Furthermore, in the cases of a rise in the real wage and financial liberalization the adjustment period is characterised by real exchange rate appreciation. This result is in line with the actual experience of most transition economies (Halpern and Wyplosz, 1997), and in this model is due to falling competitiveness as goods market prices respond faster than output to excess demand in the product market. This reflects the fact that price liberalisation is relatively easy and quick to undertake, whereas structural reform is much more complex and effective only after a considerable time delay. This analysis suggests that, notwithstanding sufficient structural reform, the rapid price liberalization has a depressing influence on output in transition economies.

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**Table 1**  
**Inflation, Output Growth and Real Exchange Rate Changes in Selected**  
**Transition Economies 1990-96 (% per annum)**

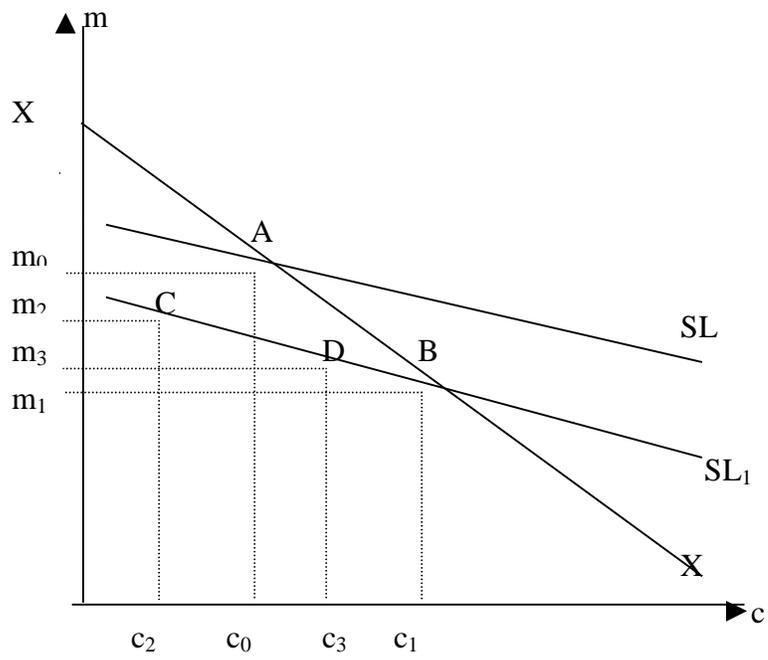
Country	1990	1991	1992	1993	1994	1995	1996
<b>Albania</b>							
Inflation		104	237	31	16	6	20
Growth	-10	-28	-10	11	9	9	5
Competitiveness <sup>1</sup>				-24.6	-22.4	-6.6	2.9
<b>Bulgaria</b>							
Inflation		339	79	64	122	33	165
Growth	-9	-12	-7	-2	2	3	-4
Competitiveness				53.7	-8.9	12.3	-14.2
<b>Czech Republic</b>							
Inflation		52	13	18	10	8	9
Growth	0	-14	-6	-1	3	5	5
Competitiveness		-7.6	4.6	16.3	5.1	3.4	6.7
<b>Hungary</b>							
Inflation		32	22	21	21	28	22
Growth	-4	-12	-3	-1	3	2	2
Competitiveness	3.7	10.4	8.8	8.8	-1.0	-4.0	2.8
<b>Poland</b>							
Inflation		60	44	38	29	22	19
Growth	-12	-7	3	4	5	7	5
Competitiveness	-15.9	56.5	6.4	7.3	1.0	8.2	8.8
<b>Romania</b>							
Inflation		223	199	296	62	28	60
Growth	-6	-13	-9	1	4	7	5
Competitiveness	-32.5	-6.9	-38.2	38.7	7.5	-2.2	-9.6
<b>Slovakia</b>							
Inflation		58	9	28	12	7	6
Growth	-3	-15	-7	-4	5	7	6
Competitiveness		-3.0	1.7	5.5	1.0	2.8	-0.3
<b>Slovenia</b>							
Inflation		247	93	23	18	9	10
Growth	-5	-8	-5	1	5	4	3
Competitiveness <sup>1</sup>				8.8	-2.6	-16.0	7.1

Sources: Inflation is end of year rate, from the EBRD *Transition Report*, 1999.

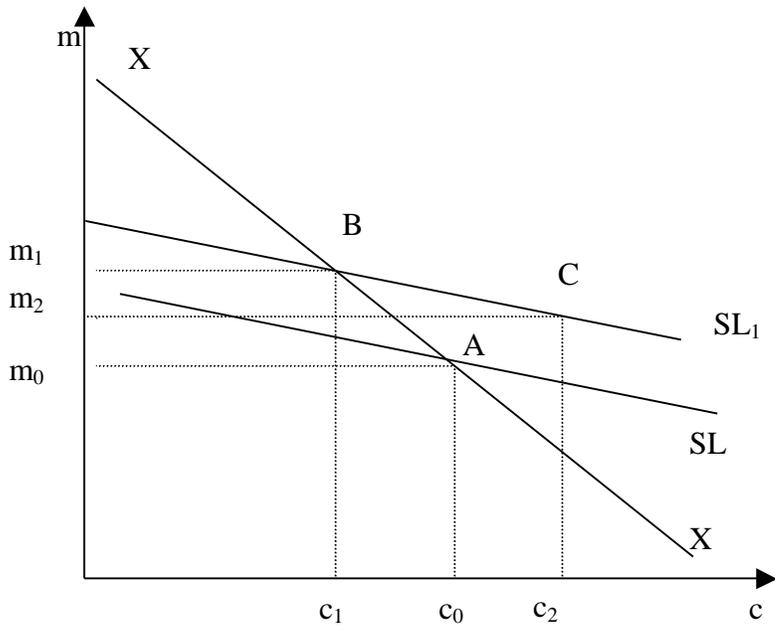
Growth is the growth of real output, from the EBRD *Transition Report*, 1999.

Competitiveness is from *International Financial Statistics*, Annual Yearbook, 2001, real effective exchange rate (line rec).

Competitiveness<sup>1</sup> is calculated from *International Financial Statistics*, Annual Yearbook, 2001 using the ratio of the US consumer price index multiplied by the average local dollar exchange rate to the local CPI, where no series is recorded for the real effective exchange rate.



**Figure 1. Model dynamics: real wage and interest rate shocks**



**Figure 2. Model dynamics: a reduction in core inflation**