

## **IMF Working Paper**

© 1998 International Monetary Fund

This is a *Working Paper* and the author(s) would welcome any comments on the present text. Citations should refer to a *Working Paper of the International Monetary Fund*. The views expressed are those of the author(s) and do not necessarily represent those of the Fund.

WP/98/101

INTERNATIONAL MONETARY FUND

European I Department

### **Inflation and Money Demand in Albania**

Prepared by Sanjay Kalra<sup>1</sup>

Authorized for distribution by Anne K. McGuirk

July 1998

#### **Abstract**

The paper uses a simple analytical framework to estimate relationships between prices, money, the exchange rate, and interest rates in Albania during 1993–97. The estimated parsimonious error correction model extends the findings of a growing literature on inflation and money demand in transition economies. The results suggest that, after the one-time effects of the 1997 crisis are taken into account, the long-run determinants of inflation and money demand remained unchanged. Strong financial policies since mid-1997 appear to have helped to restore conditions for low inflation and stable money demand.

JEL classification numbers: E31, E41

Keywords: Albania, inflation, money demand, vector autoregression

Author's e-mail address: SKALRA@IMF.ORG

---

<sup>1</sup> I am grateful to Neil Ericsson for valuable comments, and for his course on “Empirical Modeling of Time Series.” I thank Gerard Bélanger, Robert Corker, Luc Everaert, Tarhan Feyzioğlu, Anastasios Gagales, Russell Kincaid, Tim Lane, and especially Juha Kähkönen, for very useful suggestions. I am also grateful to Anne McGuirk for encouragement to pursue the project. The usual disclaimer applies.

Contents	Page
Summary . . . . .	4
I. Introduction . . . . .	5
II. Analytical framework . . . . .	8
III. Data . . . . .	11
IV. Integration and cointegration . . . . .	11
V. An error correction model of prices and money . . . . .	18
A. A parsimonious, conditional error correction model . . . . .	18
B. Model properties . . . . .	21
C. Developments in 1997 . . . . .	24
VI. Concluding remarks . . . . .	28
Tables	
1. Main economic indicators, 1992–97 . . . . .	6
2. Augmented Dickey–Fuller statistics for testing for a unit root . . . . .	13
3. Cointegration analysis . . . . .	15
4. Restricted cointegration analysis . . . . .	17
5. A parsimonious full information maximum likelihood (FIML) conditional error correction model (ECM) . . . . .	19
6. Diagnostic statistics for the FIML conditional ECM, 1993(4)–96(12) . . . . .	22
7. A parsimonious FIML conditional ECM 1993(4)–97(12) . . . . .	29
8. Diagnostic statistics for the FIML conditional ECM, 1993(4)–97(12) . . . . .	30
Figures	
1. Economic developments, 1993–97 . . . . .	7
2. Daily lek/US dollar exchange rate and fluctuation bands, 1993–96 . . . . .	10
3. Money, inflation, the exchange rate, and interest rates, 1993–97 . . . . .	12
4. Cointegration analysis . . . . .	14
5. Inflation and money growth: 1993(4)–96(12) . . . . .	20
6. Constancy statistics for the conditional ECM . . . . .	23
7. Impulse response functions of the conditional ECM . . . . .	25
8. Cumulative impulse response functions of the conditional ECM . . . . .	26

9. Forecast chow statistics for the conditional ECM . . . . .	27
10. Inflation and money growth: 1993(4)–97(12) . . . . .	31
11. Chow statistics for the conditional ECM . . . . .	32
References . . . . .	34

## SUMMARY

The paper elaborates a simple two-equation analytical framework covering the goods and money markets. It estimates a multivariate vector autoregression model of the price level, the exchange rate, money, and interest rates for Albania during 1993–97. It uses weak exogeneity tests to construct a conditional parsimonious error correction model (ECM). This ECM exhibits parameter constancy, suggesting that the determinants of inflation and money demand remained unchanged over the sample period.

The model, estimated initially for 1993–96, extends the findings of a growing literature on price formation and the behavior of money demand in transition economies. The paper finds that the money demand function was “well behaved.” In particular, it shows that money demand was homogenous with respect to the price level, was inversely related to the expected depreciation of the exchange rate, and was positively related to the interest rate and the level of economic activity. Exchange rate depreciation passed through into price inflation, but not fully, resulting in a tendency for the real exchange rate to appreciate. The dynamics of the model suggest that adjustment to disturbances was faster than is typically reported for industrial countries.

Albania descended into a crisis in March 1997, generating concerns about a potential surge in inflation and greater volatility in money demand. To account for the effects of the crisis, the ECM is reestimated using data for 1993–97 and dummy variables for 1997. In particular, the exchange rate depreciated sharply in early 1997, and appeared to stabilize thereafter. The results suggest that, once the one-time effects of the crisis on the price level and the exchange rate are taken into account, the long-run determinants of inflation and money demand remained unchanged. Strong financial policies since mid-1997 appear to have helped to restore the conditions for low inflation and stable money demand.

## I. INTRODUCTION

Inflation and money demand developments in Albania during 1993–97 took place in the context of a dramatic transition to a market economy, marked by substantial changes in institutional structures and in the policy-making environment. During 1993–95, significant progress was made in economic stabilization: inflation was brought down from near hyperinflation levels, real output grew rapidly, and reserves were built up to a comfortable level (Table 1, Figure 1). The stabilization effort was based on tight financial policies: the budget deficit was reduced substantially and monetary management was prudent. With the economy's growing import needs financed by a large volume of remittances and generous foreign aid, Albania's floating exchange rate moved within a small band over the three-year period, a feature that continued during 1996. This stability in the policy environment and the favorable outcome may have formed the basis for a decline in inflationary expectations and stable exchange rate expectations, making for stable relationships between the price level, money, and the exchange rate.

Macroeconomic performance weakened in 1996 and a full-blown crisis erupted in early 1997. The fiscal stance became lax ahead of the parliamentary elections in May 1996 and the demand pressures were reflected in higher inflation and in a worsening of the current account deficit. Events took a turn for the worse during the second half of 1996, when the growth of financial pyramid scheme went unchecked. The inevitable collapse occurred in March 1997. Widespread rioting over lost savings led to extensive civil disorder. Massive supply-side disruptions, a precipitous fall in revenue collection, and a collapse of remittances, contributed to a sharp depreciation of the exchange rate and generated strong inflationary pressures. A decisive response to the crisis and a return to responsible financial policies came only in the second half of 1997 with the formation of a new government.

This paper has two objectives. First, it seeks to uncover the quantitative relationships between the price level, money, and the exchange rate in Albania. So far, there has been little econometric analysis of inflation and money demand for Albania. In part, this reflects the short time series and the scarcity of basic data on real activity. Second, the paper seeks to assess the impact of the economic crisis of 1997 on inflation and money demand. At the onset of the crisis, the fiscal situation worsened sharply, and together with the steep depreciation of the exchange rate, prompted fears that the economy might revert to a period of very high inflation, even hyperinflation. The period was also marked by heightened uncertainty about the prospective behavior of money demand. However, except for a steep jump in March, monthly inflation was quickly brought under control. This was undoubtedly in part due to the strong policy response in the second half of 1997. There is, nevertheless, the issue of whether these developments generated a significant change in the underlying determinants of inflation and money demand.

Table 1. Albania: Main economic indicators, 1992-97

	1992	1993	1994	1995	1996	1997 Est.
	(Percent change)					
Real GDP	-7.2	9.6	9.4	8.9	9.1	-7.0
Retail prices (period average)	226.0	85.0	22.6	7.8	12.7	32.1
Retail prices (during period)	236.6	30.9	15.8	6.0	17.4	42.1
	(In percent of GDP)					
Saving-investment balance						
Foreign saving 1/	57.1	28.7	14.4	9.7	11.5	14.2
Domestic saving	-51.9	-15.5	3.5	11.3	9.0	-2.2
Public 2/	-21.9	-8.7	-5.5	-3.3	-7.6	-8.7
Private	-30.0	-6.8	9.0	14.6	16.6	6.6
Investment	5.2	13.2	17.9	21.0	20.5	12.0
Public	4.0	9.5	8.6	8.2	4.5	4.1
Private	1.2	3.7	9.3	12.8	16.0	7.9
Fiscal sector						
Revenues	23.5	25.7	24.5	23.9	18.3	17.0
Expenditures 3/	44.0	34.9	31.2	30.8	29.0	27.6
Domestically financed deficit	20.0	9.1	7.0	6.6	11.0	10.9
Overall deficit	20.3	14.4	12.4	10.3	12.1	12.7
Monetary indicators						
Broad money growth (in percent)	...	75.0	40.6	51.8	43.8	28.4
Growth in private sector credit (in percent)	...	...	61.4	15.9	30.5	22.0
Velocity of circulation	...	3.68	2.83	2.22	1.97	1.92
	(In millions of U.S. dollars)					
External sector						
Current account balance	-104	-45	-118	-58	-168	-199
(in percent of GDP)	-14.7	-3.7	-6.0	-2.4	-6.2	-8.6
Official transfers	330	320	161	118	77	77
(in percent of GDP)	46.5	26.1	8.2	4.9	2.9	3.3
Current account balance 4/	-434	-365	-279	-176	-245	-276
(in percent of GDP)	-61.1	-29.7	-14.1	-7.2	-9.1	-11.9
Trade balance	-454	-490	-460	-474	-692	-519
(in percent of GDP)	-64.0	-39.9	-23.4	-19.6	-25.7	-22.5
Gross international reserves	72	147	204	240	280	306
(in months of imports of goods and nonfactor services)	1.4	2.3	3.2	3.4	3.1	4.5
Memorandum items:						
Real GDP (in billions of leks, 1990 prices)	11.2	12.3	13.5	14.7	16.0	14.9
Nominal GDP (in billions of leks)	53.2	125.3	187.9	224.7	281.0	338.9
Nominal GDP (in billions of U.S. dollars)	0.7	1.2	2.0	2.4	2.7	2.3

Sources: Albanian authorities; and Fund staff estimates.

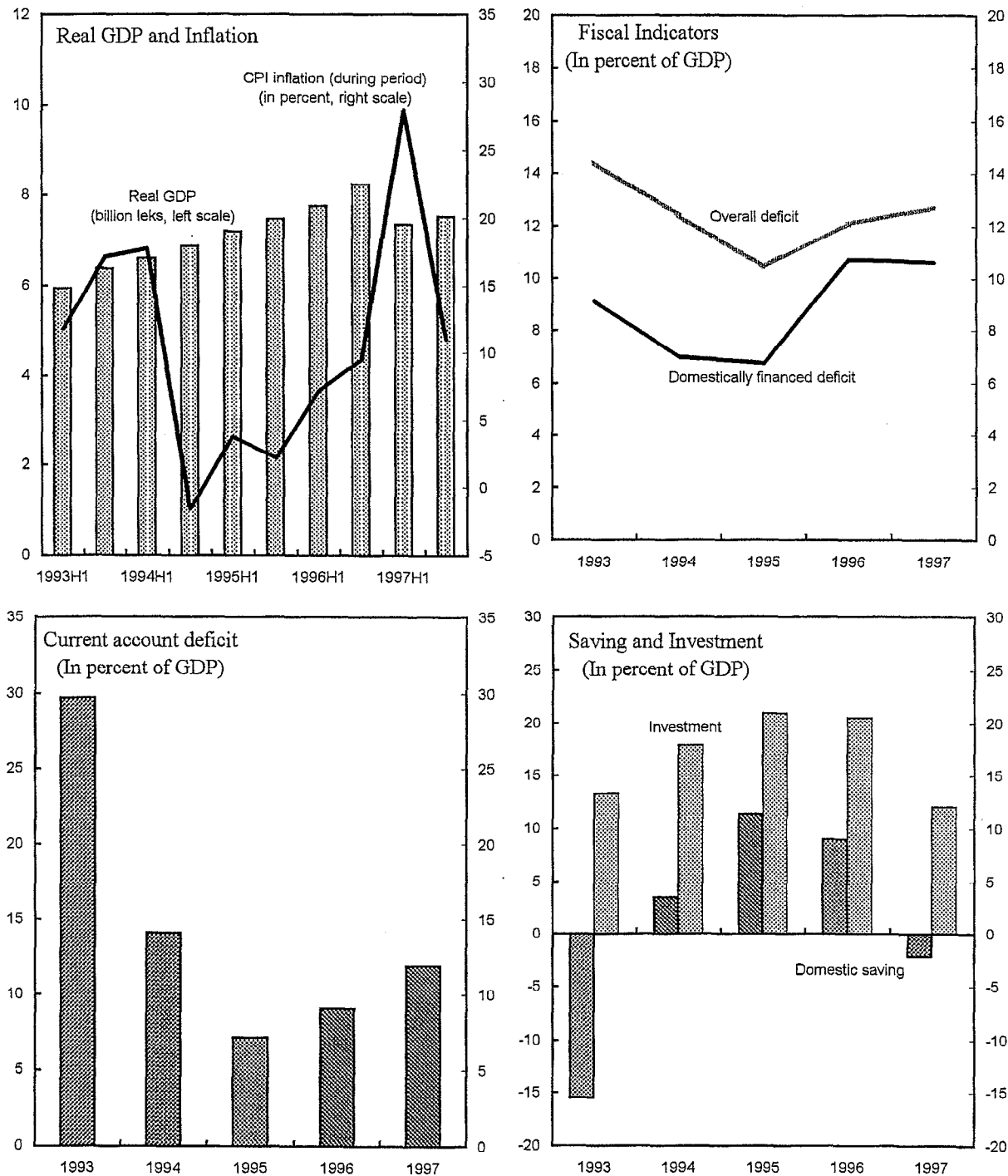
1/ Current account excluding net factor services and official transfers.

2/ Revenue (excluding grants) minus current expenditure.

3/ Commitment basis, excluding foreign financed investment.

4/ Excluding official transfers.

Figure 1. Albania: Economic developments, 1993-97



Sources: Albanian authorities; and Fund staff estimates.

This study is a part of a growing literature on inflation and money demand in transition economies. Reflecting the short length and paucity of the data series, the focus has mostly been on cross-country studies (Sahay and Vegh (1995), Fischer et. al. (1996), Begg (1996), Coorey et. al. (1997), De Broeck et. al. (1997)). These studies have produced stylized facts on, and cross-country panel data parameter estimates of, the determinants of inflation and money demand. Some individual country studies are also available (Griffiths and Pujol (1996), Domac (1997), and Ross (1998)). Albania's early experience with inflation stabilization is analyzed in McNeilly and Schiesser-Gachnang (1998).

The remainder of the paper is organized as follows: Section II outlines a simple analytical framework involving the price level, the exchange rate, money, and the interest rate. Data issues are taken up in Section III. Integration and cointegration analyses are carried out in Section IV. Based on these, a parsimonious error-correction model for prices, money, and interest rates, conditional on the exchange rate, is estimated in Section V. Section VI concludes.

## II. ANALYTICAL FRAMEWORK

The relationships between prices, money, and the exchange rate are examined using a simple two equation model of an economy with a goods market and a money market. In the goods market, the price level ( $P$ ) is assumed to be a weighted average of tradable ( $P_T$ ) and nontradables ( $P_{NT}$ ) prices; the price of tradables is determined by the exchange rate ( $E$ ) and foreign prices ( $P^*$ ) while nontradable prices are a markup over unit labor costs ( $W$ ):

$$\begin{aligned}
 (1) \quad & P = P_T^\alpha P_{NT}^{(1-\alpha)} & 0 < \alpha < 1 \\
 & P_T = E P^* & P^* = P_o^* \exp^{vt}, v > 0 \\
 & P_{NT} = (1+\rho) W & \rho > 0 \\
 & W = W_o \exp^{\phi t} & \phi > 0
 \end{aligned}$$

Substituting for the prices of tradables and nontradables in the price level equation, taking logs (all variables denoted in small letters) and using a suitable normalization,  $p$  is a function only of the exchange rate and time:

$$(2) \quad p = \alpha_1 e + \alpha_2 t$$

where  $\alpha_1 = \alpha$ , and  $\alpha_2 = [\alpha v + (1-\alpha)\phi] > 0$ .

Equations (1)–(2) also define the evolution of the real wage ( $w$ ) and the real exchange rate ( $x$ , the relative price of nontradables), using a suitable normalization, as:

$$\begin{aligned}
 w &= (\phi - \alpha_2) t - \alpha_1 e \\
 x &= (\phi - v) t
 \end{aligned}$$



The demand for money is represented as a function of the price level (P), the expected depreciation of the exchange rate (E), the interest rate (R), and the level of real activity (Y):

$$(3) \quad M^d = f(P, \text{Expected } (\Delta E/E), R, Y) \quad f_1 > 0; f_4 > 0.$$

The transactions demand for nominal balances increases as the price level rises. The inclusion of the expected rate of depreciation in the money demand function captures the portfolio choice that asset holders face. In the Albanian context, foreign cash and deposits constitute virtually the only financial alternative to domestic currency and deposits. Movements in the exchange rate constitute an important element of the relative rate of return on alternative assets and are facilitated by the curb market in foreign exchange, which is relatively efficient and can mediate a substantial volume of small transactions at low cost.<sup>2</sup> *A priori*, the sign of  $f_2$  is indeterminate and would depend on whether broad money is defined to include or exclude foreign currency denominated deposits.<sup>3</sup> With regard to the interest rate,  $f_3$  may be positive or negative. The demand for currency would fall with an increase in R but the demand for (interest bearing) demand and time deposits is likely to be higher. Finally, money demand is expected to be positively related to the level of activity.

We can therefore postulate the following (semi-log) relation between money demand, the price level, the exchange rate, the interest rate, and the level of activity:

$$(4) \quad m^d = \beta_1 p + \beta_2 e + \beta_3 R + \beta_4 y \quad \beta_1 > 0; \beta_4 > 0.$$

---

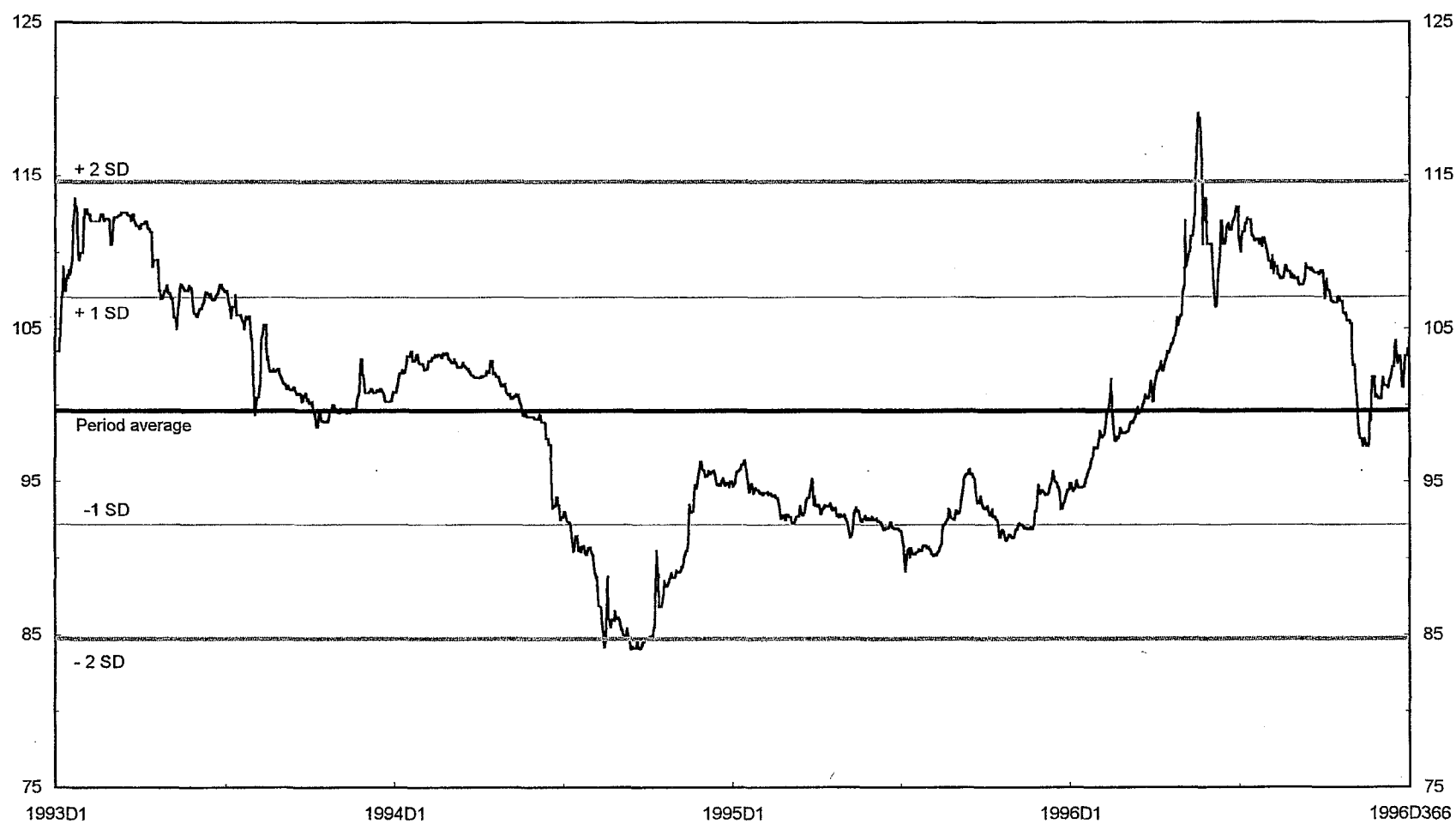
<sup>2</sup> The expectations formation mechanism used here follows Frankel (1979). The expected rate of depreciation is the sum of a trend rate of depreciation ( $\varphi$ ), and an adjustment term which is a negative function of the deviation of the *spot* market exchange rate from its “equilibrium” value:

$$\text{Expected } (\Delta E/E) = \varphi - \eta (e - e^*), \eta > 0.$$

Using a suitable normalization, we can set  $\varphi + \eta e^* = 0$ . For the conditions under which these expectations are rational, see De Broeck et. al. (1997). This expectations formation mechanism fits well with the observed stability of the exchange rate over a four year period since the inception of the float in mid-1992. Barring periods of electoral activity, the daily exchange rate of the lek against the US dollar displayed remarkable stability against the U.S. dollar (Figure 2). This stability was remarkable given the absence of any marked foreign exchange market intervention by the central bank.

<sup>3</sup> In the empirical analysis, broad money is defined to include foreign currency deposits. An expected depreciation in the exchange rate could induce: (i) a move into foreign currency denominated assets (and a shift in the composition of broad money towards foreign currency denominated assets) contributing a positive component to  $f_2$ ; and (ii) a shift to foreign currency contributing a negative component to  $f_2$ .

Figure 2. Albania: Daily lek/U.S. dollar exchange rate and fluctuation bands, 1993-96



Sources: Albanian authorities; and Fund staff estimates.

### III. DATA

Data for the period 1993–97 are used. The data are plotted in Figure 3. Monthly CPI data are available from the Albanian statistical institute, INSTAT. The price variable is the CPI index, excluding administered prices. The exchange rate is the monthly average of daily lek/US dollar rate. Data on broad money and the interest rate are available from the Bank of Albania. Broad money is defined to include domestic currency in circulation, and demand and time deposits (in domestic and foreign currency). The minimum 12-month deposit rate in state-owned commercial banks is used for the interest rate variable. In the absence of a suitable series, the nominal wage is assumed to be a function of time as in the analytical framework. With regard to the level of real activity, there are no official national income accounts. The scale variable  $Y$  is extrapolated to reflect the estimated growth of real GDP.<sup>4</sup> All variables are used without seasonal adjustments.

### IV. INTEGRATION AND COINTEGRATION

Unit root tests for the variables were conducted, and Johansen's maximum likelihood procedure was applied to test for cointegration between the variables. Table 2 lists the augmented Dickey-Fuller (ADF) statistics. All the variables appear to be integrated of at most order one. Cointegration tests between  $p$ ,  $e$ , and  $m$  (with  $R$ ,  $y$ , and the time trend as nonmodeled variables) were conducted in a third-order vector autoregression with three lags of each variable in the autoregressive distributed lag equations; the test statistics and estimates for the Johansen procedure are reported in Table 3.<sup>5</sup> The maximal and trace eigenvalues statistics ( $\lambda_{\max}$  and  $\lambda_{\text{trace}}$ ) give consistent indication of two cointegrating relationships. The three (recursively estimated) eigenvalues are reasonably constant (Figure 4). The standardized eigenvectors and adjustment coefficients of the cointegration analysis ( $\gamma'$  and  $\delta$ , respectively) are shown in Table 3.

Two sets of restrictions were imposed on  $\gamma'$  and  $\delta$ :

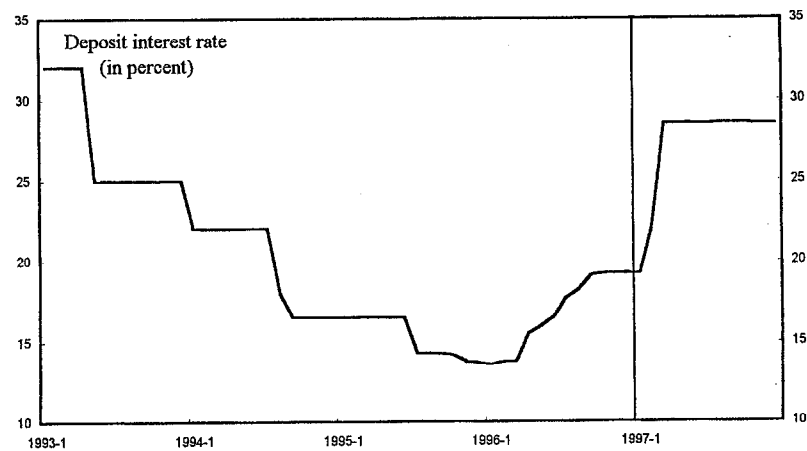
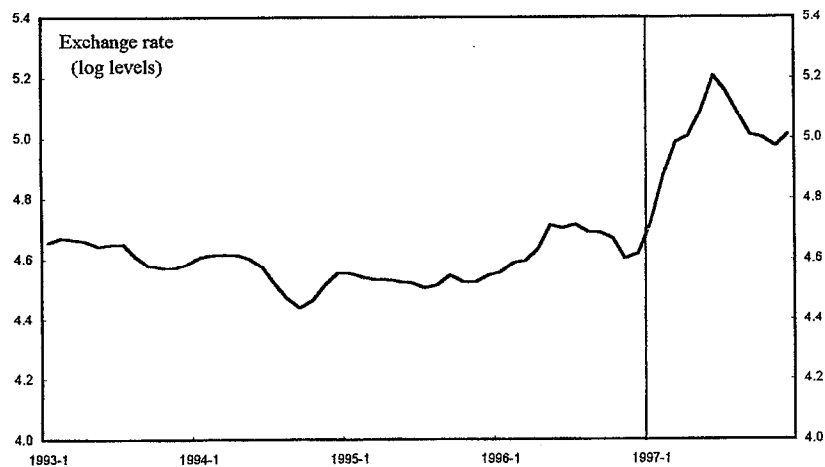
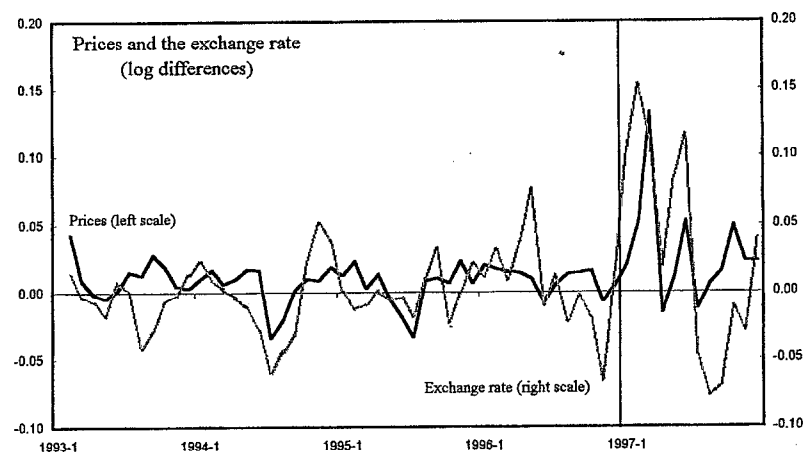
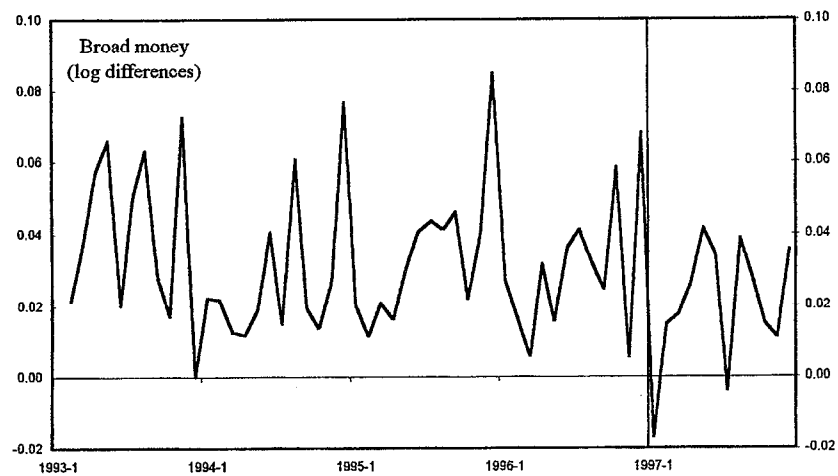
- Identification: zero restrictions were imposed to establish whether the cointegration vectors could “identify” relationships of the form (2) and (4), i.e., whether the vectors  $(1, -\gamma_{12}, 0, 0, 0, -\gamma_{16})$  and  $(-\gamma_{21}, -\gamma_{22}, 1, -\gamma_{24}, -\gamma_{25}, 0)$  lie in the cointegrating space. In addition, the restriction that nominal money demand is

---

<sup>4</sup> The monthly growth rates for real activity were assumed constant within the year, and the annual rates equal real GDP growth rates estimated by IMF staff based on available real sector data.

<sup>5</sup> The VAR was started with three lags. To economize on the number of estimated parameters, a test of model reduction to two lags was conducted, and was successful.

Figure 3. Albania: Money, prices, the exchange rate, and interest rates, 1993-97



Sources: Albanian authorities; and Fund staff estimates.

Table 2. Albania: Augmented Dickey-Fuller statistics for testing for a unit root  
Sample period: 1993(4)–96(12) 1/ 2/

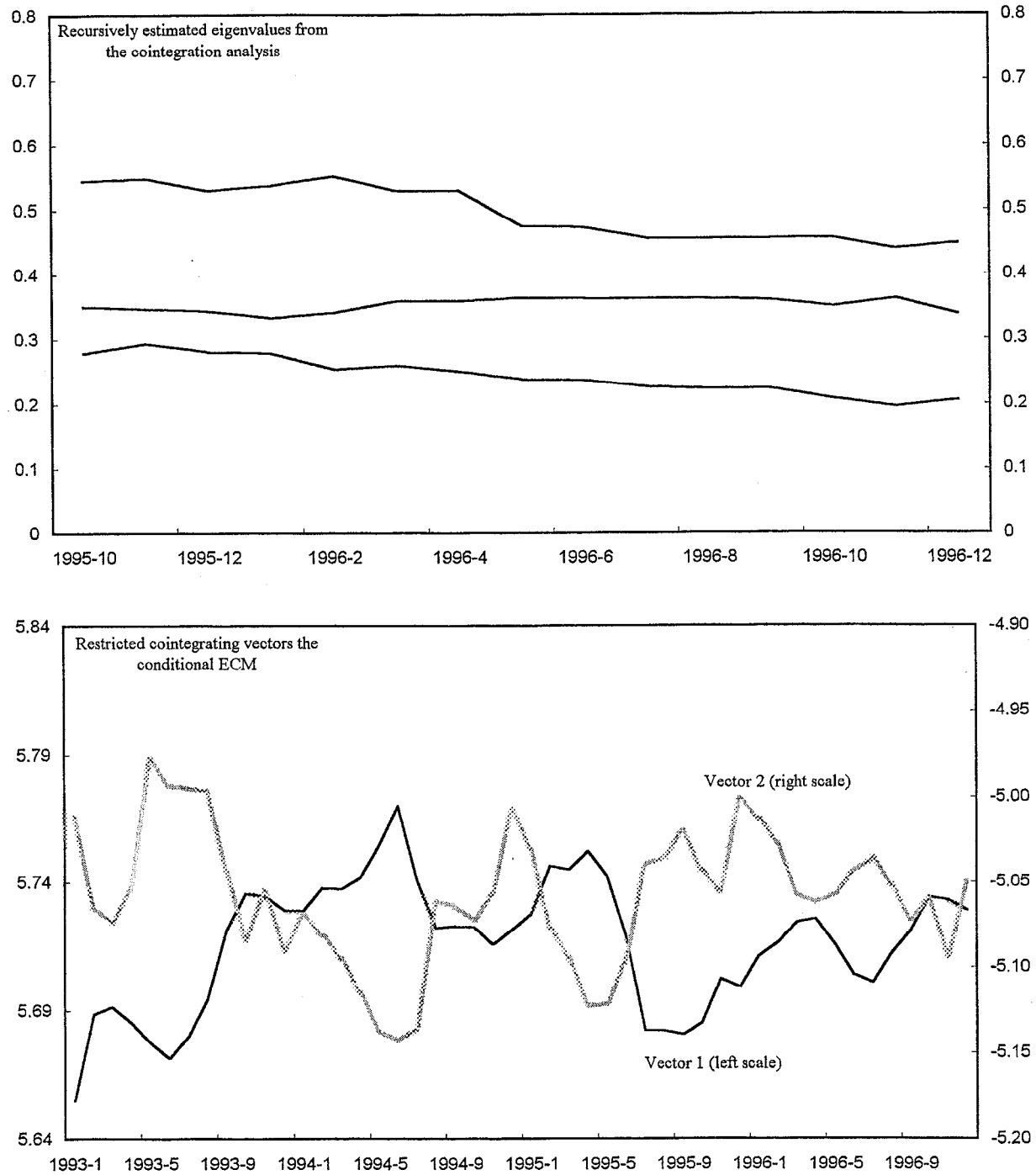
Null order	Variable			
	p	m	e	R
I(0)	-3.76* (0.36)	-5.84** (-0.05)	-3.70** (0.37)	-4.67** (0.16)
I(1)	-6.63** (-0.23)	-8.72** (-0.49)	-6.57** (-0.33)	-7.84** (0.36)

Sources: Albanian authorities; and Fund staff estimates.

1/ Two values are reported for each variable and null order—the augmented Dickey-Fuller statistic, and (in parentheses) the estimated coefficient on the lagged variable, where the coefficient should be zero under the null hypothesis of a unit root. For a given variable  $x$  and null order  $I(0)$ , the ADF statistic is testing a null hypothesis of a unit root in  $x$  against the alternative of a stationary root; for a null order  $I(1)$ , the statistic is testing a null hypothesis of a unit root in  $\Delta x$  against an alternative of a stationary root in  $\Delta x$ . Each estimated equation contains a constant and a time trend. The maximum available sample is used, and varies across the null order.

2/ Here, and in the remainder of the paper, \* and \*\* denote significance at the 5% and 1% level, respectively.

Figure 4. Albania: Cointegration analysis of prices, exchange rate, money, and interest rates



Sources: Albanian authorities; and Fund staff estimates.

Table 3. Albania: Cointegration analysis of prices, exchange rate, money, and interest rates  
Sample period: 1993(4)–96(12)

Eigenvalues	0.45	0.34	0.21		
Hypotheses 1/	$r = 0$	$r \leq 1$	$r \leq 2$		
$\lambda_{\max}$	26.8 *	18.6	10.4		
95% critical value	25.5	19.0	12.3		
$\lambda_{\text{trace}}$	55.7 **	28.9 **	10.4		
95% critical value	42.4	25.3	12.3		
Standardized eigenvectors, $\gamma'$					
p	e	m	R	y	Trend
1.00	0.07	-0.66	-0.19	1.52	0.003
16.59	1.00	23.66	-17.99	-53.87	-0.50
-0.79	4.80	1.00	-8.04	-7.12	0.001
Standardized adjustment coefficients, $\delta$					
	p	-0.31	0.002	0.011	
	e	-0.45	-0.002	-0.05	
	m	-0.09	-0.02	0.002	

Sources: Albanian authorities; and Fund staff estimates.

1/ The statistics  $\lambda_{\max}$  and  $\lambda_{\text{trace}}$  are Johansen's maximal eigenvalue and trace eigenvalue statistics for testing cointegration. The null hypothesis is in terms of the cointegration rank  $r$  and, in the case of  $r=0$  is evidence in favor of at least one cointegrating vector.

homogenous of degree 0 with regard to the price level was imposed on the second vector ( $\gamma_{21} = 1$ ).

- Weak exogeneity: The tests for weak exogeneity show that only the exchange rate fitted the bill ( $\delta_{21} = 0$ ,  $\delta_{22} = 0$ ; Table 4). In addition, the restriction that disequilibrium in the first cointegrating relationship did not affect the evolution of prices was imposed ( $\delta_{11} = 0$ ).<sup>6</sup>

The restricted cointegrating vectors and the estimated error correction parameters are presented in Table 4. The “identifying” restrictions on the cointegrating vectors and “zero” restrictions on the error correction factors were not rejected at the 1% level of significance. The restricted cointegrating relationships were reasonably stationary (Figure 4). These vectors are (standard errors in parentheses):

$$(2') \quad p^* = 0.18 e + 0.006 t \\ (0.07) \quad (0.0003)$$

$$(4') \quad m^* = p - 0.35 e + 0.71 R + 3.73 y \\ (0.16) \quad (0.36) \quad (0.15)$$

The coefficients in equations (2') and (4') have the anticipated signs, are highly significant, and measure the sensitivity of prices and money demand to the regressors:

- Equation (2') implies that over the sample period the price level was positively related to the depreciation of the exchange rate with an elasticity of 0.17. The parameter estimates of  $\alpha_1$  and  $\alpha_2$  can also be used to retrieve other parameters of equation (2). Thus,  $\alpha = \alpha_1 = 0.18$ , and  $[0.18v + 0.82 \phi] = \alpha_2 = 0.0062$ . Assuming  $v = 0.002$  (so that foreign prices increase at an annual rate of some 2½ percent), we can residually solve for  $\phi$ . The monthly growth rate of the nominal wage was thus an estimated 0.0071 (annualized 8½ percent). Moreover, the evolution of the equilibrium real wage rate and the real exchange rate can be calculated as:

$$w = 0.0009 t - 0.18 e \\ x = 0.005 t.$$

The estimated equation implies that the real wage grew over the sample period; for real exchange rate, the parameters imply an annual *appreciation* (of about 6 percent); this qualitative result sits well with the stylized fact that in transitional economies there is a tendency for the real exchange rate to appreciate.

---

<sup>6</sup> Weak exogeneity of the exchange rate is helpful in reducing the number of parameters in the conditional error correction model estimated below.



Table 4. Albania: Restricted cointegration analysis of prices, exchange rate, money, and interest rates  
Sample period: 1993(4)–96(12)

Weak exogeneity test statistics 1/						
	$\chi^2(2)$	p	e	m		
		13.9 [0.00] **	6.88 [0.03]*	8.4 [0.01] *		
Restricted eigenvectors, $\gamma'$						
	p	e	m	R	y	Trend
	1.000	-0.18144	0.000	0.000	0.000	-0.006174
	-1.000	0.34835	1.000	-0.71165	-3.7308	0.000
Standard errors of $\gamma'$						
	p	e	m	R	y	Trend
	0.00	0.067	0.00	0.00	0.00	0.00034
	0.00	0.164	0.00	0.359	0.145	0.000
Restricted adjustment coefficients, $\delta$						
	p	e	m			
	0.000	0.000	0.224			
	0.000	0.000	0.000			
	-0.857	-0.430				
Standard errors of $\delta$						
	p	e	m			
	0.000	0.000	0.049			
	0.000	0.000	0.000			
	0.202	0.139				

Sources: Albanian authorities; and Fund staff estimates.

1/ The weak exogeneity test statistics are evaluated under the assumption that  $r=2$  and so are asymptotically distributed as  $\chi^2(2)$  under the null of weak exogeneity of the specified variable.

- Equation (4') implies that in the long run, money demand rose by an estimated: (i)  $\frac{1}{3}$  percent for a one percent *appreciation* of the exchange rate; (ii)  $\frac{3}{4}$  percent if the deposit interest rate were raised by a percent; this positive relationship provides support for the policy of providing incentives for savings through the formal banking system; and (iii)  $3\frac{3}{4}$  percent if the level of real activity were one percent higher. The elasticity of money demand to the scale variable is higher than in industrial countries ( $\frac{1}{2}-1$ ), but is consistent with estimates for developing and transitional economies, where velocity shows a downward trend on account of many factors, including financial deepening. These results are consistent with the theoretical literature on the determinants of money demand, and the claim in the early transition literature that the determinants of inflation during transition are largely the same as in market economies (Sahay and Vegh (1995)).

## V. AN ERROR CORRECTION MODEL OF PRICES AND MONEY

An error correction model (ECM) of prices, money, and interest rates, conditional on the exchange rate, is developed in this section. The model is reduced to obtain a parsimonious ECM. The model parameters turn out to be statistically constant, a remarkable property given the changes in the institutional and structural changes in Albania over the sample period. The long- and short-run properties, and the adjustment mechanism of the conditional ECM are discussed. The estimated model is used to forecast the path of the price level and money demand during 1997. The outcomes are compared to forecast values to assess the impact of the crisis. The model is reestimated using a dummy variable for 1997 to take account of the structural break in the parameters. The reestimated model is constant.

### A. A parsimonious, conditional error correction model

The vector autoregression which forms the basis of the relationships in (2)' and (4)' was mapped into an  $I(0)$  system, and the reformulated system was estimated using recursive least squares. Corresponding to the lag length of two in the ADL, the lag length in the  $I(0)$  system was one. Monthly seasonal dummies were included in the system. A process of model reduction was then undertaken: (i) weak exogeneity of the exchange rate was imposed on the system, making the exchange rate a nonmodeled variable; (ii) insignificant regressors were dropped from individual equations of the system; (iii) the first cointegrating vector was dropped from the price change equation (as postulated in the "zero" restrictions); and (iv) suitable parameter restrictions were placed to increase the available degrees of freedom. Tests for model reduction were conducted and the reductions were found to be acceptable at each stage. The model, presented in Table 5, has only 12 estimated coefficients (compared to 40 in the original ADL). The restrictions imposed on the  $I(0)$  system were not rejected (the test statistic is  $\chi^2(28) = 33.63$  [0.21]).

Actual outcomes, fitted values, and forecasts of the dynamic equations of Table 5 are shown in Figure 5; the variables are closely tracked (and the residuals not shown here are well

Table 5. Albania: A parsimonious full information maximum likelihood conditional error correction model 1/  
Sample period: 1993(4)–96(12)

$$\begin{aligned} \Delta p = & 1.12 + 0.34 \Delta p_{-1} - 0.21 \Delta m_{-1} + 0.11(\Delta e - \Delta e_{-1}) + 0.21 (m - m^*)_{-1} \\ & (0.22) \quad (0.12) \quad (0.09) \quad (0.05) \quad (0.04) \\ \Delta m = & 2.78 - 0.026 (S1+S2+S6+S7) - 0.031 (S3+S4+S5+S9+S10) - 0.02 S8 - 0.023 S11 - 0.87 (p - p^*)_{-1} - 0.44 (m - m^*)_{-1} \\ & (0.62) \quad (0.008) \quad (0.008) \quad (0.01) \quad (0.01) \quad (0.17) \quad (0.10) \end{aligned}$$

Standard errors of equations:

$\Delta p$ : 0.009       $\Delta m$ : 0.015

log likelihood = 404.07

$\log|\Omega| = -17.96$      $|\Omega| = 1.59 e^{-8}$

Number of observations = 45

Likelihood ratio test of over-identifying restrictions:  $\chi^2(28) = 33.63$  [0.21]

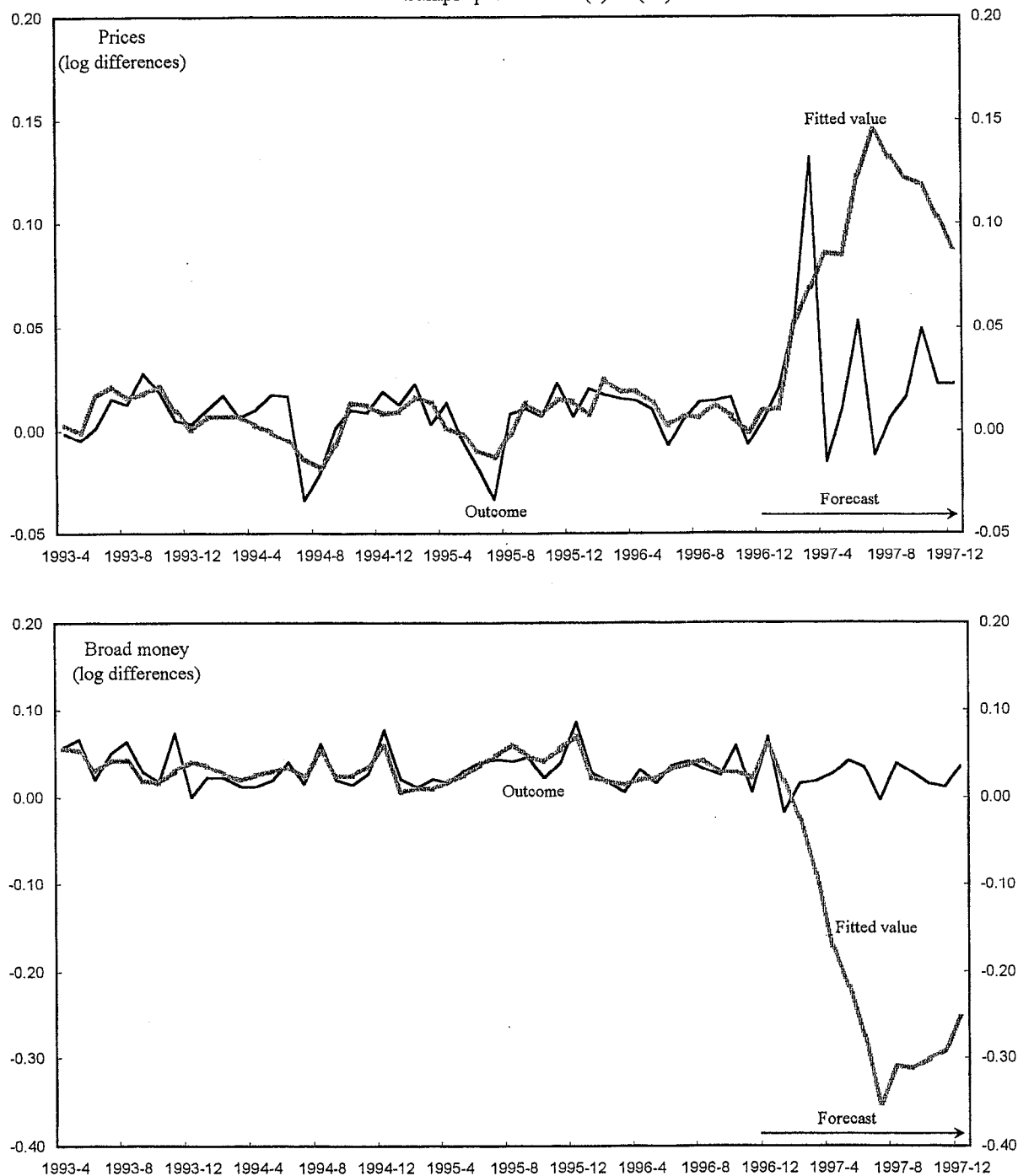
Correlation of residuals

	$\Delta p$	$\Delta m$
$\Delta p$	1.000	
$\Delta m$	-0.05	1.000

Sources: Albanian authorities; and Fund staff estimates.

1/ “ $\Delta$ ” indicates the first difference in the variable, and subscripts denote lagged (first) differences, ordinary equation standard errors are in parentheses (.), S1–S11 are monthly seasonal dummies for January–November, and  $\Omega$  is the estimated variance–covariance matrix of error terms.

Figure 5. Albania: Inflation and money growth  
Outcomes and fitted values of the conditional ECM  
Sample period: 1993(4)-96(12)



Sources: Albania authorities; and Fund staff estimates.

behaved). On the basis of the diagnostic test statistics for the system and the individual equations reported in Table 6, the model and individual equations were statistically satisfactory. The portmanteau statistics, testing for serial correlation in the error terms up to six lags, showed no evidence of serial correlation. There was no trace of heteroscedasticity, and the error terms were approximately normal.

The model parameters were jointly statistically constant, implying that price formation and money demand processes remained unchanged over the sample period. Figure 6 shows the one-step residuals of the estimated equations and the corresponding equation standard errors. The one-step ahead Chow statistics and the “break-point” Chow statistics are also plotted, and constancy is clearly not rejected.

Parameter constancy suggests that the determinants of inflation and money demand remained unchanged over the sample period. This constancy is remarkable considering the transition that the economy was undergoing, the proliferation of the pyramid scheme companies, and the changes in the policy environment in 1996. Although perhaps surprising, the constancy is explicable. A number of changes, including price and trade liberalization, had already taken place early in the transition in 1992 (see McNeilly and Schiesser (1998)). Also, a number of factors contributed to a stable economic environment, including tight financial policies, a steady pace of remittances, and substantial foreign aid. These factors helped to create stable expectations about inflation and exchange rate depreciation. Moreover, the pace of structural reform, especially in the banking system, was especially slow during 1995–96.

## **B. Model properties**

The ECM provides information on the adjustment and transmission mechanisms. In particular, two results are significant. First, the error correction parameters have a number of interesting properties. They are higher than those typically reported in industrial country studies (e.g., Ericsson and Sharma (1996), Hendry and Ericsson (1991)) which suggests that adjustment to price and money demand shocks in Albania is faster than in industrial countries. The higher values are all the more remarkable, since the money demand functions for industrial countries are typically estimated using quarterly data. Even in the context of a “general equilibrium” structure, the error correction parameters have the appropriate signs: when the price level is higher than its long run equilibrium value, there is a fall in money demand and a rise in the interest rate, when money is higher than its long run equilibrium value, the price level rises, and money demand falls. The model also permits a comparison of the impact of different kinds of disequilibria—possible only in a model with more than one market. The parameters show that the impact effect of price level disequilibria—the absolute value of the coefficient is 0.87—is larger compared to money market disequilibria (coefficients range in absolute value between 0.15 and 0.25). The results are also interesting in the context of sticky-price models à la Dornbusch, where adjustment to asset market disequilibria is faster compared to goods market disequilibria.

Table 6. Albania: Diagnostic statistics for the full information maximum likelihood error correction model  
Sample period: 1993(4)–96(12)

---

Single Equation Tests 1/

Portmanteau tests for residual autocorrelation:

$\Delta p$ : Portmanteau 6 lags	=	4.66
$\Delta m$ : Portmanteau 6 lags	=	5.61

Lagrange Multiplier F-tests for residual autocorrelation:

$\Delta p$ : AR 1–4 $F(4, 21)$	=	4.44 [0.01] *
$\Delta m$ : AR 1–4 $F(4, 21)$	=	2.64 [0.06]

Tests for Normality (Doornik and Hansen, 1994):

$\Delta p$ : Normality $\chi^2(2)$	=	0.72 [0.69]
$\Delta m$ : Normality $\chi^2(2)$	=	8.67 [0.01] *

LM test autocorrelated squared residuals (AutoRegressive Conditional Heteroscedasticity):

$\Delta p$ : ARCH 4 $F(4, 17)$	=	1.07 [0.40]
$\Delta m$ : ARCH 4 $F(4, 17)$	=	1.33 [0.30]

Vector Tests 2/

Vector portmanteau 6 lags	=	15.54
Vector LM test: AR 1–4, $F(16, 60)$	=	0.50 [0.94]
Vector normality $\chi^2(4)$	=	9.38 [0.06]

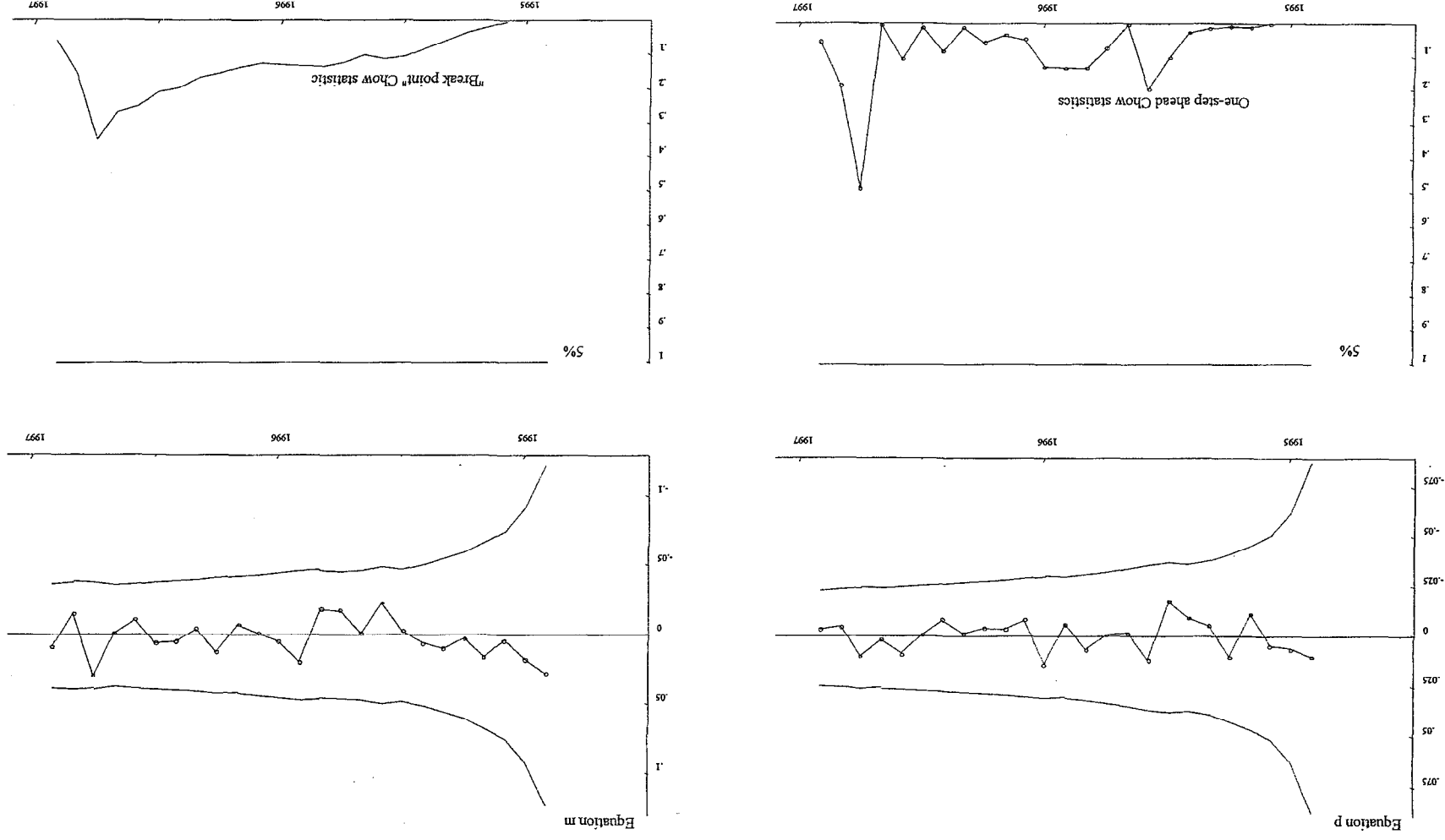
---

Sources: Albanian authorities; and Fund staff estimates.

1/ Single equation tests: The *Portmanteau statistic* is a degrees of freedom corrected version of the Box–Pierce statistic for residual autocorrelation and tests for autocorrelation upto 6 lags; small values should be treated cautiously as residual autocorrelation is biased towards 0 when lagged dependent variables are included in the estimated equations. The *LM F-statistic* test for residual autocorrelation is performed through the auxiliary regression of residuals on the original variable and lagged residuals; missing observations are set to zero. The *Normality test* amounts to testing whether the skewness and kurtosis of the residuals correspond to that of a normal distribution. The *ARCH test* tests the joint significance of lagged squared residuals (here 1–4 lags) in a regression of squared residuals on a constant and lagged squared residuals.

2/ Vector tests: The *Vector Portmanteau statistic* is the multivariate equivalent of the single equation portmanteau. For the *LM test*, lagged residuals are partialled out from the original regressors, and the likelihood of the re-estimated system is compared to the original system. The *Normality test* is a multivariate equivalent of the single equation test.

Figure 6. Albania: Constancy statistics for the conditional error correction model  
Recursive equation residuals and Chow statistics



Sources: Albanian authorities, and Fund staff estimates.

Second, the lag structure of the model also has some interesting features: only one lag of the variables is enough to capture the dynamics of inflation and money demand; there is some inflationary inertia even in the absence of such factors as price stickiness, lagged adjustment to relative price changes (Coorey et. al. (1997)), and wage indexation (Ross (1998)); and as is not uncommon, the transmission of the shocks is highly nonlinear. Figures 7 and 8 show the impact and cumulative impact, respectively, of a unit innovation in the price and money equation on inflation and on money demand growth.

### **C. Developments in 1997**

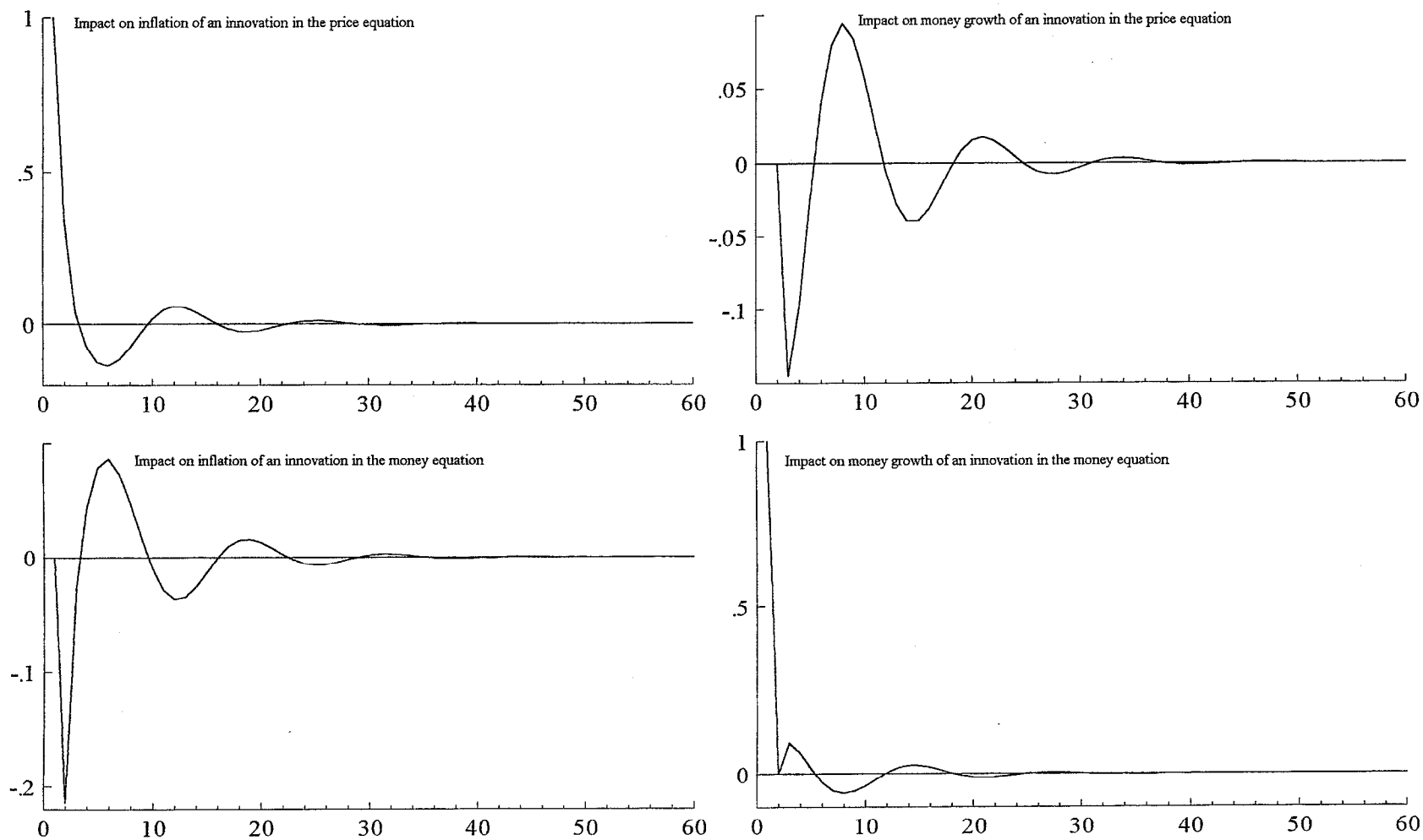
Albania descended into a crisis in March 1997. The stable policies of 1993–95 gave way to a lax policy stance by the second half of 1996, and the economy was engulfed by the rapid growth and proliferation of financial pyramid schemes. The distorting effects of the operations of the pyramid scheme companies were evident in macroeconomic indicators, including in shifts in the currency-deposit ratio. The inevitable collapse occurred in early 1997, and the pyramid scheme mania turned into a panic. Fueled by large supply-side disruptions, a precipitous drop in revenue collection, and a steep depreciation of the exchange rate, inflation rose. These factors, together with the considerable uncertainty in the policy-making environment, prompted fears that inflation could get out of hand.

Inflation was quickly brought under control and money demand remained remarkably strong. The security environment improved with the arrival of a multinational force, and revenue collection was restored rapidly with external technical assistance. Economic policy became more decisive after a new government took office in June, and financial policies were tightened in the second half of 1997. Strong efforts were made to secure a rebound in tax collection, and to keep the domestically financed deficit under check. In addition, short-term deposit interest rates were raised significantly to prop up money demand. Given that the economic and social situation recovered quickly, it is of some interest to examine whether the crisis induced only a one-time jump in the exchange rate and the price level, leaving the underlying determinants of inflation and money demand unchanged.

The hypothesis that the crisis induced a one-time jump in the exchange rate and the price level, leaving the long-run determinants of inflation and money demand unchanged, is tested by reestimating the cointegrating relationships and the error correction model for the entire period 1993–97. A clue to the form that the extended framework should take is provided by the forecast Chow statistic for the conditional ECM for 1993–96 (Figure 9). The statistic jumps, is stable after April, and parallels the movement in the exchange rate. This indicates that a break may have occurred in April 1997, and suggests the use of dummy variable (D497) for the period April–December 1997. This variable was introduced into the analysis, and a new error correction model was estimated. Cointegration analysis once again reveals the existence of two cointegrating relationships. These cointegrating vectors were estimated under the same “identifying” restrictions and “zero” restrictions as before. Furthermore, the coefficients of all variables, except the dummy variable, were restricted to the values that were arrived at for the earlier set of cointegrating vectors. The reestimated restricted cointegrating

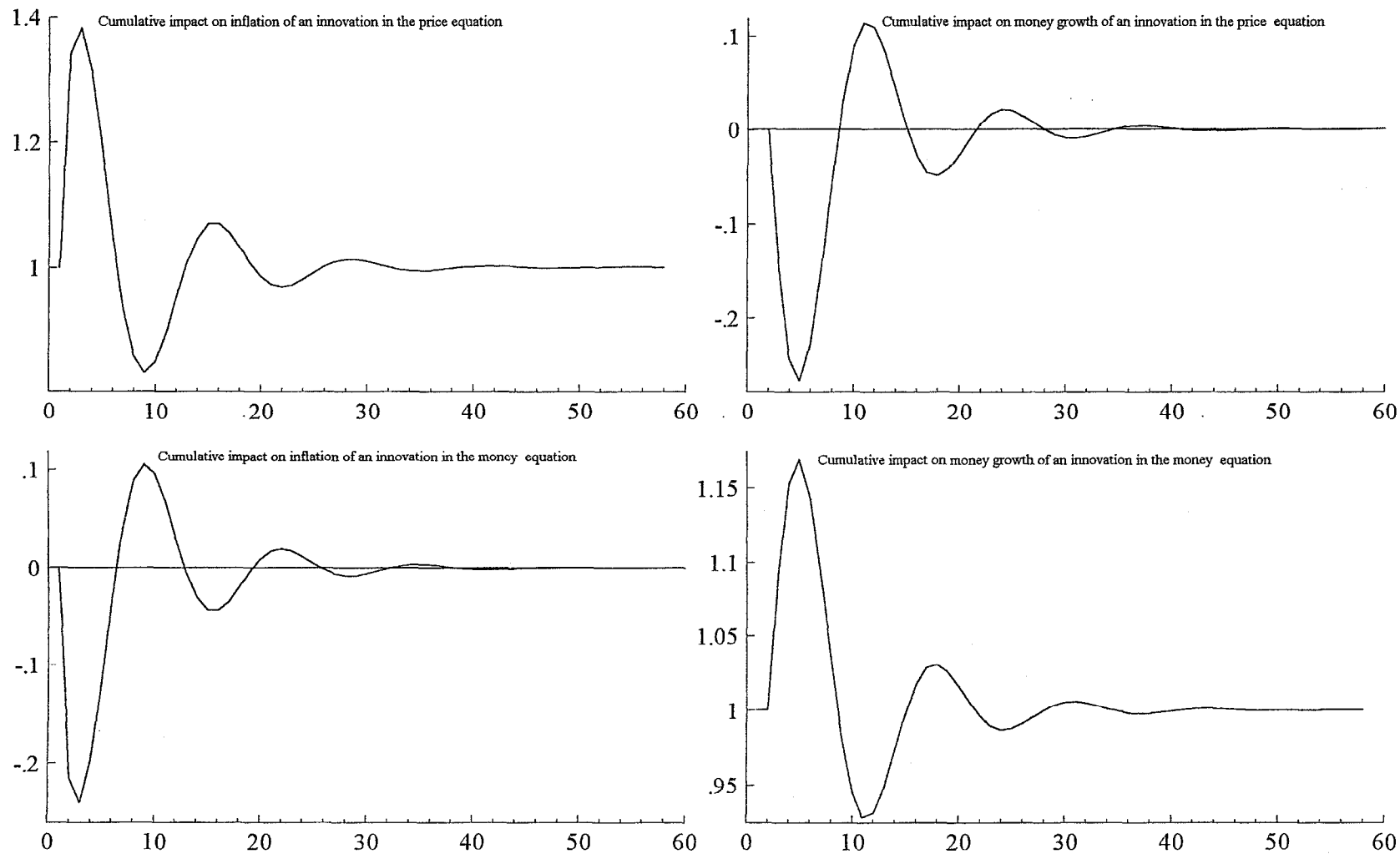


Figure 7. Albania: Impulse response functions of the conditional error correction model  
(for a unit innovation in the price and money equations)



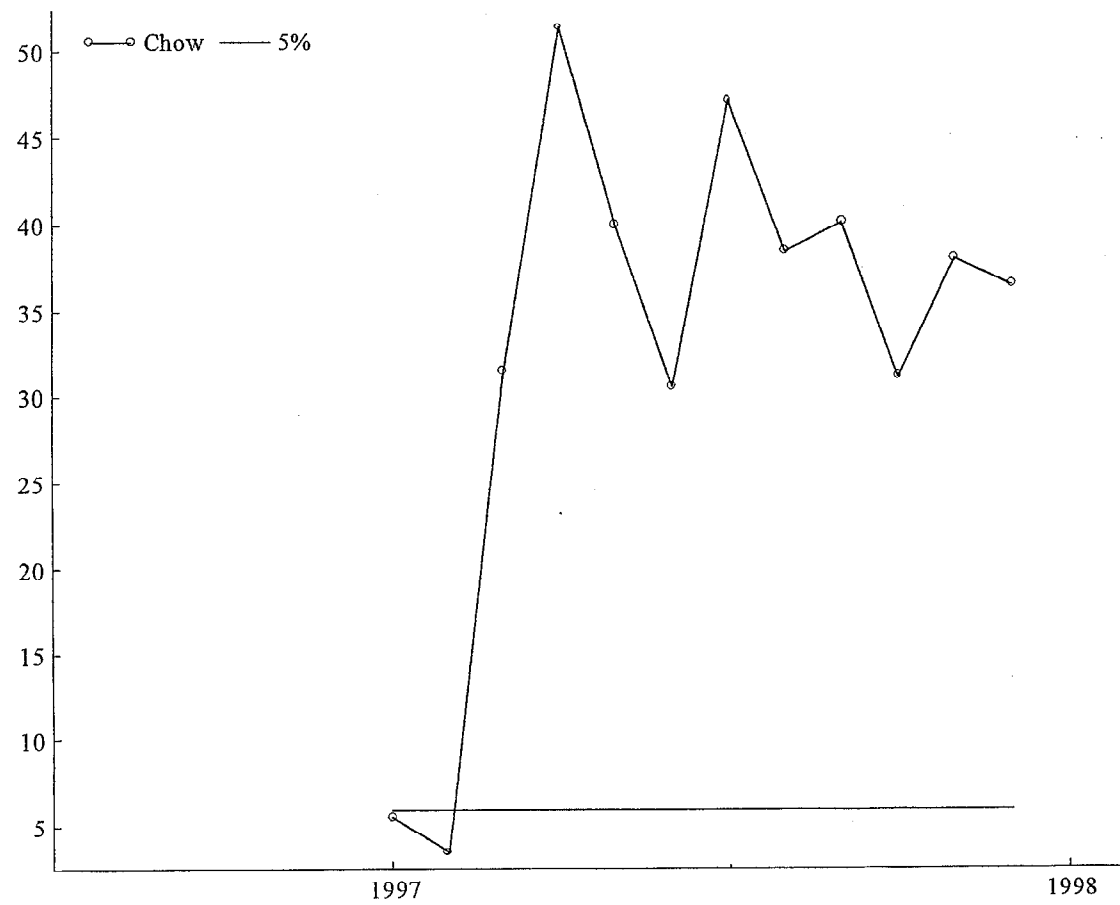
Sources: Albanian authorities; and Fund staff estimates.

Figure 8. Albania: Cumulative impulse response functions of the conditional error correction model  
(for a unit innovation in the price and money equations)



Sources: Albanian authorities; and Fund staff estimates.

Figure 9. Albania: Forecast Chow statistics for the conditional error correction model



Sources: Albanian authorities; and Fund staff estimates.

relationships were once again fairly stationary. For the period 1993–96 the same values of the cointegrating vectors as before were obtained. The reestimated vectors, where D497=1 for April–December 1997, 0 otherwise, are (standard errors in parentheses):

$$(2'') \quad p^{**} = 0.18 \, e + 0.006 \, t + 0.12 \, D497 \\ (0.02)$$

$$(4'') \quad m^{**} = p - 0.35 \, e + 0.71 \, R + 3.73 \, y + 0.46 \, D497 \\ (0.04)$$

The coefficients on the dummy are highly significant and capture the level jump in the exchange rate. The elasticities of inflation to exchange rate depreciation and of money demand to the exchange rate, the interest rate, and the level of economic activity are the same as before.

The final step is to estimate an error correction model in which these cointegrating relationships are embedded. To further capture the one-time effect of the disturbances during March and April 1997, step dummies (SD397 and SD497, respectively) were introduced in the dynamic system. This reestimated model is presented in Table 7, and has some interesting features. First, all the coefficients are significant and the error correction parameters are of the same sign as before. Second, the effect of the disturbances of March 1997 is captured in the coefficient of SD397 in the price equation; out of a total monthly inflation of 14 percent, the effect of these disturbances is estimated at about 8¼ percent. The diagnostic statistics for this model are encouraging (Table 8). The fitted values of the log differences of the price level and money demand are plotted in Figure 10, and the Chow statistics for the model are presented in Figure 11; parameter constancy is not rejected.

## VI. CONCLUDING REMARKS

This paper studied inflation and money demand developments in Albania during 1993–97. A simple analytical framework covering the goods and money markets was elaborated, and used to estimate relationships between the price level, the exchange rate, money, and interest rates. The model supports the claim that the determinants of inflation and money demand in transition economies are similar to those in market economies. In particular, for the long run, it establishes a positive relationship between the price level and the exchange rate, and between nominal (and real) money demand and exchange rate expectations, interest rates, and the level of economic activity. The estimated equations also show that there has been a tendency for the real exchange rate to appreciate. With regard to the dynamics, the model suggests that adjustment to shocks is faster compared to industrial countries, and that only a few lags are enough to capture dynamic structure of inflation and money demand.

The estimated models suggest that the long-run determinants of inflation and money demand in Albania remained unchanged as the economy was undergoing a transition to a market

Table 7. Albania: A parsimonious full information maximum likelihood conditional error correction model 1/  
Sample period: 1993(4)–97(12)

$$\begin{aligned} \Delta p = & 0.59 + 0.49 \Delta p_{-1} + 0.28(\Delta e - \Delta e_{-1}) + 0.09 SD397 - 0.08 SD497 + 0.21 (m - m^{**})_{-1} \\ & (0.18) \quad (0.11) \quad (0.04) \quad (0.01) \quad (0.02) \quad (0.04) \\ \Delta m = & 2.91 - 0.027 (S1+S2+S6+S7) - 0.031 (S3+S4+S5+S9+S10) - 0.01 S8 - 0.025 S11 - 0.70 (p - p^{**})_{-1} - 0.23 (m - m^{**})_{-1} \\ & (0.56) \quad (0.008) \quad (0.007) \quad (0.01) \quad (0.01) \quad (0.13) \quad (0.06) \end{aligned}$$

Standard errors of equations:

$\Delta p$ : 0.012       $\Delta m$ : 0.014

log likelihood = 500.57

$\log|\Omega| = -17.56$      $|\Omega| = 2.36 e^{-8}$

Number of observations = 57

Likelihood ratio test of over-identifying restrictions:  $\chi^2(27) = 34.12$  [0.16]

Correlation of residuals

	$\Delta p$	$\Delta m$
$\Delta p$	1.000	
$\Delta m$	-0.09	1.000

Sources: Albanian authorities; and Fund staff estimates.

1/ Dummy variables: SD397 is 1 for March 1997, 0 otherwise; SD497 is 1 for April 1997, 0 otherwise; and S1–S11 are monthly seasonal dummies for January–November.

Table 8. Albania: Diagnostic statistics for the full information maximum likelihood error correction model  
Sample period: 1993(4)–97(12)

---

Single Equation Tests 1/			
Portmanteau tests for residual autocorrelation:			
$\Delta p$	: Portmanteau 7 lags	=	6.78
$\Delta m$	: Portmanteau 7 lags	=	5.28
Lagrange Multiplier F-tests for residual autocorrelation:			
$\Delta p$	: AR 1–4 F(4, 31)	=	3.93 [0.01] *
$\Delta m$	: AR 1–4 F(4, 31)	=	3.38 [0.01] *
Tests for Normality (Doornik and Hansen, 1994):			
$\Delta p$	: Normality $\chi^2(2)$	=	0.16 [0.92]
$\Delta m$	: Normality $\chi^2(2)$	=	1.72 [0.42]
LM test autocorrelated squared residuals (AutoRegressive Conditional Heteroscedasticity):			
$\Delta p$	: ARCH 4 F(4, 27)	=	0.50 [0.73]
$\Delta m$	: ARCH 4 F(4, 27)	=	0.50 [0.73]
Vector Tests 2/			
Vector portmanteau 7 lags			
		=	26.68
Vector LM test: AR 1-4, F(16, 80)			
		=	1.08 [0.38]
Vector normality $\chi^2(4)$			
		=	1.95 [0.74]

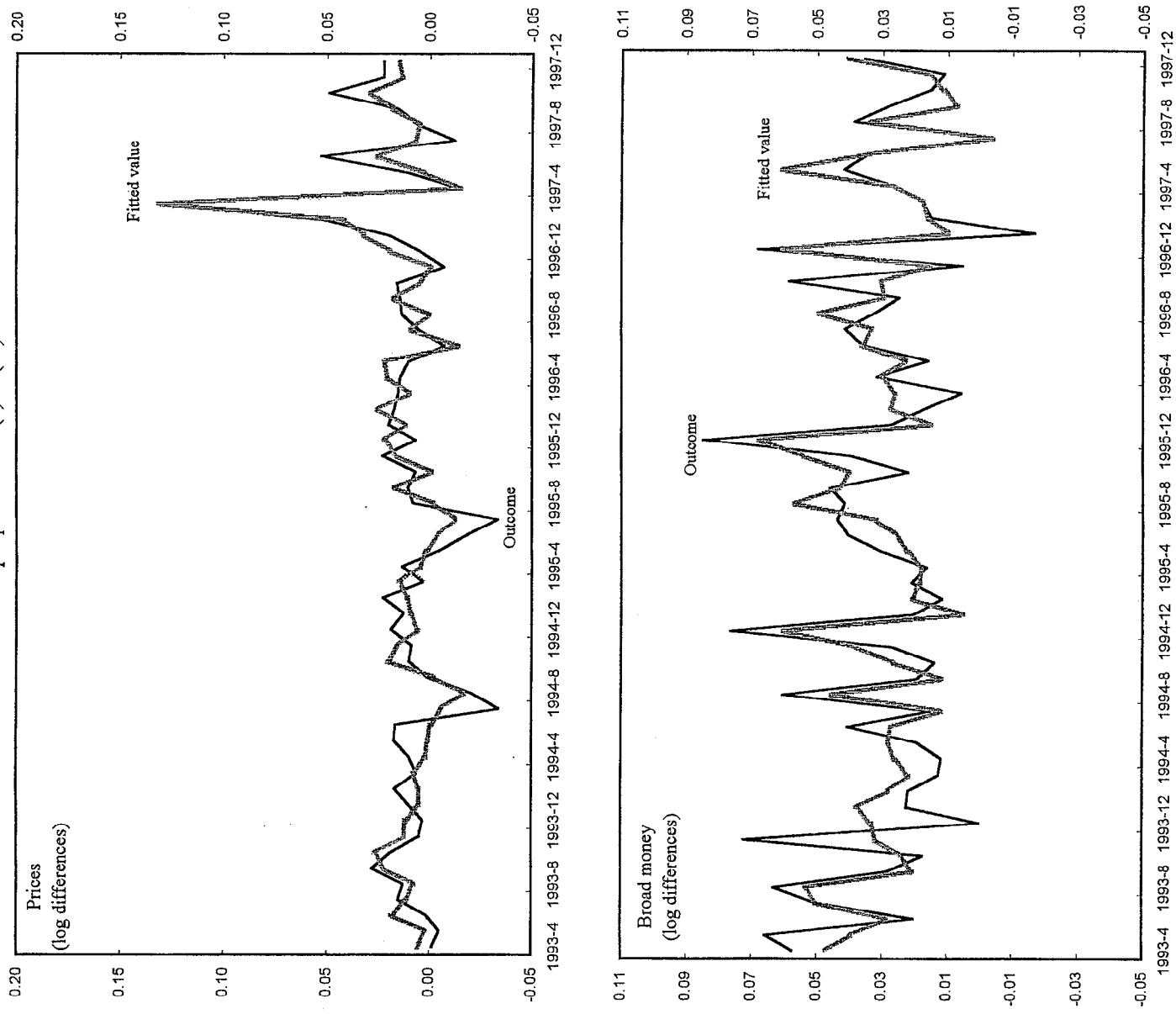
---

Sources: Albanian authorities; and Fund staff estimates.

1/ Single equation tests: The *Portmanteau statistic* is a degrees of freedom corrected version of the Box–Pierce statistic for residual autocorrelation and tests for autocorrelation upto 6 lags; small values should be treated cautiously as residual autocorrelation is biased towards 0 when lagged dependent variables are included in the estimated equations. The *LM F-statistic* test for residual autocorrelation is performed through the auxiliary regression of residuals on the original variable and lagged residuals; missing observations are set to zero. The *Normality test* amounts to testing whether the skewness and kurtosis of the residuals correspond to that of a normal distribution. The *ARCH test* tests the joint significance of lagged squared residuals (here 1–4 lags) in a regression of squared residuals on a constant and lagged squared residuals.

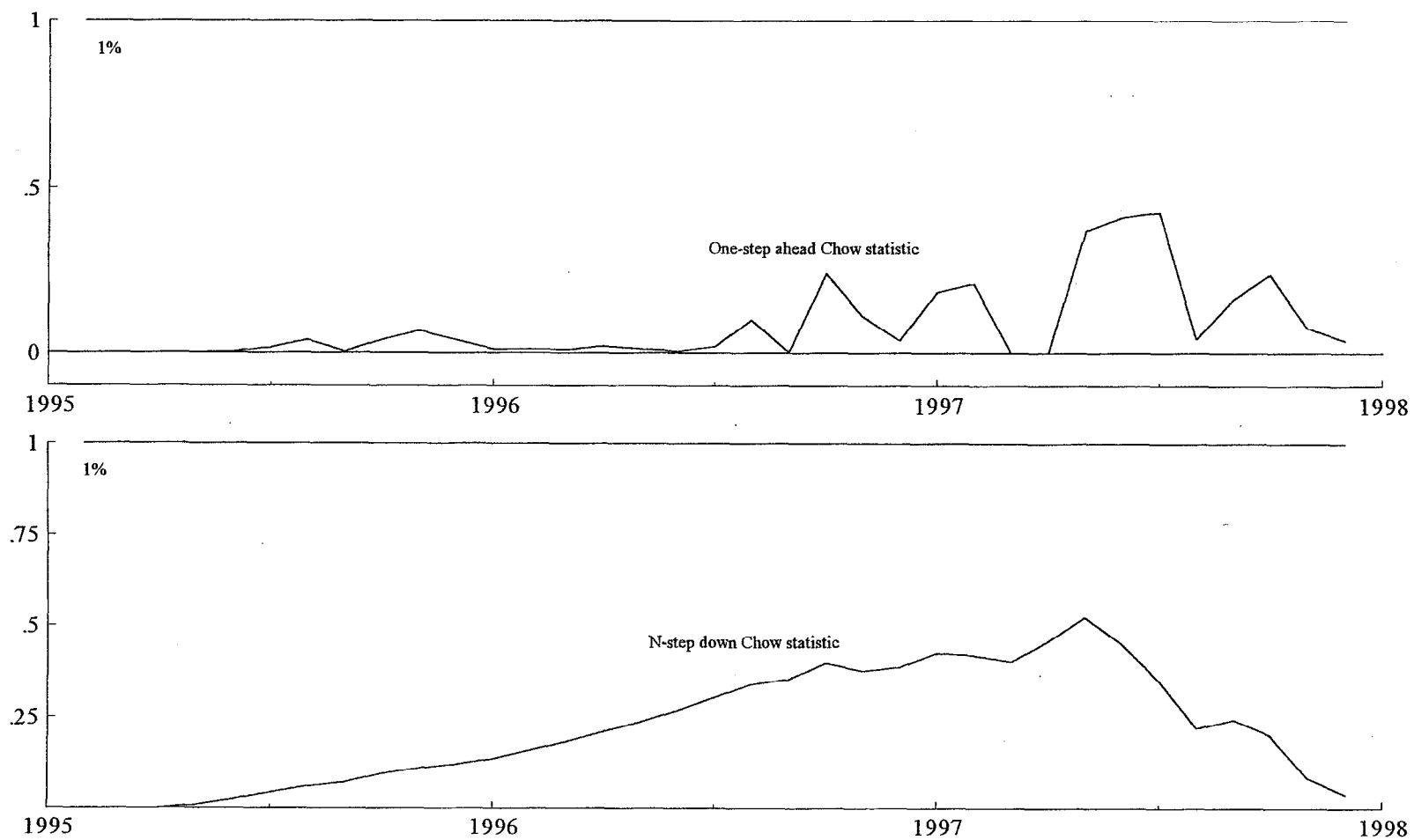
2/ Vector tests: The *Vector Portmanteau statistic* is the multivariate equivalent of the single equation portmanteau. For the *LM test*, lagged residuals are partialled out from the original regressors, and the likelihood of the reestimated system is compared to the original system. The *Normality test* is a multivariate equivalent of the single equation test.

Figure 10. Albania: Inflation and money growth  
Outcomes and fitted values of the conditional ECM  
Sample period: 1993(4)-97(12)



Sources: Albania authorities; and Fund staff estimates.

Figure 11. Albania: Chow statistics for the conditional error correction model  
Sample period: 1993(4)-1997(12)



Sources: Albanian authorities; and Fund staff estimates.



economy. This appeared to be true even for the crisis-plagued year 1997, once the one-time effect of the supply-side disturbances and the sharp increase in the exchange rate to a higher level around which it appeared to stabilize are taken into account. The paper also highlighted the role that an early “big-bang” liberalization and tight financial policies may have played in laying the foundations for stable money demand by maintaining a stable exchange rate and by keeping inflation under check. Even in the absence of a well-defined money demand function to guide economic policy-making in the early years of a money-based stabilization, the focus on strong policies, with the floating exchange rate serving as an indicator of the stance of policies, was appropriate. This focus was regained in the aftermath of the crisis, and played an important role in bringing inflation under check.

## REFERENCES

- Banerjee, A., J. Dolado, J.H. Galbraith and D.F. Hendry, "Co-integration, error-correction, and the econometric analysis of non-stationary Data", OUP, 1993.
- Begg, D.K.H. (1996), Monetary policy in central and eastern Europe: Lessons after a half decade of transition, IMF working paper WP/96/108, Washington, DC.
- Coorey, S., M. Mecagni and E. Offerdal (1996), Inflation in transition economies: The role relative price adjustment, IMF working paper WP/96/138, Washington, DC.
- De Broeck, M., K. Krajnyák, and H. Lorie (1997), Explaining and forecasting the velocity of money in transition economies, IMF working paper WP/97/108, Washington, DC.
- Domac, I. (1997), The main determinants of inflation in Albania, mimeo., Ministry of Economic Cooperation and Development, Tirana.
- Doornik, J.A. and D.F. Hendry, "Modeling dynamic systems using PcFiml 9.0", International Thomson Business Press, London, 1997.
- Ericsson, N.R. and S. Sharma (1996), Broad money and financial liberalization in Greece, IMF Working Paper No. 96/62.
- Fischer, S., R. Sahay and C. Vegh (1995), Stabilization and growth in transition economies: Early experiences, IMF working paper, WP/96/31, Washington, DC.
- Frankel, J. (1979), On the mark: A theory of floating exchange rates based on real interest differentials, *AER*, Vol. 69, pp. 610–22.
- Griffiths, M. and T. Pujol (1996), Moderate inflation in Poland: A real story, IMF working paper, WP/96/57, Washington, DC.
- Hendry, D.F. and N. R. Ericsson (1991), Modeling the demand for money in the United Kingdom and the United States, *European Economic Review*, 35, 4, 833–881.
- McNeilly, C. and D. Schiesser-Gachnang (1998), Reducing inflation: Lessons from Albania's early success, IMF working paper, WP/98/78, Washington, DC.
- Ross, K. (1998), Post-stabilization inflation dynamics in Slovenia, IMF working paper, WP/98/27, Washington, DC.
- Sahay, R. and C. Vegh (1995), Inflation and stabilization in transition economies: A comparison with market economies, IMF working paper, WP/95/8, Washington, DC.