

Sources of Real Exchange Rate Fluctuations in Transition Economies: The Case of Poland and Hungary¹

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For two successful transition economies, Hungary and Poland, this paper examines Brada's (1998) conjecture that, as a result of diverse fiscal and monetary policies, real exchange rates in some economies should follow a path that mirrors that effect of real shocks and in others they should follow a path that reflects monetary shocks. To test this hypothesis, we use a structural VAR model and, assuming long-run neutrality of nominal shocks, we decompose real exchange rate and price movements into those attributable to real and nominal shocks. Using monthly data from 1990 to 1999 for Hungary and Poland, we find that nominal shocks had a major influence in explaining real exchange rate movements in Poland, while real shocks had a larger influence on real exchange rate movements in Hungary. *J. Comp. Econ.*, June 2001, 29(2), pp. 257–275. Southern Illinois University, Carbondale, Illinois 62901; Department of Economics and Finance, Southern Illinois University,

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1. INTRODUCTION

The exchange rate has been an important policy tool for many transition economies, serving as a nominal anchor for stabilization efforts. At the same time, foreign exchange rate management has been an important element in staving off external imbalances. Many countries began the transition with sharp nominal and real depreciations of their currency. This was followed by real appreciation as domestic inflation exceeded subsequent nominal depreciation over the course of transition (Brada, 1998).

The transition process involves dismantling old production structures and initiating structural reforms. Consequently, productivity growth and real wage changes may exert upward pressure on the real exchange rate according to the Balassa–Samuelson hypothesis, which posits that real exchange rate appreciation occurs in fast-growing, innovative economies (Halpern and Wyplosz, 1997). Liberalization of capital accounts and the subsequent capital inflows also lead to appreciation of the real exchange rate (Orlowski, 1998; Brada, 1998). Finally, nominal shocks can influence real exchange rates in high inflation countries. For example, Desai (1998) argues that much real appreciation was due to fiscal imbalances in transition economies, and Nemenyi (1997, p. 160) concludes that “[f]iscal policy changes are indeed the main driving forces of real economic fluctuations in Hungary.”

Movements in the real exchange rate play a significant role in altering international competitiveness, which is critical to the ongoing trade reorientation toward the West.² Real appreciation also encourages short-term portfolio inflows, possibly at the expense of long-term portfolio capital inflows or foreign direct investment (Orlowski, 2000). In addition, movements in real exchange rates may affect inflation and output significantly in transition economies. Real exchange rate movements can also signal a currency crisis. In his analysis of the Czech exchange rate crisis of 1997, Begg (1998) shows the critical role played by real appreciation of the koruna in the years leading up to the crisis even though the koruna was still somewhat undervalued at the time the crisis broke out. Drabek and Brada (1998) analyze how commercial policy has been used to slow down the effects of the real appreciation of currencies on trade in transition economies.

²For recent analyses of the role of real exchange rates in transition economies, see Halpern and Wyplosz (1997), Orlowski and Corrigan (1997), and Orlowski (1998, 2000).

Because transition economies have followed different fiscal and monetary policies (Desai, 1997, 1998), the path of exchange rate appreciation is likely to be different across countries. In fact, Brada (1998, p. 620) argues that "if we accept Begg's (1998) evidence of slow productivity growth in the Czech Republic as a characteristic of other transition economies, then Desai's (1998) evidence of the very different fiscal and monetary policies to be found among the transition economies suggests that monetary shocks should predominate over productivity shocks in both frequency and intensity."

By decomposing real exchange rate and price movements into those attributable to real and nominal shocks, we examine Brada's conjecture and provide insights into the sources of movements in real exchange rates and prices. Such decomposition is accomplished by imposing the long-run neutrality restriction that nominal shocks have no long-run effect on the real exchange rate, which is consistent with economic theory. Because real exchange rates tend to have a permanent component, Lastrapes (1992) and Enders and Lee (1997) used the assumption of long-run neutrality of nominal shocks to discern the temporary and permanent components of the real exchange rate.

This decomposition is also useful to gauge the effectiveness of monetary and exchange rate policies in transition economies. A large temporary component in the real exchange rate due to nominal shocks may indicate a high degree of nominal inertia in commodity prices. Hence, policymakers have the ability to influence the real exchange rate and to alter competitiveness. This property also raises the possibility of increased real exchange rate variability induced by nominal shocks.

Our sample covers the transition period from January 1990 to March 1999 in Poland and Hungary.³ We investigate the statistical significance of some country- and period-specific events such as regime changes and the financial crises in East Asia and Russia to account for potential structural breaks in data. Based on the decomposition results, we explore and judge the ability of policymakers to affect real exchange rates through adherence to nominal anchors such as monetary and exchange rate policies.

The rest of the paper is organized as follows. In the next section, we provide an overview of monetary policy in Hungary and Poland. Section 3 provides an explanation of data employed and describes our methodology. In Section 4, we present the empirical results. Section 5 provides relevant data about indicators of real exchange rate movements in Hungary and Poland. Finally, Section 6 compares the evidence reported in Section 4 with evidence from industrial and developing countries and discusses policy implications of empirical findings.

³Other transition economies, including the Czech Republic, are not included due to insufficient observations. For the Czech Republic, data start in 1993, which does not provide enough degrees of freedom to get reliable estimates using the structural VAR model. In a future study, we plan to include other transition economies and draw more general conclusions. In this sense, our paper is exploratory and provides an initial analysis of this issue.

2. MONETARY POLICY IN HUNGARY AND POLAND⁴

2.1. Hungary

Initially, Hungary followed a gradualist macroeconomic policy as the authorities sought to balance the desire for reducing inflation with the need to control the government deficit and to service a large external debt at the beginning of the 1990's. Too large a reduction in inflation would have reduced government revenues and increased expenditures on the social safety net, thus increasing the government's need to borrow abroad. The official exchange rate was tied to a currency basket consisting of 50% U.S. dollar and 50% German mark weights until May 1994, when the weights for the reference basket changed to 70% ECU and 30% U.S. dollar. Monetary policy included active exchange rate management based on a currency peg with a narrow band of permitted fluctuations (Kutan and Brada, 2000).

The initial exchange rate policy, which aimed at a real appreciation of the forint to help combat domestic inflation, was determined to be too costly because of the declining competitiveness of Hungarian exports and sluggish growth. Moreover, it failed to provide a nominal exchange rate anchor to reduce inflationary expectations. These costs began to appear in 1993, when the current account deficit reached 9% of GDP and then increased to 9.4% the following year. At the same time, the government's budget deficit remained unacceptably high (Table 1). Financing this deficit required monetary expansion as well as high interest rates so that commercial banks would find government securities attractive, thus fueling the inflation that the strong forint policy had sought to reduce. The persistence of these twin deficits (Table 1) created uncertainty among Hungary's foreign creditors as well as concerns about the stability of the forint. The fact that the foreign debt was also growing steadily put Hungary at risk of insolvency. This macroeconomic situation was certainly not sustainable.

During the 1990 to 1994 period, a loose fiscal policy led to growing budget deficits and a high level of foreign debt. The disinflation policy combined with a fixed exchange rate resulted in continuous real appreciation, causing a loss of competitiveness and high current account deficits (Table 1). The two conflicting priorities of the government, control of inflation and improving international competitiveness, led to speculation against the forint, which undermined the credibility of the exchange rate regime. Liberalization of foreign exchange operations and the continuous real appreciation of the forint, resulting in significant capital inflows, gradually narrowed the ability of the monetary authorities to control the money supply. Moreover, during this period, there was no coordination between monetary and fiscal policy (Nemenyi, 1997).

The 1994 Mexican crisis further worsened Hungary's ability to borrow in international markets as the risk premium increased for emerging markets. The government realized that it could not sustain the dual objectives of controlling

⁴ This section draws on Kutan and Brada (2000).

TABLE 1
Hungary: Macroeconomic Indicators, 1991 to 1999

	1991	1992	1993	1994	1995	1996	1997	1998	1999
GDP real growth rate (%)	-11.9	-3.1	-0.6	2.9	1.5	1.3	4.6	5.1	4.2
CPI rate of inflation (%)	34.2	23.0	22.5	18.9	28.3	23.5	18.3	14.4	10.6
In % of GDP:									
Current account balance	0.8	0.9	-9.0	-9.4	-5.6	-3.7	-2.1	-4.8	-4.3
Government deficit ^a	3.0	7.0	6.5	8.4	6.7	3.1	4.8	4.8	3.7
Public debt									
Consolidated ^b	66.9	65.0	84.3	83.2	85.4	71.7	63.6	63.5	63.5
Nonconsolidated ^c	74.7	79.0	90.8	88.3	86.5	72.6	63.7	62.1	59.4

Source. Central Statistical Office Hungary, National Bank of Hungary, and Kiss and Szapary (2000).

Note. Figures for 1999 are preliminary.

^a Based on official data reported in Kiss and Szapary (2000, Table 2), which include transactions of the central government, the social security funds, the local authorities, and the extrabudgetary funds. For details, see Kiss and Szapary (2000).

^b Government and National Bank of Hungary, excluding the sterilization instruments of the central bank; see Kiss and Szapary (2000, Table 1).

^c Nonconsolidated with the National Bank of Hungary. For details, see Kiss and Szapary (2000, Table 1).

inflation and improving international competitiveness at the same time and, as a result, announced a major fiscal adjustment program in March 1995 (Szapary and Jakab, 1998). Fiscal policy was tightened to reduce the twin deficits through lower government expenditures, higher import tariffs, and reduced government borrowing. These measures cut the official budget deficit from 8.4% of GDP in 1994 to 6.7% in 1995 and 3.1% in 1996 (Table 1). Economic growth showed as the result of the March 1995 measures, but it soon accelerated. Higher growth strained the macroeconomic balance as the current account deficit increased to 4.8% of GDP in 1998 (Table 1). Inflation declined steadily, in part due to falling prices of imports and also to the slowing rate of depreciation of the forint. Price stability was declared the key goal of monetary policy in the long run. However, the evidence presented in Table 1 does not corroborate this claim, as there is wavering in both inflation and current account figures especially in 1996 and 1997.

The March 1995 measures included a major change in the nominal exchange rate regime intended to achieve credibility for economic policy and reduce the uncertainty associated with future policy measures so as to restore investors' confidence in the system (Nemenyi, 1997). Following a 9% devaluation of the official exchange rate, a preannounced crawling band exchange rate system was introduced in March 1995. The band of permitted fluctuations was set at 2.25% on either side of the parity, which has been maintained to the current period. The rate of crawl was set according to an inflation target. The initial monthly rate was 1.9% and it was gradually reduced to 0.3% in April 2000. The official currency basket was changed to 70% DM and 30% U.S. dollar in January 1997, and the DM was

replaced by the euro in January 1998. In January 2000, the exchange rate was completely tied to the euro.

The preannounced rate of devaluation in the crawling peg regime served as a more effective nominal anchor for monetary policy than had the periodic devaluations in the previous regime. It reduced speculation and attempts to time foreign exchange transaction to anticipate devaluations. Hungary sterilized some of the inflows of short-term foreign capital as interest rates rose in the post-stabilization period, but in smaller amounts and at lower costs (Szapáry and Jakab, 1998). Hence, the post-1995 measures were more effective in reducing speculative capital inflows than the initial policy of periodic devaluations.

2.2. Poland

The stabilization of the Polish economy began under much less favorable conditions than those found in Hungary. In 1989, inflation peaked at 54.8% per month, the government deficit was nearly 8% of GDP, and both loss-making Polish firms and the government deficit were financed by rapid expansion of money and credit. Although the government began to deal with the crisis in late 1989, the major stabilization program began on January 1, 1990, with the Balcerowicz Plan. The zloty (zl) was devalued from 5,560 zl/US\$ to 9,500 zl/US\$ and was pegged at the latter rate. Monetary and fiscal policies were tightened, enabling the government to achieve a surplus equivalent to 3.1% of GDP in 1990 (Table 2), and credit creation was sharply curtailed (Brada and Kutan, 1999). The consequences of stabilization and liberalization were sufficiently virulent, both in the upsurge in prices and in the decline in production, to lead to an easing of macroeconomic policy late in 1990. However, the effects of this policy change were felt more in an acceleration of inflation than in real output growth (Wellisz, 1997), and the government

TABLE 2
Poland: Macroeconomic Indicators, 1990 to 1999

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
GDP real growth rate	-11.6	-7.0	2.6	3.8	5.2	7.0	6.1	6.9	4.8	3.5
CPI rate of inflation (end year)	249.0	60.4	44.3	37.6	29.4	21.6	18.5	13.2	8.6	6.5
In % of GDP:										
Current Account balance	5.2	-2.8	-3.7	-2.7	-1	4.3	-0.9	-3	-4.3	-6.7
General government balance ^a	3.1	-6.7	-6.7	-3.1	-3.1	-2.8	-3.3	-3.1	-3.0	-3.0
Public debt	n.a.	n.a.	147.3	108.6	69.0	59.0	53.6	49.4	43.0	n.a.

Source. EBRD Transition Report, various issues, EIU, and national statistics.

Note. Figures for 1999 are estimates only.

^a General government includes the state, municipalities, and extrabudgetary funds. General government balance excludes privatization receipts.

soon abandoned this effort. As the recession deepened in 1991, the fiscal deficit reappeared and high inflation reduced the competitiveness of Polish exports. The zloty was devalued by 17% in May 1991 and its peg was shifted to a basket of currencies.

Policy priorities gradually shifted from encouraging stabilization to stimulating growth (Krzak, 1996). Although the fiscal deficit was cut from 6.7% of GDP in 1992 to 3.1% in 1993 (Table 2), a level around which it has fluctuated since, monetary policy was relatively expansionary. While real interest rates remained positive, money supply and credit growth consistently outpaced the targets set by the National Bank of Poland (NBP). The zloty's peg was abandoned in October of 1991, replaced by a crawling peg in the same month with a preannounced devaluation of 1.8% per month against a basket of currencies (Nutti, 2000). Over time, the rate of depreciation has been reduced and there have also been one-off devaluations and revaluations to accommodate exogenous shocks. In 1995, the band within which the zloty could fluctuate was widened to $\pm 7\%$. Poland's exchange rate policy was sufficiently credible to foreign investors that short-term capital inflows began to be a problem for the NBP by 1995 when, even with some NBP sterilization, capital inflows accounted for 59% of the growth of the money supply (Krzak, 1996). As a result, controlling the money supply became more difficult for the monetary authorities.

Although Poland has had a higher rate of inflation than Hungary through the 1990's, it has also had a faster rate of growth of real GDP (Table 2). Relatively higher growth in Poland may be due as much to an earlier start in implementing economic reforms as to better economic policy. Analogously, Poland's higher rate of inflation may reflect its more severe initial macroeconomic disequilibrium rather than an inability to restrain the growth of the money supply. Recently, output growth has slowed somewhat due to a fall in exports to Russia and the Ukraine, caused by the financial crises in those countries. As inflation has slackened and as the nominal anchor of the crawling peg has decreased in importance with a further widening of the bands, Poland has adopted inflation targeting (Brada and Kutun, 1999). In 1998, the Monetary Policy Council set a goal of lowering Polish inflation to 6.8–7.8% in 1999 and to 4% as measured by the CPI by the year 2003. As shown in Table 2, the projected inflation rate for 1999 is 6.5%, which is much lower than the estimates made by the Council in 1998 for 1999, suggesting that the inflation targeting policy has been effective in Poland.

Brada (1998) and Desai (1997, 1998) argue that different initial conditions and different starting times of stabilization programs result in different paths for real exchange rates and prices. Different approaches to monetary policy also lead to different behavior in real exchange rates. The post-1995 exchange rate regime of Hungary focused strongly on the stability of the nominal exchange rate as a tool of disinflation and on preventing significant real appreciation of the forint in order to sustain the current account balance and to control capital inflows (Orlowski, 2000). In addition, Hungary experienced some shock therapy, e.g.,

the bankruptcy legislation introduced in the early 1990's. The 1995 Bokros package also contained elements of shock therapy, including drastic cuts in budget spending, devaluation of the forint, change to a crawling peg, and the introduction of import surcharges. Thus, real exchange rate movements of the forint should have been driven mainly by real shocks because the Hungarian authorities had limited monetary discretion. Monetary policy was geared to nominal exchange rate stability and radical measures were taken that generated substantial real shocks to the economy. On the other hand, Poland moved gradually from a rigid fixed exchange rate targeting regime to a more flexible system with wide bands over time. Thus, given price inertia, the higher level of nominal exchange rate volatility that was evident in Poland can be expected to bring about larger real exchange rate fluctuations.

3. DATA AND METHODOLOGICAL ISSUES

Since Poland and Hungary implemented managed exchange rate regimes, their nominal exchange rates may not be stochastic. Instead of using nominal exchange rates, we thus consider the log of the price level, p_t , measured by the Consumer Price Index (CPI), and the log of the real exchange rate, q_t , in our bivariate decompositions.⁵ The latter is the CPI-based real effective exchange rate index, that is, the relative price of domestic goods in terms of foreign goods. The data are monthly observations from 1990:01 to 1999:03 taken from the CD ROM edition of *International Financial Statistics*. In order to specify properly the VAR, we test for unit roots, stationarity, and cointegration.

Table 3 presents the augmented Dickey–Fuller (ADF), Kwiatkowski–Phillips–Schmitt–Shin (KPSS), and cointegration test statistics. The maximum lag in the ADF test is specified using the general-to-specific procedure (Hall, 1994). Starting from a maximum lag of 16, the lag length is pared down depending on the significance of the last coefficient. In testing for a unit root, we consider the possibility of a linear trend in price levels. The ADF test statistics indicate that a unit root (nonstationarity) cannot be rejected for real exchange rates and prices. KPSS tests in Table 3 confirm that stationarity can be rejected at conventional significance levels. Thus, both tests indicate that the real exchange and price levels are nonstationary, which is a necessary condition for cointegration. Table 3 also presents the two-step test for cointegration. In the first step, the real exchange rate is regressed on a constant and the price level. Then, the residuals are tested for unit roots using an ADF test. The test statistic in both Poland and Hungary indicate that the price level and the real exchange rate are not cointegrated; hence, a VAR in first differences is appropriate.

⁵ An initial version of this paper computed decomposition based on real and nominal exchange rates instead of real exchange rates and price levels. We are thankful to a referee for suggesting that it may not be proper to use nominal exchange rates in our analysis because of the managed nature of these rates during our sample period.

TABLE 3
Unit Root, Stationarity, and Cointegration Tests

	Poland		Hungary	
	REER ^a	CPI ^b	REER ^a	CPI ^b
ADF statistic	-2.40	-0.67	-2.49	-0.26
Lag length	11	13	10	14
KPSS statistic ^c	1.842	0.540	1.525	0.330
Cointegration ADF statistic ^d		-2.76		-1.37
Lag length		10		10

^a The test assumes a constant in the ADF and KPSS procedures. The ADF critical values for 100 observations are -2.89 (5%) and -3.51 (1%). The KPSS critical values are 0.463 (5%) and 0.739 (1%).

^b The test assumes a constant and a linear trend in the ADF and KPSS procedures. The ADF critical values for 100 observations are -3.45 (5%) and -3.73 (1%). The KPSS critical values are 0.146 (5%) and 0.216 (1%).

^c Lag truncation is set at 4.

^d The cointegration test is the residual ADF statistic from the regression of REER on a constant and CPI. The critical value of the test for 2 variables and 100 observations at the 5% significance level is -3.37. The critical value is from Engle and Yoo (1987, p. 157).

While the sample period may be too short to assess mean reversion in real exchange rates, we believe that it is appropriate to model exchange rates as a unit root process within the sample period. This assumption allows us to estimate the exchange rate variability attributable to nominal and to real shocks. Assuming nonstationary real exchange rates is approximate for two reasons. First, purchasing power parity, which implies stationary real exchange rates, holds under very restrictive conditions that are unlikely to be met in transition economies (Brada, 1998). Second, in their analysis of equilibrium real exchange rates in transition economies, Halpern and Wyplosz (1997) argue that equilibrium real exchange rates should exhibit an upward trend over time as these countries catch up with the West and as productivity and real wages increase over time. Because such shocks are generally random or stochastic in nature, real exchange rates will have a permanent or stochastic component during this period.

Consider two types of orthogonal shocks, each of which could be the source of variation in the observed movements in real exchange rates and prices. A real shock, ε_{rt} , reflects changes in endowment, productivity shocks, and technology, and a nominal shock, ε_{nt} , is caused by nominal money supply shocks or devaluation of the exchange rate. Because the vector $\Delta y_t = [\Delta q_t \ \Delta p_t]'$ is stationary, it can be written as an infinite moving average in the structural shocks; i.e.,

$$\begin{bmatrix} \Delta q_t \\ \Delta p_t \end{bmatrix} = \begin{bmatrix} A_{11}(L) & A_{12}(L) \\ A_{21}(L) & A_{22}(L) \end{bmatrix} \begin{bmatrix} \varepsilon_{rt} \\ \varepsilon_{nt} \end{bmatrix}, \quad (1)$$

where A_{ij} are polynomials in the lag operator, L . In order to identify the shocks, it is assumed that nominal shocks have no long-run effect on the real exchange rate. This assumption can be imposed by restricting the coefficients in $A_{12}(L)$ to sum to zero. If $a_{ij}(k)$ is the k th coefficient in $A_{ij}(L)$, the restriction is equivalent to

$$\sum_{k=0}^{\infty} a_{12}(k) = 0, \quad (2)$$

so that the cumulative effect of ε_{nr} on Δq_t is zero. Note that the effects of nominal and real shocks on prices are not restricted. This method of decomposing a series into its permanent and temporary components is valid provided the joint behavior of real exchange rate and price level contains reliable information about the underlying sources of fluctuations (Lastrapes, 1992).

4. EMPIRICAL RESULTS

A finite-order bivariate vector autoregressive model (VAR) is estimated for Poland and Hungary. Starting with a maximum lag of 16, a likelihood ratio test indicates that the VAR can be pared down to 12 lags. In order to examine the possibility of exogenous shifts in the variables and regime changes, we test for the significance of period and policy-specific dummies. First, for both countries, 1990 to 1991 represents a period of price liberalizations and frequent devaluations. Second, the Asian and Russian crisis in 1997 to 1998 may have influenced the time path of the endogenous variables. Furthermore, the implementation of the crawling peg regime in Hungary after March 1995 and the various exchange rate regimes in Poland are considered. Table 4 presents definitions of various dummies along with likelihood ratio tests and p -values for the significance of these dummies. In

TABLE 4
Likelihood Ratio Tests of Period-Specific Dummies

	Poland			Hungary		
	<i>d1</i>	<i>d2</i>	<i>d4</i>	<i>d1</i>	<i>d2</i>	<i>d3</i>
Likelihood ratio $\sim \chi^2(2)$	5.70	0.66	6.63	5.21	0.86	7.42
p -Value (%)	5.79	71.79	3.64	7.37	64.97	2.44

Note. Definition of dummies:

d1 (price liberalizations and devaluations), 1990:1–1991:12 = 1, 0 otherwise;

d2 (Asian and Russian crisis), 1997:5–1998:8 = 1, 0 otherwise;

d3 (crawling peg in Hungary), 1995:5–1999:3 = 1, 0 otherwise;

d4 (Polish exchange rate regimes),

a. Peg 1990:1–1991:5 = 0,

b. Crawling peg 1991:6–1995:4 = 1,

c. Crawling band 1995:5–1999:3 = 2.

TABLE 5

Variance Decomposition of Real Exchange Rates and Price Levels (Percentage of Forecast Error Variance Attributable to ε_r and ε_n)

Month	Poland				Hungary			
	Real exchange rate		Prices		Real exchange rate		Prices	
	ε_r	ε_n	ε_r	ε_n	ε_r	ε_n	ε_r	ε_n
1	36.9	63.1	92.9	7.1	77.9	22.1	8.7	91.3
3	54.7	45.3	77.3	22.7	83.6	16.4	10.3	89.7
6	67.6	32.4	61.2	38.8	89.5	10.5	9.0	91.0
9	67.6	32.4	46.3	53.7	89.7	10.3	6.7	93.3
12	66.2	33.8	41.7	58.3	90.9	9.1	7.0	93.0
18	73.5	26.5	48.5	51.5	92.3	7.7	3.7	96.3
24	76.0	24.0	45.1	54.9	93.4	6.6	5.3	94.7
30	79.0	21.0	45.0	55.0	94.2	5.8	4.9	95.1
36	81.2	18.8	44.4	55.6	94.8	5.2	5.9	94.1
LR	100.0	0.0	43.1	56.9	100.0	0.0	8.6	91.4

each case, the resulting likelihood ratio test statistic is distributed as a χ^2 with two degrees of freedom.

The initial transition dummy $d1$ is significant for both Hungary and Poland at the 10% significance level. However, the Asian and Russian crisis dummy, $d2$, is not significant for either country. This evidence is broadly consistent with the findings of Orlowski (1999), who studied the effects of the Asian and Russian crises on the economies of Poland, Hungary, and the Czech Republic. The dummy variable $d3$, which represents the implementation of the preannounced crawling peg regime in Hungary in March 1995, and dummy variable $d4$, which represents three different exchange rate regimes in Poland, are statistically significant at the 5% level. Hence, in the final VAR model, we include $d1$ and $d3$ for Hungary and $d1$ and $d4$ for Poland.

After specifying properly the VARs, the restriction in Eq. (2) is imposed and the shocks are identified. The dynamic effects of the nominal and real shocks can be analyzed by variance decompositions (VDC) and impulse response functions (IRF). By construction, the effects of nominal shocks on real exchange rate necessarily decrease. In the long run, nominal shocks are constrained to have no effect on the real exchange rate. However, nominal shocks can play a significant role in explaining real exchange rate volatility in the short run. The results in Table 5 indicate that a sizable proportion of real exchange rate variability is due to nominal shocks in Poland.⁶ Specifically, at short-term forecasting horizons such

⁶This finding lends some empirical support to disequilibrium models of the exchange rate that attribute short-run excess volatility in nominal and real exchange rates to nominal shocks (e.g., Dornbusch, 1976).

as a month, nominal shocks explain 63.1% of the real exchange rate forecast error variance. Moreover, nominal shocks continue to play an important role after 36 months, which may point to some inertia in relative commodity price adjustment in Poland.⁷ A key policy implication of these results is that, to the extent that nominal shocks stem from monetary policy actions, monetary policy has had a significant role in influencing the real exchange rate in Poland. Finally, almost all of the variation in the price level in the short run is due to real shocks in Poland.

By contrast, VDC results for Hungary indicate that, although nominal shocks explain over 20% of real exchange rate variability at a one-month horizon, there is little effect of nominal shocks after one year. Changes in real exchange rates are dominated by real shocks. On the other hand, the relative contribution of nominal shocks to price level variability is higher in Hungary than in Poland. In Poland, real shocks explain 43% of the price level in the long run, while the effect of real shocks on the price level is negligible in Hungary. A possible explanation for the relative preponderance of real shocks in explaining price levels in Poland is pervasive structural imbalances in the real economy (Pujol and Griffiths, 1998). Such imbalances often lead to large relative price changes. In order to improve profitability and to remain in business, firms increased prices in certain sectors, e.g., utilities and housing, well above those in other sectors. Moreover, large loss-making firms did not face hard budget constraints because they accounted for sizable employment and wielded substantial political powers. Furthermore widespread indexation magnifies sectoral price changes. Based on a wage-price model of the Polish economy, Pujol and Griffiths (1998) estimate that, after four years, the initial inflationary impact of a CPI shock is quadrupled even if the exchange rate remains the same. As the result of reforms in the 1970's and 1980's, Hungarian relative prices were aligned better with world prices and, as a result, relative prices changes were smaller.

Given nominal exchange rate targeting in Hungary, it is interesting to find that the effect of real shocks on the price level is negligible. This result may provide important insight into the rate of the crawl and the price-setting behavior of domestic agents.⁸ Accordingly, Hungarian authorities resorted to inflation to correct supply and demand imbalances. This policy has helped to avoid a surge of inflation in the initial phase of the transition from 1990 to 1991, when prices were fully liberalized. However, in the subsequent period, any sign of external imbalances immediately generated expectations of accelerating inflation. For example, worsening external imbalances in the 1992 to 1995 period generated substantial inflationary expectations. As the public expected inflation to follow from the deficit problem, price makers kept inflation higher than would otherwise have been warranted. Moreover, price-setting firms did not reduce prices as the rate of devaluation declined in 1992 to 1993. To a large extent, inflation in Hungary is driven by expectations (Suranyi and Vincze, 1998).

⁷ The significance of nominal shocks in explaining real exchange rate movements is consistent with evidence reported in Enders and Lee (1997) for Brazil and Argentina.

⁸ We are grateful to a referee for pointing out the role of expectations.

5. FURTHER ANALYSIS: INDICATORS OF REAL EXCHANGE MOVEMENTS

The different policy approaches taken by each country toward economic liberalization provide a plausible explanation for the differences in results. In the earlier years, real exchange rate movements in Poland were driven by the large initial undervaluation of the nominal exchange rate in relation to the purchasing power estimate. If the initial devaluation resulted in an undervalued exchange, there would be less pressure to devalue further. Hence, real appreciation can occur for a longer period in Poland before devaluation is in order. The initial disequilibrium between the actual exchange rate and the exchange rate suggested by purchasing power parity (PPP) complicated the management of exchange rate regimes in transition countries (Desai, 1997; Portes, 1994). As a result, Poland had to announce larger devaluations to eliminate the initial disequilibrium in the exchange rate. In contrast, Hungary did not have this problem. Real forces, such as the upgrading of old technologies through foreign direct investment and the increase in product quality and structure, and real shocks to the economy, such as bankruptcy laws, drastic cuts in budget spending, devaluation of the forint, a change to a crawling peg, and introduction of import surcharges, have been the main driving forces of the observed real exchange rate appreciation in Hungary during our sample period. Hungarian privatization through sales to foreign strategic owners should have led to more restructuring. Szapary and Jakab (1998) report that, during the 1992 to 1997 period, the productivity of labor in Hungarian manufacturing industry rose by an average of 14% per year. The recent improvement in the trade balance reflects not only increase in productivity but also diversification toward new exports of machinery, electronics, and other products that have emerged as a result of foreign direct investment (FDI) and privatization. Elteto et al. (2000) indicate that 41% of FDI inflows to Hungary in 1998 took place via privatization. Hunya (2000, Table 1) also reports that foreign direct investment stock as a percentage of GDP in Hungary was 38.5% in 1998, and the same figure for Poland was only 15.7%. Hence, real appreciation of the forint was driven by significant real shocks in Hungary.

To provide more insight into the real exchange rate developments in both countries, Table 6 reports data on measures of unit labor costs, productivity, and real wages. Both countries experienced significant productivity gains in the transition period. Because firms in both countries can be seen as price takers in international markets, productivity and real wage developments determine relative competitiveness.⁹ Although unit labor costs declined in Poland until 1994, with the exception of 1991, they increased continuously starting in 1995. The opposite pattern emerges in Hungary, as unit labor costs increased until 1992 but have declined steadily thereafter. Thus, declining labor costs played an important role in the appreciation of the forint in the 1990's. For Poland, while there was

⁹ Krajnyak and Zettelmeyer (1998) give a detailed assessment of the extent of the change in competitiveness.

TABLE 6
Factors Influencing Real Exchange Rate Movements: Hungary and Poland (Annual % Change)

	1991	1992	1993	1994	1995	1996	1997
Hungary							
Unit Labor Costs (ULC), manufacturing sector							
DM ULC	29.4	7.6	-9.6	-1.0	-8.7	n.a.	n.a.
US\$ ULC				-3.6	-19.1	-3.4	0.6
Productivity	0.4	5.8	5.9	4.0	6.2	4.1	3.4
Real wages	-8.2	-1.1	2.5	1.3	-5.6	-1.7	2.7
Poland							
Unit labor costs, manufacturing sector							
DM ULC	66.5	-8.7	-8.8	-7.3	15.1	n.a.	n.a.
US\$ ULC				-6.2	2.9	9.0	3.0
Productivity	-2.6	6.1	3.3	5.2	3.3	1.3	4.4
Real wages	0.7	-6.2	-2.2	2.7	3.8	5.9	6.7

Source. DRI, IMF, EBRD Transition Report, and our own calculations.

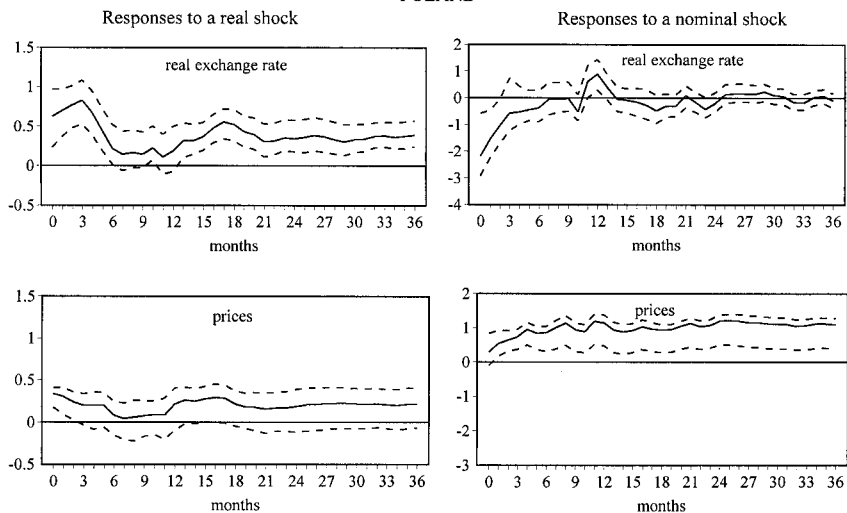
little wage pressure from 1990 to 1994, recent real wage increases have exceeded productivity gains, leading to increases in unit labor costs that have slowed down appreciation in the real exchange rate. On the other hand, Hungary still enjoys productivity gains above real wage increases, which result in decreasing unit labor costs and increasing competitiveness.¹⁰ Thus, the leveling off of the competitiveness of Polish exports in 1995 and the continuing increase in competitiveness in Hungary until 1997 seem to corroborate the hypothesis that there was a sizable transitory component in the real exchange rate in Poland but not in Hungary.

The dynamic path of exchange rate responses can be explored by examining the impulse response functions (IRFs). Figure 1 presents the responses of real and nominal exchange rates to nominal and real shocks. The IRFs are presented with a 90% confidence interval obtained by a bootstrapping technique based on 10,000 draws. The real exchange rate increases in response to a real shock in both countries follow a similar time path and the responses appear to be statistically significant. In response to a real shock that raises the relative price of domestic goods, the price level in both countries increases. However, except for the initial response, the response of the price level is not statistically significant.

The responses to a nominal shock exhibit two interesting patterns. First, in both countries, the real exchange rate depreciates in response to a nominal shock, indicating nominal inertia in commodity prices and some overshooting of the nominal exchange rate. Since the real exchange rate is the relative price of domestic goods, a nominal shock leads to a nominal depreciation of domestic currency that

¹⁰ For further evidence on quantifying productivity gains in selected transition economies, see Brada and Kutan (2000a, 2000b).

POLAND



HUNGARY

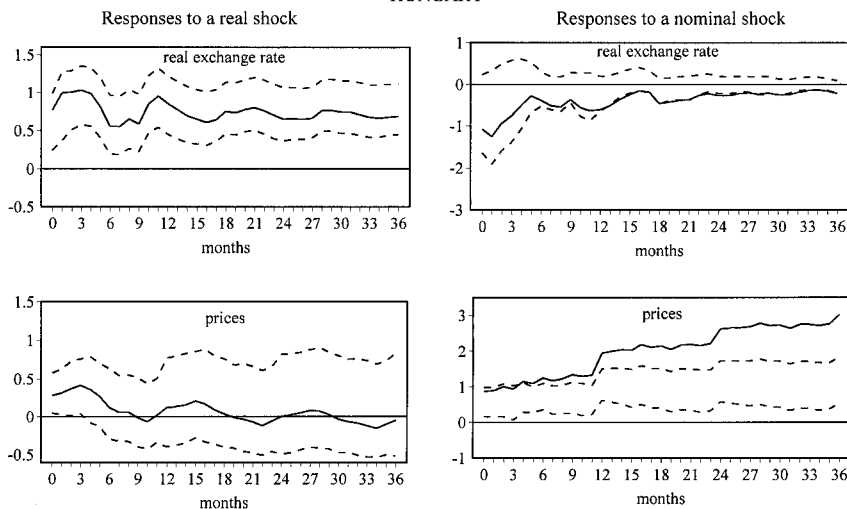


FIG. 1. Impulse response functions with 90% confidence interval.

exceeds the increase in the price level; hence, the real exchange rate depreciates. Data reveal that the standard deviation of the percentage change in the nominal exchange rate exceeds that of inflation in both countries.¹¹ However, this overshooting does not seem to be statistically significant for Hungary. Second, the

¹¹ The standard deviation of inflation in Hungary is 0.0060 compared to a 1% change in the nominal exchange rate with a standard deviation of 0.0075. The figures for Poland are 0.0096 and 0.0104, respectively.

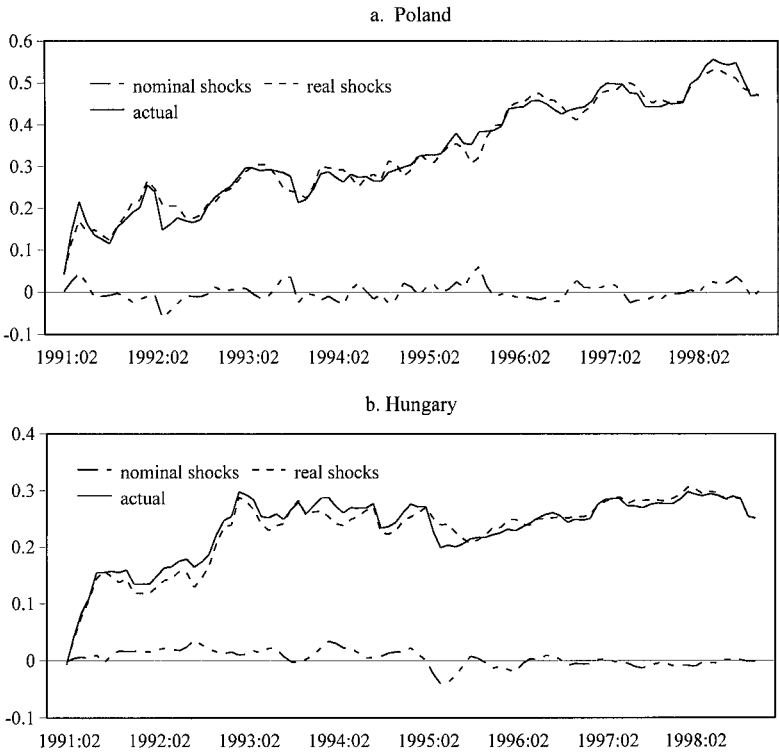


FIG. 2. A historical decomposition of the real exchange rate.

price level increases in response to a nominal shock as expected. The responses of prices to a nominal shock seem to be statistically significant in both countries. However, the point estimates in Hungary lie outside the confidence interval. Since confidence intervals give an idea about the true response, one should focus on the interval itself and not the sample response.

Finally, a historical decomposition of the real exchange rate is obtained from a simulation based on the moving average representation in which the deterministic trend is assumed to be due to real shocks. In panel a of Fig. 2, real exchange rate movements due to real shocks are smoother than those due to nominal shocks for Poland. Historical decomposition of the real exchange rate for Hungary indicates that nominal shocks had no major impact on the real exchange rate, particularly after 1995. Moreover, nominal shocks contributed little to real exchange rate variability in Hungary.

6. CONCLUSION: POLICY IMPLICATIONS

Our results show that nominal shocks had a larger influence in explaining the short-run changes in the real exchange rates in Poland, whereas real shocks had a

larger influence in Hungary. Although these results support Brada's (1998) thesis that transition economies should follow different exchange rate paths, they do not lend support to the notion that one type of shock, i.e., a monetary shock, should necessarily dominate other types of shocks, e.g., productivity shocks. Indeed, our results indicate that real shocks had more effect than nominal shocks on exchange rates in Hungary, but that the opposite was true in Poland.

The finding for Hungary is consistent with the evidence reported for industrial countries in Lastrapes (1992) and Enders and Lee (1997) that real factors play a key role in determining the behavior of real exchange rate in industrial countries, while monetary variables have insignificant, short-lived effect. In contrast, the results for Poland imply that there is scope for the effectiveness of monetary and exchange rate policies in manipulating the real exchange rate, at least in the short run. In other words, an exchange rate and/or monetary policy aimed at maintaining international competitiveness through realistic exchange rates by managing the nominal exchange rate has been possible in Poland. In contrast, our results imply that the Hungarian government needs to focus particularly on the real side of the economy, for instance, further improving efficiency and productivity, to improve its competitiveness.

The dynamic effects of nominal and real shocks in Poland and Hungary can be compared with those reported by Lastrapes (1992) for selected industrial countries such as Germany, Japan, Canada, and Italy, and by Enders and Lee (1997) for low-inflation countries, Canada, Germany, and Japan, and for high-inflation, developing countries, Argentina and Brazil. For industrial countries with low inflation rates, both studies concluded that real shocks explain the bulk of real exchange rate movements. Our evidence for Hungary is consistent with this finding as nominal shocks do not affect real exchange rate movements at a relatively low or moderate level of inflation. For high-inflation economies, such as Argentina and Brazil, Enders and Lee (1997) report that nominal shocks dominated the time path of both real and nominal exchange rates. The evidence for Poland complements this finding in that nominal shocks played a significant role in explaining real exchange rate fluctuations. Although the inflation rate declined significantly over time in Poland, the significant initial price shocks and the large and persistent inflationary expectations played an important role in the determination of the real exchange rate of the zloty.¹²

The importance of nominal shocks for real exchange rate movements has important policy implications. First, if nominal shocks have a sizable impact on real exchange rates, minimizing nominal shock variability, perhaps by following a stable monetary policy, is important to achieving exchange rate stability. Second, since real exchange rate responses to nominal shocks imply some degree of commodity price inertia, especially in Poland, government policy can influence the real

¹² Brada and Kutan (1999) provide evidence of persistent inflationary expectations in Poland and in other transition economies.

exchange rate by manipulating the nominal exchange rate. Finally, depending on trade elasticities, the authorities have some leverage over external balance problems arising from adverse terms of trade shocks, such as the CMEA shock. For example, Brada and Kután (1997) estimate a model of Czech trade and show that the redirection of Czech trade toward the West was supported by the government's exchange rate policies.

Our results have implications for modeling exchange rates in transition economies. Sticky-price, disequilibrium models (Dornbusch, 1976) predict that real exchange rates are driven by nominal shocks while the equilibrium exchange rate models of Stockman (1980, 1987) emphasize the importance of real shocks in driving real exchange rate movements. For Poland, sticky-price, disequilibrium models may explain the behavior of the real exchange rate. For Hungary, because the findings suggest that exchange rate fluctuations have been due primarily to real shocks, equilibrium exchange rate models are more suitable.

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