WPS 1234

POLICY RESEARCH WORKING PAPER 1234

Price Formation, Nominal Anchors, and Stabilization Policies in Hungary

An Empirical Analysis

There is a tradeoff between faster disinflation and external competitiveness in Hungary's open economy, in which the exchange rate is used as a nominal anchor in disinflation.

Andrés Solimano
David E. Yuravlivker

The World Bank
Policy Research Department,
Macroeconomics and Growth Division
and
Europe and Central Asia,
Country Department II,
Country Operations Division
December 1993

POLICY RESEARCH WORKING PAPER 1234

Summary findings

Solimano and Yuravlivker empirically explore the inflationary process in Hungary. Using monthly data, they provide econometric estimates of the determinants of inflation for 1990-92.

Empirical estimates of price equations — both consumer price index (CPI) and producer price index (PPI) — show the exchange rate's quantitative importance and statistical significance in price formation in Hungary during the period of intensified reform as the economy became more open to international trade in both inputs and final goods.

Their estimates show that the money supply affects consumer and producer prices with several lags; its impact on prices is small in the short run. Nominal wages have a more significant effect on the CPI than on the PPI.

Solimano and Yuravlivker present policy simulations of alternative rules for the exchange rate and the money supply and their effect on the rate of inflation and the level of the real exchange rate. They find that a rule of fixing the exchange rate entails a lower level of CPI inflation — 5 percentage points less of CPI inflation a year — than if the rule is based only on reducing the rate of money growth (to 1 percent a month).

But a fixed exchange rate policy is associated with greater appreciation of the real exchange rate than is the policy of money-based disinflation — nearly 4 percentage points more real appreciation a year. A PPP-based exchange rate rule stabilizes the real exchange rate at the cost of a substantial acceleration in inflation.

These exercises illustrate the nature and magnitude of the tradeoffs between faster disinflation and the level of external competitiveness in an open economy such as Hungary that uses the exchange rate as a nominal anchor in disinflation.

This paper — a joint product of the Macroeconomics and Growth Division, Policy Research Department, and Europe and Central Asia, Country Department II, Country Operations Division — is part of a larger effort in the Bank to study the macroeconomics of transition. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Susana Florez, room N11-018, extension 39075 (36 pages). December 1993.

Price Formation, Nominal Anchors, and Stabilization Policies in Hungary. An Empirical Analysis.*

By

Andrés Solimano
(PRDTM)

and

David E. Yuravlivker
(EC2CO)

* Helpful comments by Alan Gelb, Michel Noel, Mark Stone, Artur Szentgyorgyvari and and Imre Tarafas to a first draft of this paper are appreciated.

* We acknowledge the efficient assistance from Bruce Courtney and Raimundo Soto in the preparation of this paper.

TABLE OF CONTENTS.

1. Introduction.

Economic stability is a key pre requisite for further progress in structural transformation in transition economies. Low and predictable inflation is important to assure that market signals do convey relevant economic information on relative scarcities in the economy so to properly guide resource allocation decisions. Moreover, recent research is showing a high sensitivity of investment to different measures of economic instability, chiefly the rate of inflation[1]. Then not only static resource allocation but also capital formation and growth can be adversely affected by inflation. In this perspective, a better understanding of the nature of the inflationary process and the policy choices to reduce and stabilize inflation is an area of great policy relevance. Further, in economies increasingly integrated to world markets in trade of both final goods and intermediate inputs, the use of the nominal exchange rate for anti-stabilization purposes has also an impact on international competitiveness that needs to be carefully considered.

In the group of countries undertaking post-socialist transitions, Hungary stands out as one with a relatively long tradition in economic reform, which adopted a gradual approach, and where large macroeconomic imbalances and rampant inflation have been avoided.[2] In contrast to other countries in the region, in Hungary the acceleration of the reform process after the political change of the late 1980s has been accompanied by moderate inflation: in the last four years, the CPI increased by an annual average of 25 percent. On the

---

[1] See Pindyck and Solimano (1993).

[2] Of course, historically that was not always the case. Hungary had hyperinflation both in 1923 and in 1946. The latter one was one of the most virulent in recent economic history (See Solimano, 1991).

stabilization front, the problem of Hungary is how to converge to lower inflation levels (10-15 percent per year? below 10 percent?) without hampering other objectives of economic policy, like the resumption of growth, and the maintenance of external competitiveness.

This paper investigates the process of price formation in Hungary and evaluates the use of different nominal anchors for disinflation. It provides orders of magnitude of the trade-offs between inflation and the real exchange rate during the course of stabilization under alternative monetary and exchange rate policy rules. The paper is organized as follows: section 2 provides a background on recent economic developments in Hungary. Section 3 sets-up a simple model of inflation determination in which both aggregate demand and aggregate supply factors interact to determine the rate of inflation. In section 4, the model is estimated econometrically using 1990-1992 monthly data of consumer prices (CPI), producer prices (PPI), wages, the exchange rate, international prices and money. This sample covers the most critical transition period. In section 5, the econometric estimates are used to simulate the following policy alternatives: (1) a policy of fixing the exchange rate; (2) a policy of reducing the rate of growth of the money supply; (3) a combined policy of fixing the exchange rate with reducing the rate of money growth; (4) a PPP (Purchasing Power Parity) based exchange rate policy. These policies are evaluated in terms of two criteria: (a) impact on inflation and (b) effects on the real exchange rate. Finally, section 6 includes some concluding remarks.

2. Background. Main Macroeconomic Developments in Hungary.

Hungary was the first COMECON country to start moving away from rigid central planning as early as the 1960s. The reform process started with the adoption of the New Economic Policy in 1968 and was never fully reversed, as happened for instance, in post-1968 Czechoslovakia. Despite periods of some back-tracking, particularly in the mid-1970s, "reform communism" allowed Hungary much more time to develop practices and attitudes conducive to the functioning of markets than other countries in Eastern Europe and the former Soviet Union. While the journey toward private ownership, hard budget constraints, and free markets and prices started in earnest only in the mid-1980s, two decades of experimentation with market socialism did prepare the ground.

In the second half of the 1980s, expanding domestic demand and exports surpluses in non-convertible trade were accompanied by declining convertible exports. Relaxation of restrictions on foreign exchange purchases for travel purposes led to substantial capital outflows. These factors, together with increasing interest payments, resulted in a sharp deterioration of the current account in convertible currencies and to a severe foreign exchange liquidity crisis.

The democratic Government elected in May 1990 responded forcefully to the crisis by implementing a stabilization and structural adjustment program that was supported by the IMF and the World Bank. A key element of the program were periodic adjustments of the exchange rate to enhance the international competitiveness of Hungarian exports while preventing an inflationary spiral. The Government's strategy aimed at complementing macroeconomic stabilization with a program of systemic transformation to a full-fledged

market economy through liberalizing external trade and decontrolling prices, privatizing state-owned enterprises, encouraging the development of the private sector, and establishing a liberal environment for foreign investment.

The stabilization program of 1990-91 was very successful in turning around the current account of the balance of payments from a deficit of nearly $1.5 billion in 1989 to a surplus of $123 million in 1990 and about $300 million per year in 1991-92 (Table 1). This adjustment was achieved despite unfavorable external shocks, including probably the worst drought this century, the unexpected shortfall in Soviet oil deliveries, higher energy prices resulting from the Gulf crisis and the collapse of CMEA trade. As the CMEA collapsed, exports were successfully redirected to western markets and the country kept current on all its external debt obligations. The situation stabilized, Hungary's access to international bond markets greatly improved and the country attracted over one-half of the total direct foreign investment provided to Central and Eastern Europe in 1991-92. After a slow start, foreign capital inflows accelerated rapidly in 1991, spurred by a rapid growth of direct foreign investment that amounted to nearly US$1.5 billion in each of the last two years. As a result, international reserves surpassed US$5 billion by the end of 1992, equivalent to about six months of imports.

TABLE 1

HUNGARY: SELECTED ECONOMIC INDICATORS

	1989	1990	1991	1992 Prel.	1993 Proj.
GDP Growth (annual change, %)	0.4	-3.3	-10.2	-4.5	-2.0
o/w industrial production	-2.0	-7.7	-16.7	-10.0	2.0
Exports GNFS (volume indices)	1.2	-2.7	-8.7	4.7	-10.0
Imports GNFS (volume indices)	1.8	-4.6	-7.7	-4.1	2.0
Current Account (million dollars)	-1438	123	267	314	-1500 -
(% of GDP)	-4.9	0.4	0.8	0.9	4.5
Direct Foreign Investment (million dollars)	187	311	1459	1415	1300
Consolidated state budget (% of GDP)	-1.3	-0.1	-4.5	-7.6	-7.0
CPI (annual rate of change, %)	17.0	28.9	35.0	23.0	22-24
PPI (average) (annual rate of change, %)	15.4	22.0	32.6	11.5	10-12
Nominal devaluation (rate of change, %) (CPI)	22.0	5.0	22.0	5.5	

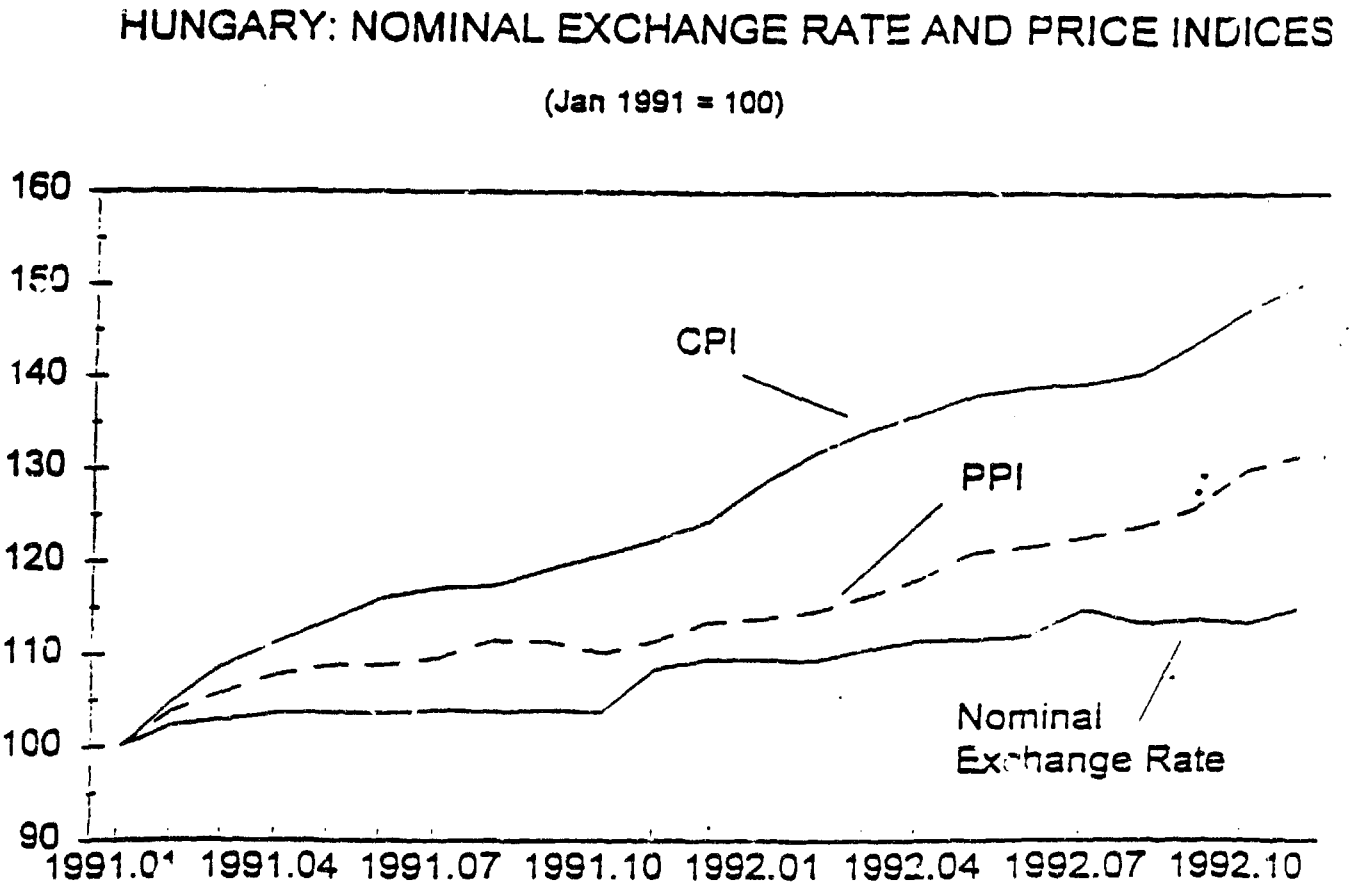
The impact of external shocks and domestic reform on aggregate economic activity has been severe: measured GDP has contracted by a cumulative 18 percent between 1989 and 1992, reflecting the collapse of CMEA trade, the restrictive impact of stabilization policies on domestic demand and the falling output in the SOE (State-Owned Enterprise) sector. Production in both industry and agriculture declined by 30-35%, while the rate of consumer price inflation accelerated and peaked at 35% in 1991, declining thereafter to 23% in 1992.[3]

[3] See Solimano (1993a) and (1993b) for a comparative analysis of output behavior during the post-socialist transitions.

As a result of the recession, unemployment increased rapidly to over 12 percent of the labor force by end-1992.

The continuous recession led to a rapidly deteriorating fiscal situation. On the revenue side, tax receipts fell short of expectations as the drop in output was larger than expected, the SOE tax base continued to shrink, and the Government was unable to collect efficiently from the expanding private sector. On the expenditure side, the rapid increase in the number of both unemployment claims and social assistance requests exerted powerful upward pressures, which have been difficult to resist in the absence of a sharp curtailment in the acquired rights of some social security recipients. Thus, the consolidated state budget deficit increased to 4.5% of GDP in 1991 -- more than twice the projected level-- and again to 7% of GDP in 1992. This levels of the fiscal deficits are certainly incompatible with a low inflation rate in the long run. However, in the short to medium

FIGURE 1


HUNGARY: NOMINAL EXCHANGE RATE AND PRICE INDICES
(Jan 1991 = 100)
160
150
140
130
120
110
100
90
CPI
PPI
Nominal
Exchange Rate
1991.01
1991.04
1991.07
1991.10
1992.01
1992.04
1992.07
1992.10

term the government has resorted to non-inflationary means of financing. In fact, the Government was able to finance these large deficits mostly by borrowing from domestic commercial banks, which captured the rapidly growing household savings. Thus, the fiscal deficits were financed without increasing foreign indebtedness or exacerbating inflationary pressures.

Preliminary data for the first half of 1993 indicates that economic activity has continued on its downward trend. Industrial production and sales were roughly stagnant compared to the same period last year, although several branches (e.g., basic metals, machinery and equipment) show growth rates of 10-15%. The agricultural sector, however, is in a state of flux following the severe drought and the ongoing changes in ownership structure. Consumer price increases reflect the two-step hike in the minimum VAT rate from 0 to 10%, and expectations for a decline in the 1993 rate of inflation may not materialize.

The objective of reducing inflation led to a slowdown in the rate of devaluation in late 1992 and early 1993, which, along with sizeable capital inflows, produced an appreciation of the real exchange rate. Partly as a result of this appreciation and partly because of lagged adjustment to the collapse of CMEA trade and the recession in Western countries, exports declined sharply in the first half of 1993. Merchandise exports fell by about 30%, and the resulting trade deficit was over $2 billion, compared to $275 million in the corresponding period last year. The NBH has reacted to these developments by accelerating the rate of mini-devaluations since the second quarter of 1993 with potential inflationary consequences operating directly through the cost of imported goods and inputs and indirectly through wage

increases via de facto indexation mechanisms. Thus, the dilemma of choosing the appropriate monetary and exchange rate policy to lower inflation and maintain international competitiveness is more relevant than ever before.

Exchange Rate Policy, Inflation and the Real Exchange Rate

Until December 1991, Hungary pegged its exchange rate to a basket of 11 currencies, with annually adjusted weights to reflect the direction of foreign trade. Then the peg changed to a basket with weights of one-half US$ dollar and one-half ECU. Finally, on August 1993 it switched the peg to one-half US dollar and one-half DM. In all cases, it followed a policy of mini-devaluation to compensate for the inflation differential between domestic and foreign prices. In addition, in setting the rate of devaluation, important considerations have been the level of international reserves and the size of capital inflows as was the case in several Latin-American countries pursuing crawling-peg policies in the 1970s.[4]

The need for exchange rate adjustment, particularly in the last two years, was greatly affected by cross-currencies fluctuations: as the dollar weakened in early 1992, it led to an effective depreciation of the forint since the actual share of US dollar trade is lower than one-half, thereby reducing the need for a larger devaluation.[5] In addition, facing rising

[4] See Yuravlivker (1985).

[5] The pattern of devaluations in last four years has been the following: 22% in 3 steps in 1989, 5% in 2 steps in 1990, 22% in 2 steps in 1991, and 5.5% in 3 steps in 1992. The sharp drop in exports since late 1992 has led the National Bank to devalue 5 times in 1993 by an accumulated 14% during the first 9 months of this year.

inflation rates in 1992, the authorities slowed the pace of devaluations fearing the potential impact on prices.

The real effective exchange rate (REER) depreciated from 1985 to 1989 and appreciated thereafter. The magnitudes of the changes depend on the definition: deflating by the PPI, the REER depreciated by 25% in 1985-92 but appreciated by 11% in the second part of that period (1989-92). Using the industrial unit labor cost as deflator, it depreciated by 5% in 1985-92 and appreciated by 23% since 1989. With the CPI, the magnitudes are similar to the latter.

The evolution of inflation in Hungary in the last few years reflect the effect of changes in 'fundamentals' and one-time price shocks. The introduction of the VAT and some price deregulation undertaken in 1988 was accompanied by an increase in CPI inflation from one-digit level to 16-17% per year in 1988-89. A jump to a second step -- 29% in 1990 and 35% in 1991 -- resulted from the extensive liberalization of prices[6], the reduction in subsidies, higher excises taxes and acceleration in the rate of devaluation (see below). An interesting fact of the dynamics of inflation in Hungary is that the Producer Price Index lagged consistently behind consumer prices in the period 1989-1992. In 1992 the rate of change of the PPI was only half as high as the rate of change of the CPI. The faster increase in consumer prices than producer prices is a similar phenomenon to other transition economies, may reflect declining consumer subsidies, increasing retail mark-ups and growing prices of services. The relatively large fiscal deficits in 1992-93 were not a major factor in

[6] By end-1991, nearly 90% of consumer prices were market determined, compared to just over 50% in 1985.

the inflationary process since the government was able to finance them by issuing internal debt acquired through private savings channeled through the banking system rather than by resorting to the use of the inflation-tax. A more systematic attempt at modelling and estimating inflation equations in Hungary is carried-out in the next two sections.

3. A Simple Model of Inflation.

Modelling price formation in a transition economy like Hungary is not an easy task. Transition economies are a blend of different sectors with different behavioral rules. Firms in the state sector may follow mark-up pricing while private firms operating in competitive markets may be price-takers. At the empirical level, the estimation of price equations or other models face the difficulty that the structure of the economy is changing in the transition period. Fortunately, a sample that reflects a period, where a dominant proportion of prices are free (market-determined) is already available at a monthly frequency for prices, wages, the exchange rate and money[7].

A Model of Aggregate Demand and Aggregate Supply.

At conceptual level, a basic distinction to be made is between aggregate demand and aggregate supply. The traditional socialist economies were economies that operated in conditions of permanent excess demand e.g. the " Shortage economy"[8], in which most markets operated as "sellers markets". The lack of operation of the price system, the

[7] Because of the limited observations, estimating models with annual data will include both the structure of the socialist period and the transition one.

[8] See Kornai (1980, 1991).

tendency for the enterprise sector to operate with "soft" budget constraints, and the existence of a built-in "investment-hunger" by managers and planners generated, at an aggregated level, chronic excess demand in the economy. These disequilibria, in turn, showed-up as shortages of final products and inputs, queues, black markets, low quality products and forced substitution of final goods by consumers and inputs by producers.

The post-socialist transition changed the picture. One view is that restrictive demand policies and the ensuing "transformational recession" have shifted the regime from excess demand and shortages in which output was supply determined (resource constrained) to a regime in which output was demand determined [9] On the other hand, since the transition renders a part of the existing capital stock economically obsolete, the supply side could still be a binding constraint to output expansion in the medium run. Thus, in our framework, the price level (or the rate of inflation) and aggregate output (or the rate of GDP growth) are both jointly determined by the interplay of aggregate demand factors (money, fiscal variables, the exchange rate) and aggregate supply factors (wages, the local price of imported inputs which in turn depends upon the exchange rate, the rate of productivity growth). Let us turn now to the main building blocks of our model.

Aggregate supply.

Let us assume that the economy has an aggregate production function, F(.), in three factors: labor, L, imported intermediate inputs, IM, and physical capital, K.

(1) $Y = F(L, IM, K)$

[9] Kornai (1993) argues that in the post-socialist transitions suffering a "transformational recession" the economy shifted from being "resource (supply) constrained" to be "demand constrained".

Assuming cost-minimization, the demand for labor will be a function of the real wage, W/P, and the price of imported intermediate inputs EPn*/P and the capital stock, which is assumed to be a fixed factor.

(2) $L = L(W/P, EPn^*/P, K)$

The demand for imported intermediate inputs is a function of the relative price of imported inputs, EPn^*/P, where E is the nominal exchange rate, Pn^*, is the international price of imported inputs and P is the local price level. The relative price of imported goods thus defined is also the real exchange rate.

(3) $IM = IM(EPn^*/P, W/P, K)$

Replacing equations (3) and (2) in (1) we get the aggregate supply function, Ys,(ϵ is a supply shift factor)

(4) $Ys = Ys(W/P, EPn^*/P, K, \epsilon)$

The level of aggregate output will be a negative function of the real wage and the real price of imported inputs[10].

Aggregate demand

Aggregate demand, Yd, is equal to the sum of private consumption, C, total investment, I, government consumption, G, exports, X, minus imports, M.

(5) $Yd = C + I + G + X - M$

---

[10] We assume, for simplicity, that there is no change in relative prices in dollars between intermediate inputs and an average basket of tradable final goods. The model can be easily expanded to include a more realistic differentiation between the prices of imported materials and energy and the price index of all traded goods.

Assuming that consumption is a function of disposable income[11], investment depends on the real interest rate or directly on the stock of real balances (or credit) and that exports and imports depend on the real exchange rate, domestic output and foreign output, Y^*. Assuming equilibrium in the money market (the real interest rate can be expressed as a function of the stock of real balances and the level of income) we can write:

$$(6)\quad Yd = Yd(\, M/P,\ Z,\ EP^*/P,\ Y^*,\ v)$$

where Z is a vector of fiscal variables, $Z=\{\, G,\ t\}$ comprising government consumption, G, and taxes, t, and v is a demand shift factor. Aggregate demand will be a positive function of the stock of real balances, the real exchange rate, (assuming the devaluation is expansionary), the level of public consumption and foreign income. In turn, output demanded will be a negative function of taxes.

Figure 2 shows the macroeconomic equilibrium of the system as represented by the intersection of the upward sloping aggregate supply (AS) and the downward sloping aggregate demand (AD) schedules where the vertical axis measures the price level, P, and the horizontal axis the level of GDP, Y. In equilibrium, aggregate demand is equal to aggregate supply and that determines the price level and the level of real GDP for given values of M, E, W and other shifting parameters of the demand and supply functions.[12]:

$$(7)\quad Ys(\, W/P,\ EPn^*/P,\ K,\ \epsilon) = Yd(\, M/P,\ Z,\ EP^*/P,\ Y^*,\ v)$$

---

[11] It also could be made a function of the level of real wealth.

[12] As Bruno (1992) argues the model will need to incorporate two additional equations to determine endogenously the three relative prices of the system: W/P, EP^*/P and M/P. One possibility suggested is to incorporate the net excess for labor (a labor market) and the net flow excess demand for foreign exchange (the current account of the balance of payments).

Solving for the price level we get:

(8) $P = P(W, E, M, q)$

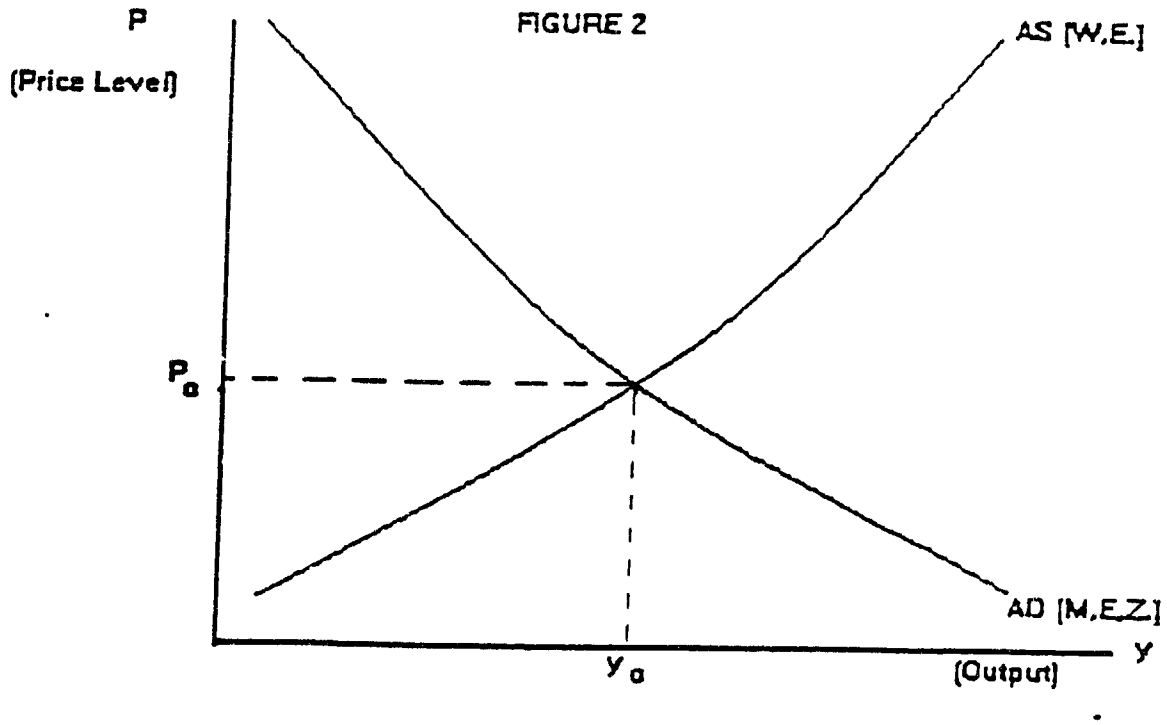
In this specification the price level depends both on demand and supply factors, like nominal wages, the nominal exchange rate, the nominal money supply. In turn, the factor q includes all the other constants appearing in equation (7). Expressing equation (8) in rates of growth form we obtain the following inflation equation:[13]

(9) $\pi = \delta P/P = a\ GWAGE + b[GE + GP^*] + c\ GM + v$

This equation shows that the rate of inflation, π, is a function of:

- the rate of growth of nominal wages, GWAGE.
- the rate of devaluation of the exchange rate plus the rate of international inflation $GE + GP^*$.
- the rate of growth of the money supply, GM.
- the effect of supply and demand shocks comprised in $v = \delta Z/Z + \delta q/q$.

[13] This is an 'equilibrium' rate of inflation in the sense that it is consistent with continuous equilibrium in the goods and money markets. Inflationary expectations are assumed as given.



Moreover, for condition of homogeneity in the real aggregate demand and aggregate supply functions, we have that $a + b + c = 1$.

The model could be extended also to include also indexation rules for wages and the exchange rate and an accommodation rule for the money supply (see Corbo and Solimano, 1991 and Bruno, 1992, for further elaboration along that lines).

4. Econometric Estimates.

In this section we present the main results of the estimation of inflation equations based on the specification of equation (9) allowing for lags in the effects of the different explanatory variables. The sample runs from 1990(1) to 1992(11) and uses monthly

information. The equation is estimated by Ordinary Least Squares for two price indices: the rate of change of the Consumer Price Index and the rate of change of the Producer Price Index[14]. As the product (or input) composition of the two indices is different for producer and consumer prices we should not expect to obtain the same coefficients for the explanatory variables of the model in the CPI and PPI equations. In general, the CPI includes a larger share of non-traded goods. The appendix provides more information on the construction of the right-hand side variables in the estimation.

Consumer Price Inflation.

Table 2 presents the estimates of the model for the specification using the rate of change of the CPI as explanatory variables for two versions of the model: one in which the coefficients are unconstrained and another in which the coefficients are constrained to sum one (homogeneity condition). A dummy variable is included to capture the special effects of price liberalization waves introduced in January-February 1990 and 1991.

In the unrestricted specification both the exchange rate (adjusted for international inflation) and the rate of growth of nominal wages are statistically significant at 95 percent. The coefficient of the contemporary variable GE $+GP^*$ is between 0.34 and 0.38. The sum of the coefficients of that variable for the current and lagged month is over 0.9 in the unrestricted version. The coefficients of the rate of growth of wages in the CPI equation is

[14] Simultaneity problems are bound to be less important in the case of Hungary as the degree of wage indexation is low and the exchange rate and monetary policies are not fully accommodating. Moreover, the lack of valid instruments at monthly frequency precludes the estimation of the model by two Stages Least Squares or Instrumental Variables.

about 0.15-0.17. When the coefficients of wages of the current period and one and two months lags are added-up the resulting coefficient rises to 0.28 (Table 2, eqn.1).

The coefficient of current period money growth appears with the wrong sign. The sum of the coefficients with one and two month lag is around 0.40-0.46 for the unrestricted specifications.

Let us turn now to the estimation with the restriction that the coefficients sum one. The parameter of the exchange rate (plus foreign inflation) variable lies in the range of 0.40 - 0.62 depending upon the specification and the number of lags included. This value of the coefficient of the exchange rate shows that a 10 percent devaluation would produce an increase in the CPI between 4 and 6.2 percent, ceteris paribus, say holding wages and money fixed after the devaluation. The coefficient of wages is between 0.20, (specification with no lags) and 0.23 when two lags are added up. The coefficient of the sum of two months lagged money growth (M1) is between 0.40 (eqn. 4, table 2) and 0.44 for the specification represented by (eqn. 7, table 2).

In general these results show that the exchange rate (and foreign inflation) has a quantitatively important impact on CPI inflation. Besides, this variable is the only one that is statistically significant across different specifications. Moreover, the impact of changes in the rate of growth of M1 on CPI inflation is weak in the short term and operates with several lags.[15] The rate of growth of wages also has an impact on CPI inflation though its quantitative importance is not very large. These findings suggests that a policy of exchange

[15] Unpublished estimations conducted at the National Bank of Hungary suggest that changes in domestic credit have also a large impact on consumer prices.

rate based-disinflation is bound to have a bigger short-term impact on reducing inflation than a strategy that relies only on reducing the rate of money growth. These findings supports the notion held by the NBH that the exchange rate has a relatively large impact on domestic prices and therefore it can be used as a nominal anchor for stabilization. However, further research is needed to gauge the impact of the associated real exchange rate appreciation (see section 5) on exports and import flows and hence on the trade balance.

Producer Prices Inflation.

The estimation of price equations using the producer price index, PPI, as dependent variable yields, in general, weak results and imprecise estimates (see Table 3).

In the unrestricted specifications (equations 1 and 2, table 3) only the sum of exchange rate devaluation plus foreign inflation is statistically significant in the different specifications. The value of the coefficient for the current period value of $GE+GP^*$ is around 0.55 and the sum of the coefficients for this variable plus two lags lie in the range of 0.71 and 0.79. As these equations show, the impact of exchange rate policy on the PPI is sizeable and quicker than on the CPI given the former's larger share of traded goods.[16]

The coefficient of the rate of change of nominal wages in the PPI equation is very small and statistically insignificant. The sum of the coefficients of the rate of growth of M1 of the current and lagged periods is in the range of 0.33 and 0.39.

[16] Estimations conducted at the NBH suggests that the full inflationary impact of exchange rate changes may take 3-4 quarters.

It is worth noting that on impact, the effect of a change in the rate of devaluation has a greater impact on the rate of inflation measured by the PPI than the rate of inflation of the CPI. This result is consistent with the lower rate of inflation of PPI than CPI observed in Hungary in the last few years.

Table 2

HUNGARY. PRICE EQUATIONS

Dependent Variable: Rate of Change of CPI.

	GWAGE	GWAGE(-1)	GWAGE(-2)	GE+GP*	GE(-1)+GP*-1	GE-(2)+GP*(-2)	GM1	GM1(-1)	GM1(-2)	DUMMY	GCPI(-1)	GCPI(-2)	R^2	D.W.
Unrestricted														
EQ1	0.154*	0.085	0.045	0.389*	0.384	0.207*	-0.21	0.116	0.280*	-0.004			0.69	1.27
	(2.72)	(1.20)	(0.64)	(5.071)	(1.76)	(2.36)	(-1.98)	(1.16)	(3.73)	(-0.15)				
EQ2	0.168*			0.387*	0.349*	0.169*	-0.13	0.177*	0.285*	-0.003			0.66	1.20
	(3.26)			(5.38)	(2.06)	(2.19)	(-1.59)	(2.26)	(4.08)	(-0.14)				
EQ3				0.343*				0.184*	0.114		0.523*			
				(5.46)				(3.38)	(1.85)		(7.60)			
Restricted														
EQ4	0.129*	0.067	0.038	0.334*	-0.028	0.185*	-0.121	0.178	0.218	0.049*			0.92	1.7
	(2.103)	(0.87)	(0.49)	(4.15)	(-0.20)	(1.93)	(-1.079)	(1.66)		(2.47)				
EQ5	0.204*			0.623*			0.173			0.038*			0.74	1.56
	(2.47)			(7.88)			(2.19)			(2.29)				
EQ6				0.40*						-0.012	0.694		0.89	1.72
				(5.25)						(-1.35)	(8.22)			
EQ7				0.564*			0.095	0.346*		0.010			0.86	1.45
				(8.30)			(1.39)	(3.66)		(0.88)				

t - Statistic under parenthesis

* significant at 95 percent.

Table 3

HUNGARY. PRICE EQUATIONS

Dependent Variable: Rate of Change of PFL

	GWAGE	GWAGE(-1)	GWAGE(-2)	GE+GP	GE(-1)+GP(-1)	GE(-2)+GP(-2)	GM1	GM1(-1)	GM1(-2)	GCPI(-1)	DUMMY	R^2	D.W.
Unrestricted													
EQ1	0.048	0.005	0.072	0.546*	0.148	0.028	0.035	0.194	0.096		0.011	0.51	1.25
	(0.48)	(0.041)	(0.59)	(4.02)	(0.39)	(0.185)	(0.18)	(1.10)	(0.73)		(0.22)		
EQ2	0.058			0.555*	0.230	0.016	0.038	0.235	0.120		-0.001	0.50	1.16
	(0.67)			(4.55)	(0.802)	(0.122)	(0.27)	(1.77)	(1.01)		(-0.025)		
Restricted													
EQ3	0.038	-0.002	0.069	0.519*	-0.006	0.02	0.071	0.217	0.073		0.031	0.79	1.41
	(0.40)	-0.011)	(0.58)	(4.13)	(-0.03)	(0.13)	(0.40)	(1.30)			(1.022)		
EQ4	0.058			0.689*			0.253				0.019	0.66	1.33
	(0.66)			(8.25)			(3.03)				(1.13)		
EQ5				0.658*			0.154	0.188		0.374*	-0.019	0.77	1.7
				(7.81)			(1.88)	(2.35)		(2.75)	1.25)		

t - Statistic

* Significant at 95 percent level.

5. Policy Options for Disinflation: Simulation Results.

To explore more systematically different strategies of disinflation that are relevant for Hungary, we use the estimates of the model to simulate four types of disinflation options. The options explored contrast policies of money-based stabilization with exchange rate-based stabilization besides mixed strategies and an exchange-rate policy oriented to keep the real exchange rate constant in presence of inflation.

In general, the difference between exchange rate versus money-based disinflation lie in the distribution over time of the costs of stabilization and the transmission mechanisms through which the price level and output are affected by each stabilization strategy.

In general, money-based stabilization tends, to generate a recession in the short term as tight money rise real interest rates and cut domestic absorption. Clearly, the costs of disinflation are paid at the beginning of the program. In contrast, exchange rate-based stabilization programs may, in principle, avoid a recession or even produce an initial boom in economic activity (see Kiguel and Liviatan, 1992). In fact, the usual pattern in an exchange rate-based stabilization program is a fall in real interest rates and a real appreciation of the exchange rate because price inertia and wage stickiness. If the real interest rate effect dominates a recession can be avoided in the short-term. However, the real currency appreciation in the medium run will have a recessionary effect as domestic output becomes less competitive in international markets. Thus, the costs of stabilization tend to be postponed over time in programs using the exchange rate as a nominal anchor.

Regarding the effect on the price level, a money-based program acts, chiefly, by creating slack that moderates both wage increases in the labor market and price changes in the goods market.

Moreover, in exchange rate-based stabilization programs, the nominal exchange rate exerts a moderate effect on the price level though several channels: it reduces the rate of increase in the domestic price of imported intermediate inputs, it slowdown the rate of increase of imported final goods (chiefly consumption goods) and indirectly it reduces the rate of growth of wages if they are indexed to the CPI.[17]

Most of these effects are already included in our inflation model and are reflected in the elasticities of aggregate demand and aggregate supply with respect to the money supply and the exchange rate. Our price estimates are thus function of those structural parameters.

The four strategies of disinflation that are simulated for the period 1991(1) to 1992(11) are[18]:

(1) A policy of fixing the nominal exchange rate, GE=0 (Simulation 1).[19]. It is assumed that this policy is credible to the public and that is backed by a sufficient level of international reserves at the Central Bank.

---

[17] See Dornbusch (1986), Sachs and Larrain (1993), ch. 15.

[18] The simulation starts on 1991(1) to take into account the period in which most basic misalignment in relative prices were corrected and the economy operated more or less under a regime of free prices.

[19] A simulation of this policy with a full macro-model would include the estimation of a money demand equation and also the capital account, see Fischer (1984). Alternatively, it could be assumed that the monetary authorities sterilize any additional increase in the amount of money resulting from inflows of reserves.

(2) A policy of reducing the rate of growth of M1 to 1 percent per month (Sim. 2).

(3) A combined policy of fixing the exchange rate and reducing the rate of growth of the money supply to a rate of 1 percent per month, GE =0 and GM1 = 1 percent (Sim.3)[20].

(4) A policy of devaluing the exchange rate at a rate equal to the difference between (last month) domestic and foreign inflation (Simulation 4).

These policies, in turn, are evaluated in terms of two criteria (see tables 4 and 5):

. Velocity and magnitude of disinflation.

. Impact on the real exchange rate.

This illustrates a basic dilemma in stabilization in open economies that use the exchange rate as a nominal anchor for disinflationary purposes: namely that disinflation might be bought at the price of a real appreciation of the exchange rate that affects external competitiveness, the development of the export sector and possibly the attainment of current account targets.

Simulation 1 amounts to a strategy of exchange rate based stabilization, simulation 2 is a strategy of money-based stabilization and Simulation 3 is a combination of Simulations 1 and 2. Simulation 4 amounts to a PPP (purchasing power parity) rule seeking to maintain a constant real exchange rate. This last policy is oriented to preserve external balance and promote exports rather than reduce inflation. Though, it is still worth exploring the inflationary implications of this policy.

---

[20] This simulation assumes that the monetary authorities can impose restrictions on capital mobility in order to delink domestic from international interest rates.

Table 4 reports the results of the path of CPI inflation[21] associated with each of the four policy simulations just described. Moreover, a base simulation is also presented using the actual values of the right hand side variables of the model. The regression coefficients used in the different simulations correspond to equation 5 (restricted specification) in table 2.

As it can be seen from table 4, the simulation that combines a fixed nominal exchange rate with reduced money growth (sim. 3), is the one that yields the lowest inflation rate: 1 percent per month which amounts to an annualized rate of 12.9 percent. This implies a reduction of near 10 percentage points of inflation per year compared to the base simulation (see bottom table 4). In simulation 1 (fixed exchange rate) the monthly rate of CPI inflation is 1.2 percent with an annual rate of 15.4 percent. In turn, a policy of money-based disinflation, GM1 = 1% per month, (simulation 2) yields a monthly rate of inflation of 1.5 percent with a corresponding annual inflation rate of 19.8 percent. Finally a PPP based exchange rate rule gives a rate of inflation per year of 36 percent; substantially higher than the inflation rate associated with any other simulation, included the base simulation.[22]

Table 5 shows the evolution of the real exchange rate, defined as EP^*/P, associated with each simulation. The results show that the degree of real exchange appreciation is greater for the policy of fixing the exchange (simulation 1) than for any other policy simulation. In simulation 1 (exchange rate-based disinflation) the cumulative real appreciation from 1991(1) to 1992(11) is 24.3 percent and in simulation 2 (money-based

---

[21] Since the estimates for PPI were rather unstable we preferred to simulate the effects of the different policy rules on CPI inflation.

[22] The question of what price index to use when pursuing a PPP rule is not trivial, particularly when the rate of inflation of various indices are relatively different, as is the case in Hungary. Here the CPI is used as indexer for consistency to obtain dynamic simulations since the CPI equation is more stable than the PPI equation.

stabilization) the cumulative appreciation is 16.4 percent. As it could be expected the policy of PPP rule is the only rule consistent with a constant real exchange rate at the end of the simulation period.[23]

Clearly, the simulations illustrate the orders of magnitude of the implicit trade-off between using the exchange rate for anti-inflationary purposes (simulation 1 and 3) instead of gearing it to real exchange rate targets (simulation 4). When the exchange rate is used for stabilization the disinflation is quicker but it is accompanied by a larger real appreciation of the currency. In contrast, a PPP rule avoids a real appreciation and maintains a stable real exchange rate under (moderate) rate of price level increases, though, at the same time, it introduces an "inflationary bias" in the system through a policy of persistent devaluation[24]

[23] Since these are counterfactual simulations, we implicitly assume the absence of any real shock (terms of trade, productivity) during the simulation period that would call for an adjustment of the real exchange rate.

[24] In this model we have not included explicitly the existence of wage indexation to the CPI. In that case, the inflationary impact of a PPP rule or any change in the rate of devaluation or in the level of the nominal exchange rate would be larger since it would entail also an acceleration in the rate of growth of nominal wages.

TABLE 4
HUNGARY. INFLATION RATE
UNDER ALTERNATIVE EXCHANGE RATE
AND MONETARY RULES

CPI Inflation

	Base	SIM.1	SIM.2	SIM.3	SIM.4
1991.01	6.7	6.7	6.7	6.7	6.7
1991.02	4.9	5.5	4.8	5.4	8.2
1991.03	1.2	0.2	1.2	0.3	4.1
1991.04	1.6	0.9	1.6	0.8	3.3
1991.05	1.5	0.8	1.1	0.4	2.9
1991.06	0.5	0.3	0.5	0.3	1.7
1991.07	1.1	1.0	0.8	0.7	2.0
1991.08	-0.4	-0.9	-0.5	-0.9	1.0
1991.09	1.9	1.2	1.9	1.2	1.2
1991.10	1.1	0.4	1.1	0.4	2.0
1991.11	4.5	3.8	3.9	3.2	2.4
1991.12	2.1	2.0	0.6	0.5	2.6
1992.01	-0.6	-0.7	-0.0	-0.1	0.6
1992.02	0.9	0.3	1.0	0.4	2.7
1992.03	3.6	1.1	3.5	1.0	4.5
1992.04	0.8	1.3	0.5	0.9	1.3
1992.05	0.5	0.3	0.5	0.3	1.2
1992.06	1.3	0.8	0.9	0.4	2.0
1992.07	2.8	2.0	2.4	1.6	1.7
1992.08	-0.7	-0.3	-1.1	-0.7	0.4
1992.09	0.9	0.5	0.8	0.4	1.2
1992.10	0.3	-0.0	0.3	-0.0	2.0
1992.11	2.7	0.5	2.4	0.2	4.3
Monthly inflation rate (average percent)	1.7	1.2	1.5	1.0	2.6
Annualized inflation rate (percent)	22.5	15.4	19.8	12.9	36.0

TABLE 5

HUNGARY. REAL EXCHANGE RATE UNDER ALTERNATIVE EXCHANGE RATE AND MONETARY RULES

	BASE	SIMUL1	SIMUL2	SIMUL3	SIMUL4
1991.01	100.00	100.0	100.0	100.0	100.0
1991.02	97.2	94.4	97.5	94.7	98.1
1991.03	96.5	93.8	96.4	93.9	99.6
1991.04	93.2	93.0	95.6	93.2	101.2
1991.05	93.4	91.9	94.6	92.9	101.0
1991.06	93.0	91.7	94.1	92.6	102.5
1991.07	90.7	90.7	93.8	92.2	102.7
1991.08	90.3	90.2	92.8	91.8	101.9
1991.09	89.3	90.0	92.2	91.5	104.0
1991.10	88.8	89.8	91.2	91.4	103.1
1991.11	88.3	86.0	91.7	88.6	101.6
1991.12	88.8	82.4	91.6	87.7	99.1
1992.01	91.5	83.1	91.2	87.3	102.3
1992.02	87.2	83.2	90.3	87.1	103.4
1992.03	83.6	82.2	88.3	86.2	101.2
1992.04	85.0	80.9	88.7	85.5	102.3
1992.05	84.7	80.6	88.2	85.2	103.0
1992.06	82.7	79.5	87.6	84.7	102.4
1992.07	83.0	77.4	87.4	83.1	101.4
1992.08	84.4	77.1	87.0	83.4	102.2
1992.09	83.0	76.5	86.4	82.9	102.7
1992.10	81.3	76.4	85.8	82.8	103.2
1992.11	77.2	75.7	83.6	82.5	100.8

FIGURE 3

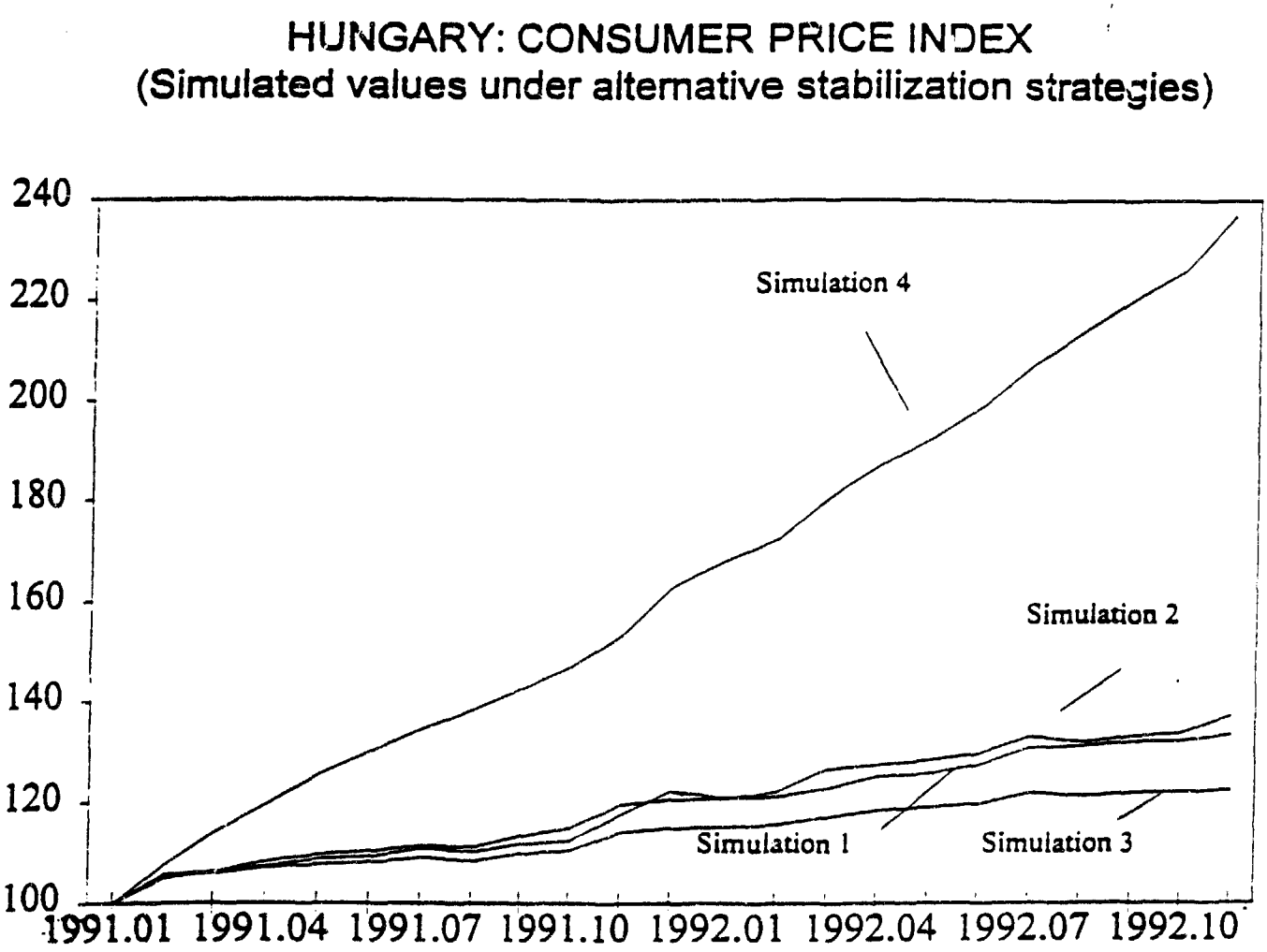
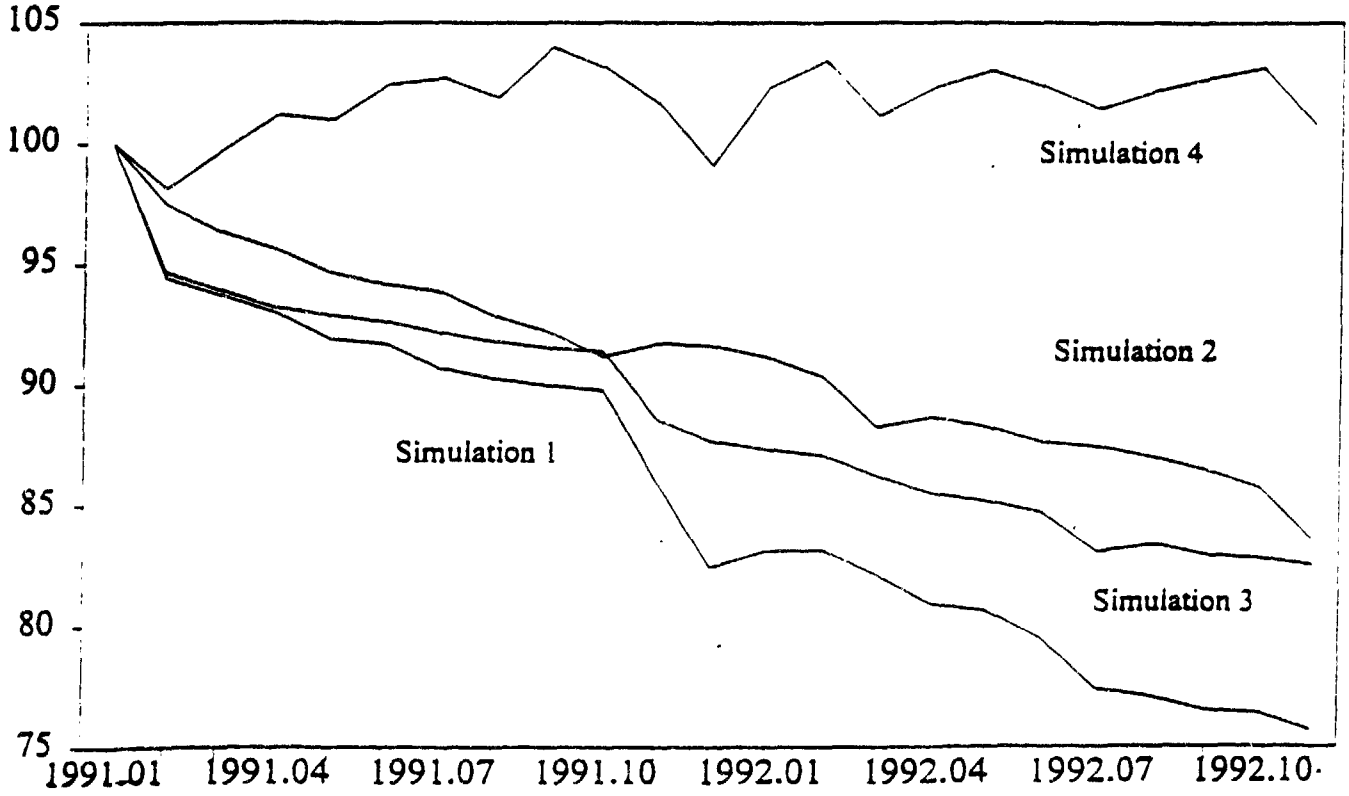

HUNGARY: CONSUMER PRICE INDEX
(Simulated values under alternative stabilization strategies)
240
220
200
180
160
140
120
100
Simulation 4
Simulation 2
Simulation 1
Simulation 3
1991.01
1991.04
1991.07
1991.10
1992.01
1992.04
1992.07
1992.10

FIGURE 4

HUNGARY: REAL EXCHANGE RATE
(Simulated values under alternative stabilization strategies)



6. Concluding Remarks

This paper has explored, empirically, the inflationary process in Hungary, and provided econometric estimates of the determinants of CPI and PPI inflation for the period 1990-1992 using monthly data. The empirical estimates of price equations –both CPI and PPI– show the quantitative importance and statistical significance of the exchange rate in the process of price formation in Hungary during the period of intensification of reforms (price liberalization while the economy became more open to international trade of final goods and inputs). Our estimates show that the money supply affects consumer and producer prices with several lags and its impact on prices is small in the short run. Moreover, nominal wages have a more significant effect on the CPI than on the PPI.

The paper presents illustrative policy simulations of alternative rules for the exchange rate and the money supply in terms of their impact on the rate of inflation and the level of the real exchange rate. It is found that a rule of fixing the exchange rate entails a lower level of CPI inflation --some 5 percentage points of less CPI inflation per year--than a rule based on reducing the rate of money growth (to 1 percent per month). However, a fixed exchange rate policy is associated with a larger appreciation of the real exchange rate than a policy of money based disinflation--nearly 4 percentage points more of real appreciation per year. In turn, a PPP based exchange rate rule stabilizes the real exchange rate at the cost of a substantial acceleration in inflation.

In this way, these exercises illustrate the nature and magnitude of the trade-offs between faster disinflation and the level of external competitiveness in an open economy like Hungary that uses the exchange rate as a nominal anchor in disinflation.

Areas of further policy interest that require more analysis in the future refer to the causality between real appreciation and capital inflows, the process of wage formation in the transition period and the channels through which changes in the real exchange rate affect trade flows, spending and output.

References

M. Bruno (1992) 'Shocks and Accommodation: The Dicothomy and Mechanics of High Inflation' mimeo.

V. Corbo and A. Solimano (1991) "Chile's Experience with Stabilization Revisited" in M. Bruno et.al. (eds.) Lessons of Economic Stabilization and Its Aftermath MIT Press.

S. Commander and F. Coricelli (1992) "Price and Wage Dynamics and Inflation in Socialist Economies: Empirical Models for Hungary and Poland" in The World Bank Economic Review January, Vol. 6, #1.

R. Dornbusch and S. Fischer (1993)"Moderate Inflation" The World Bank Economic Review Jan, 7, 1-44.

R. Dornbusch (1986) 'Inflation, Exchange Rates and Stabilization' Princeton Essays in International Finance. #165, October.

A. Solimano, O. Sunkel and M. Blejer 1993 (eds), Rebuilding Capitalism. Alternative Roads after Socialism and Dirigisme. The University of Michigan Press (forthcoming).

S. Fischer(1984) "Real Balances, The Real Exchange Rate and Indexation: Real Variables in Disinflation" NBER Working Paper # 1497.

M. Kiguel and N. Liviatan (1992) 'The Business Cycle Associated with Exchange Rate-Based Stabilization' The World Bank Economic Review. Vol. 6, 2, May.

J. Kornai (1993) "Transformational Recession. A General Phenomenon Examined Through the Example of Hungary's Development". Francois Perroux Lecture. Discussion Paper # 1. Collegium Budapest. Institute for Advanced Study, Budapest, Hungary.

R. Pindyck and A. Solimano (1993) 'Economic Instability and Aggregate Investment' PRE Working Paper # 1148 and O. Blanchard and S. Fischer (eds.) in NBER Macroeconomic Annual, 1993.

J. Sachs and F. Larrain (1993) Macroeconomics. In the Global Economy. Prentice-Hall.

A. Solimano (1991) " Economic Transformation in Eastern and Central Europe: An Historical and International Perspective", Ch.1 in V. Corbo et.al. Reforming Central and Eastern European Economies. Initial Results and Challenges.A World Bank Symposium.

- (1993) 'The Post-Socialist Transitions in Comparative Perspective: Policy Issues and Recent Experiences' World Development Vol. 21, # 11, November (forthcoming).

D. Yuravlivker (1985) "Crawling Peg and the Real Exchange Rate - Some Evidence From the Southern Cone", Journal of Development Economics 18: 381-393.

Appendix

Construction of the Variables

GPPI Rate of change in the Producer Price Index.
Source: Central Statistical Office.

GCPI Rate of change in the Consumer Price Index.
Source: Central Statistical Office.

GE Rate of change of the exchange rate.
The exchange rate is a weighted average index constructed as:
(0.5) * Forint/US$ + (0.5) * Forint/ ECU. Source: National Bank of Hungary.

GP* Rate of change of the index of wholesale prices of Hungary's main trading partners. Source: National Bank of Hungary.

GM1 Rate of change in the stock of currency outside banks, enterprise deposits, household deposits, and other liquid deposits. Source: National Bank of Hungary.

GWAGE Rate of change in the index of average manufacturing wages. Source: Central Statistical Office.

DUMMY The dummy variable equals 1 in January and February of 1990 and 1991. For all other months it equals zero.

The indices, are escalated to December 1990 = 100.

All the series are monthly data collected from the Hungarian Central Statistical Office and the National Bank of Hungary. However, prior to 1992, wage data was only on a quarterly basis. We have interpolated the quarterly wage data through December 1991 to get monthly wage series for the pre-1992 period.

Policy Research Working Paper Series

	Title	Author	Date	Contact for paper
WPS1208	Primary School Achievement in English and Mathematics in Zimbabwe: A Multi-Level Analysis	Levi M. Nyagura Abby Riddell	October 1993	I. Conachy 33669
WPS1209	Should East Asia Go Regional? No, No, and Maybe	Arvind Panagariya	October 1993	D. Ballantyne 37947
WPS1210	The Taxation of Natural Resources: Principles and Policy Issues	Robin Boadway Frank Flatters	October 1993	C. Jones 37699
WPS1211	Savings-Investment Correlations and Capital Mobility in Developing Countries	Nlandu Mamingi	October 1993	R. Vo 31047
WPS1212	The Links between Economic Policy and Research: Three Examples from Ghana and Some General Thoughts	Ravi Kanbur	October 1993	P. Attipoe 526-3003
WPS1213	Japanese Foreign Direct Investment: Recent Trends, Determinants, and Prospects	Kwang W. Jun Frank Sader Haruo Horaguchi Hyuntai Kwak	November 1993	S. King-Watson 33730
WPS1214	Trade, Aid, and Investment in Sub-Saharan Africa	Ishrat Husain	November 1993	M. Youssef 34637
WPS1215	How Much Do Distortions Affect Growth?	William Easterly	November 1993	R. Martin 39065
WPS1216	Regulation, Institutions, and Commitment: Privatization and Regulation in the Argentine Telecommunications Sector	Alice Hill Manuel Angel Abdala	November 1993	D. Evans 38526
WPS1217	Unitary versus Collective Models of the Household: Time to Shift the Burden of Proof?	Pierre-Andre Chiappori Lawrence Haddad John Hoddinott Ravi Kanbur	November 1993	P. Attipoe 526-3002
WPS1218	Implementation of Trade Reform in Sub-Saharan Africa: How Much Heat and How Much Light?	John Nash	November 1993	D. Ballantyne 37947
WPS1219	Decentralizing Water Resource Management: Economic Incentives, Accountability, and Assurance	K. William Easter Robert R. Hearne	November 1993	M. Wu 30480
WPS1220	Developing Countries and the Uruguay Round: Negotiations on Services	Bernard Hoekman	November 1993	L. O'Connor 37009

Policy Research Working Paper Series

	Title	Author	Date	Contact for paper
WPS1221	Does Research and Development Contribute to Economic Growth in Developing Countries?	Nancy Birdsall Changyong Rhee	November 1993	S. Rajan 33747
WPS1222	Trade Reform in Ten Sub-Saharan Countries: Achievements and Failures	Faezeh Foroutan	November 1993	S. Fallon 38009
WPS1223	How Robust Is a Poverty Profile?	Martin Ravallion Benu Bidani	November 1993	P. Cook 33902
WPS1224	Devaluation in Low-Inflation Economies	Miguel A. Kiguel Nita Ghei	November 1993	R. Luz 39059
WPS1225	Intra-Sub-Saharan African Trade: Is It Too Little?	Faezeh Foroutan Lant Pritchett	November 1993	S. Fallon 38009
WPS1226	Forecasting Volatility in Commodity Markets	Kenneth F. Kroner Devin P. Kneafsey Stijn Claessens	November 1993	F. Hatab 35835
WPS1227	Designing Water Institutions: Market Failures and Institutional Response	Marie Leigh Livingston	December 1993	C. Spooner 30464
WPS1228	Competition, Competition Policy, and the GATT	Bernard M. Hoekman Petros C. Mavroidis	December 1993	L. O'Connor 37009
WPS1229	The Structure, Regulation, and Performance of Pension Funds in Nine Industrial Countries	E. P. Davis	December 1993	P. Infante 37642
WPS1230	Unemployment in Mexico: Its Characteristics and Determinants	Ana Revenga Michelle Riboud	December 1993	R. Stephen 37040
WPS1231	Making a Market: Mass Privatization in the Czech and Slovak Republics	Nemat Shafik	December 1993	A. Correa 38549
WPS1232	Will GATT Enforcement Control Antidumping?	J. Michael Finger K. C. Fung	December 1993	N. Artis 37947
WPS1233	Hedging Cotton Price Risk in Francophone African Countries	Sudhakar Satyanarayan Elton Thigpen Panos Varangis	December 1993	D. Gustafson 33714
WPS1234	Price Formation, Nominal Anchors, and Stabilization Policies in Hungary: An Empirical Analysis	Andrés Solimano David E. Yuravlivker	December 1993	S. Florez 39075