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Yugoslav Inflation and Money

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Abstract

Yugoslav inflation unfolded as a classic wage-price-exchange rate spiral through the 1970s and 1980s and exploded into hyperinflation in the last quarter of 1989. This paper examines the process of monetary accommodation of inflation, the behavior of demand for money, and the interaction between the two in Yugoslavia. The asset-liability structure of the Central Bank, together with the policy stance on exchange and interest rates, led to a significant feedback from inflation to money supply. Real money balances are found to have been cointegrated with other economic variables despite their explosive and seasonal nature, and hence in long-run equilibrium relationship as economic theory would suggest.

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Summary

Yugoslav inflation, in double digit levels throughout the 1970s and 1980s, unfolded as a classic wage-price-exchange rate spiral and exploded into hyperinflation in the last quarter of 1989. This paper shows how increases in the velocity of money and in the money supply led to the perpetuation and acceleration of inflation in Yugoslavia.

The National Bank of Yugoslavia's commitment to support economic activity through prevention of systemic disruptions caused by liquidity problems, the existence of foreign currency deposits, and successive devaluations in the absence of supporting policies led to a significant feedback from inflation to money supply. Furthermore, the Bank's selective credit and foreign currency redeposit schemes were inappropriate and led to losses and a deteriorating net worth of the Bank. These losses were exacerbated by the Bank's underwriting of exchange losses on commercial banks' foreign currency redeposits in the face of repeated devaluations during the 1980s. The apparent puzzle of the absence of any significant public sector deficit during the course of Yugoslav inflation is resolved when the accumulating losses of the Bank are taken into account. These losses were perhaps part of the consolidated public sector deficit on an accrued basis, and this mounting deficit could be the reason for excessive money growth.

Over the years, foreign currency deposits became very close substitutes for dinar liquidity. Prospects of devaluations combined with inadequate interest rates on dinar assets induced economic agents to hold a growing proportion of their liquid resources in foreign currency deposits. The behavior of velocity of monetary aggregates, which either partially or fully exclude the dinar value of foreign currency deposits, leads to serious doubts about the usefulness of such aggregates as intermediate targets of monetary policy.

Real money balances including foreign currency deposits are found to have been cointegrated with other economic variables, despite their explosive and seasonal nature, and hence were in a long run equilibrium relationship as economic theory would suggest. The short-run dynamics of demand for real balances, however, proved to be predictable but complicated. Thus, the best policy for Yugoslavia appears to be the pursuit of a steady and tenacious monetary policy without any effort at fine tuning. This will require interest rates closely in line with those prevailing in international markets and an exchange rate policy that avoids a continuously rising dinar value of foreign currency deposits. The feasibility of pursuing such a policy opens up the fundamental "whys" of monetary policy and points to the necessity of addressing structural issues.

I. Introduction

One of the widely accepted tenets of monetary theory is that persistent inflation, irrespective of its root cause, is a monetary phenomenon. This paper examines the process of monetary accommodation of inflation, the behavior of the demand for money, and the interaction between the two in Yugoslavia in the two decades prior to November 1989. A major conclusion is that the temptation of fine tuning should be resisted and Yugoslavia needs a steady and tenacious monetary policy along with the structural measures that make it possible.

Yugoslav inflation, which was in double digit levels throughout the 1970s and 1980s, unfolded as a classic wage-price-exchange rate spiral and exploded into hyperinflation in the last quarter of 1989 (Chart 1a). A stabilization program launched by the authorities on December 18, 1989 achieved quick successes and inflation was brought down from above 50 percent per month at the end of 1989 to almost zero in the second quarter of 1990. 1/

In the economic literature explanations of inflation run along two distinct, if sometimes intertwined, lines. The first, called "structuralist", delves into the political economy of a country, into its ownership structure, the efficiency of investment and industry, and competition between different groups. 2/ The second, termed "monetarist", explains inflation in terms of the interaction between money and prices. Monetarists have been called "structuralists in a hurry", because their explanation of monetary accommodation of inflation seldom goes beyond the proximate or mechanical determinants of money supply to elaborate the fundamental structural forces driving the process. Although this paper is more in the monetarist tradition, it is recognized that a full explanation of inflation has to explain what lay

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1/ Growing policy slippages led to a renewed buildup of inflationary pressure in Yugoslavia since mid-summer of 1990.

2/ The possible inflationary bias of Yugoslav socialism under workers' self-management has been the subject of a lively discussion along structuralist lines. See e.g. Mates (1987), Mencinger (1987), Bradley and Smith (1988).

behind the decisions by the monetary authorities to increase the money stock to accommodate inflation. 1/ This goes beyond the scope of this paper. 2/ 3/

Apart from examining the demand for money, in this paper we also investigate the proximate determinants of base money in Yugoslavia, i.e. the supply of money. We find that the asset-liability structure of the National Bank of Yugoslavia (NBY), especially the foreign currency liabilities to domestic banks and subsidized loans, complicated the conduct of monetary policy and in an inflationary environment led to large increases in high powered money, and thereby reinforced inflation.

The plan of the paper is as follows. Section II describes some salient features of Yugoslav inflation and proximate determinants of base money growth. The seasonal properties and orders of integration of the variables relating to the demand for money are investigated in Section III. The demand for money in the long and the short run are estimated in Section IV. Section V analyzes some of the implications of the findings and draws conclusions. Appendices A and B contain some econometric details.

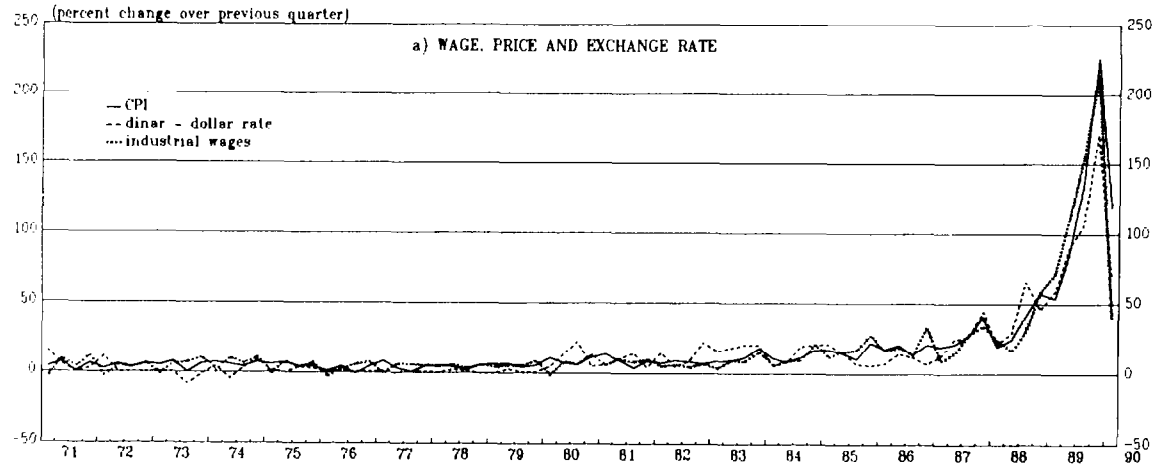
1/ Chowdhury, Grubaugh and Stollar (1990) found that money supply in Yugoslavia was endogenous between 1964 and 1986. There is similar evidence on how inflation itself caused money to grow in many other countries: several countries in Europe during 1920s and Brazil, Chile, Indonesia and Israel in more recent period. For the European experience see Sargent and Wallace (1973), for Brazil and Chile see Hanson (1980), for Indonesia Aghevli and Khan (1977) and for Israel Brezis, Leiderman and Melnick (1983).

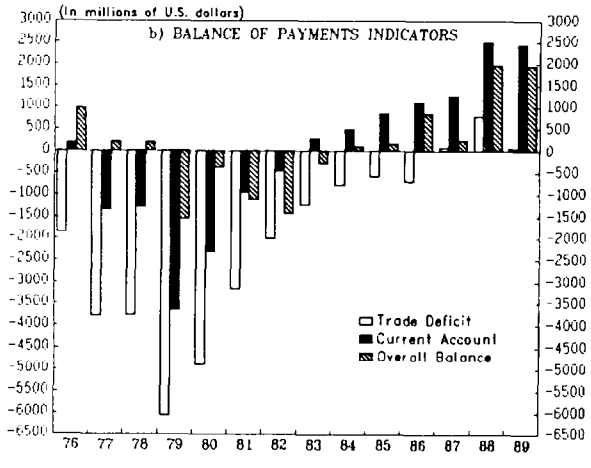
2/ For a survey of theoretical developments for explaining central bank behavior, see Cukierman (1986).

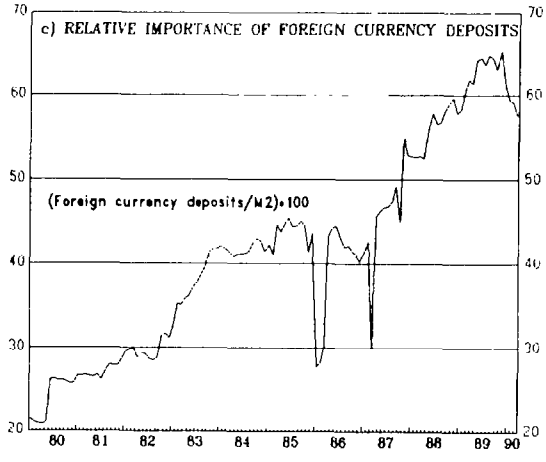
3/ There are several possible reasons why money supply may be increased in response to inflation. These include, among others, the Olivera-Tanzi effect of inflation on public sector revenues resulting in increasing deficits, increased subsidies to targetted groups and a deliberate attempt to avoid any disruptions in economic activity because of liquidity constraints. As a possible reason for passivity of money supply in Yugoslavia, Tyson (1979) has argued that in the absence of severe sanctions for payment defaults, enterprises deliberately generated liquidity crises and payments defaults to obtain fixed interest short-term credit with a high subsidy element in an inflationary environment. Coupled with a policy commitment to avoid disruptions in economic activity, this led to money supply increasing with inflation.

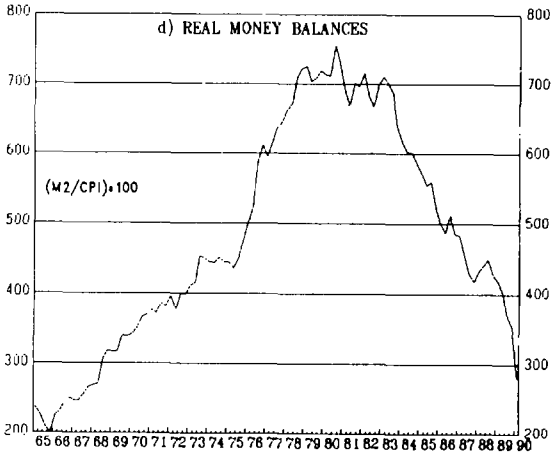
CHART 1

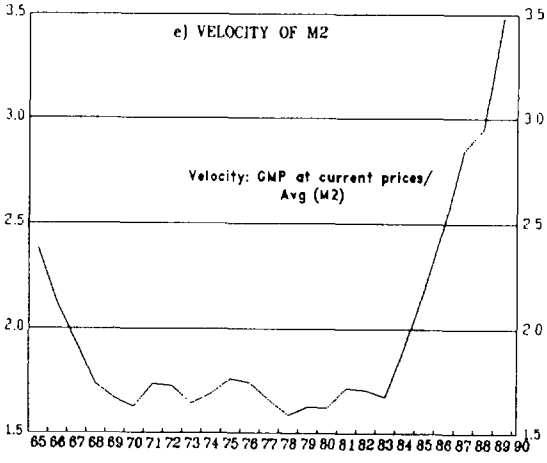
YUGOSLAVIA: INFLATION AND MONEY
KEY INDICATORS











Source: IFS.

II. Yugoslav Inflation and Base Money Creation

Consumer prices grew at an annual average rate of 38 percent between 1965 and 1988 while base money rose at 50 percent. 1/ 2/ The annual average rate of retail price inflation in Yugoslavia increased from 12.5 percent in the 1960s to 17.5 percent in the 1970s and 75 percent in the 1980s (to 1988). There was also a deterioration in the external trade deficit, which was financed by workers' remittances, tourism earnings and capital inflows from abroad till 1979. With the jump in trade deficit from US$3.8 billion in 1978 to US$6.0 billion in 1979 (Chart 1b) and the emergence of financing difficulties, the focus of policies shifted in 1980 from accelerated development through increased investment and imports to external adjustment. 3/ The dinar was devalued by almost 30 percent in 1980, and throughout the 1980s there were successive devaluations in line with inflation aimed at maintaining the real effective exchange rate at the new lower level. The average trade deficit in the 1980s was US$700 million lower than in the 1970s. But growth faltered to an annual average of 0.7 percent from 6.1 percent in the previous decade and the rate of inflation more than quadrupled.

Against this background, the rest of this section examines the proximate determinants of base money growth, and hence the mechanism through which inflation was accommodated. The first three subsections examine the linkages in an inflationary context between base money growth on the one hand and reserve flows and external sector policy, and public sector deficit on the other. The last subsection takes up the question of the appropriate definition of base money in Yugoslavia in the context of the specific characteristics of the asset and liability structure of the NBY.

1. Base money growth: quantitative overview

Base money is the main component of the liabilities of the central bank. The assets of the central bank consist mainly of credits to the private sector and banks, the government, and foreign assets (mostly foreign exchange reserves). It is therefore possible to describe the

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1/ Although base money grew faster than prices between 1965 and 1988 and resulted in an overall increase in real base money, there was a dramatic difference in the relative behavior of the two series before and after 1980 (see Chart 1d).

2/ All the data used in this study were taken from the International Monetary Funds' International Financial Statistics (IFS), with two exceptions. Data on deposit rate of interest prior to December, 1984 and foreign currency deposits were from the Yugoslav Bankers' Association. I am grateful to Mr. Petrović of the NBY for making these data available to me.

3/ The external environment deteriorated sharply in 1979 following the oil price shock and the increase in interest rates in world financial markets.

proximate determinants of the growth of base money in terms of the growth of central bank credit and foreign assets. The relevant factors for Yugoslavia are set out in this subsection.

From the balance sheet identity of the NBY

$$(1) \quad BM_t = NCPB_t + NCG_t + NFA_t - OI_t ,$$

the sources of base money growth can be described in terms of:

$$(2) \quad \frac{\Delta BM_t}{BM_{t-1}} = \frac{\Delta NCPB_t}{BM_{t-1}} + \frac{\Delta NCG_t}{BM_{t-1}} + \frac{\Delta NFA_t}{BM_{t-1}} - \frac{\Delta OI_t}{BM_{t-1}}$$

where BM is base money liability, NCPB is net outstanding credit to the private sector and banks, NCG is net credit to the government, NFA is net foreign assets of the NBY, OI is other items (net) or the residual liability, $\Delta x_t = x_t - x_{t-1}$ and subscript t refers to year t. Table 1 presents the relevant Yugoslav data for the period 1965-88. 1/

Direct loans by the NBY to the nongovernment sector and commercial banks rose at an average annual rate of 36 percent and thereby contributed 21 percentage points to the overall average annual growth rate of 50 percent in base money. The corresponding average contributions of credit to government and of net foreign inflows to base money growth were 5 and -8 percentage points, respectively. As can be seen in the table, the growth of total credit and net foreign assets contributed less than 20 percentage points of the average growth in base money between 1965 and 1988, leaving 32 percentage points to be accounted for by movements in the residual.

The rapid growth in the residual item--other items (net)--in the NBY's balance sheet mainly reflects the heavy losses suffered by the NBY. Consolidated losses are classified as other assets. They broadly correspond to the difference between consolidated liabilities and assets and provide a rough indicator of the negative net worth of the NBY. These losses arose mainly from the underwriting by the NBY of the exchange losses on the foreign currency deposits the commercial banks held at the NBY. In addition, the provision of cheap credit to the private sector and banks greatly reduced NBY's revenues below their potential. The next two subsections discuss these issues further.

1/ There was a revision in the method of collecting data on components of base money in 1965 which determined the choice of the starting year. For the analyses of base money growth in Table 1 annual data were used because use of monthly data would have added little apart from complicating the exercise.

Table 1. Yugoslavia: Inflation and Base Money Growth 1/

	Inflation (CPI) (in percent)	Rate of growth of base money	Contribution to base money growth (in percentage points)				Net foreign Assets in millions of US$
			Credit to private sector & banks	Net credit to government	Net Foreign Assets	Residual	
1965	47.9	35.7	12.8	33.1	-5.3	-5.0	-80.0
1966	6.7	3.2	-13.4	10.2	4.8	1.6	-8.0
1967	6.3	0.5	4.1	-1.0	-3.1	0.5	-56.0
1968	5.9	17.5	20.1	-5.7	7.7	-4.6	64.0
1969	12.6	18.9	13.6	3.9	1.3	-	88.0
1970	9.9	13.6	31.4	3.7	-8.5	-12.9	-96.0
1971	18.0	19.8	24.3	6.8	-8.8	-2.6	-229.4
1972	16.2	48.5	3.2	18.2	24.9	2.2	311.8
1973	21.1	26.8	16.4	6.4	13.7	-9.7	820.5
1974	23.1	6.5	11.9	9.2	-15.0	0.3	140.7
1975	20.8	20.8	11.5	12.3	-2.8	-0.1	16.7
1976	9.4	46.9	24.0	6.3	16.8	-0.2	839.2
1977	13.1	11.0	7.2	1.0	-0.9	3.7	763.0
1978	16.5	83.9	71.3	9.3	3.9	-0.6	1,060.5
1979	23.1	20.5	21.8	4.5	-14.2	8.4	-959.5
1980	57.5	33.3	21.5	-0.5	-15.1	27.3	-2,289.3
1981	35.6	34.8	29.6	-0.4	-5.5	11.1	2,166.9
1982	32.7	41.5	26.8	0.7	-19.2	33.2	-3,235.0
1983	60.1	62.9	24.3	-0.1	-40.4	79.0	-4,247.6
1984	53.1	56.9	25.8	-0.1	-31.2	62.4	-4,490.5
1985	75.4	62.1	21.9	-0.5	-21.0	61.7	-4,447.4
1986	91.6	92.4	29.7	-0.8	-7.1	70.6	-3,569.9
1987	168.7	192.7	35.0	8.3	-47.1	196.5	-3,789.2
1988	240.5	255.7	39.6	-4.2	-16.8	237.1	-1,522.5
Average:							
1965-88	38.3	50.3	21.4	5.2	-7.9	31.5	-1,128.5

1/ All rates of growth refer to end of period.

2. Base money and the external sector

The analysis of the impact of the external sector on base money growth can start from changes in NFA. Changes in NFA occur because of both reserve flows and revaluation of past stocks when the exchange rate changes. NFA made a positive contribution to reserve money creation during 1965-78 because of reserve inflows: NFA increased from a net liability position of US$80 million in 1965 to more than US$1 billion in 1978. The adverse balance of payments development in 1979 reduced the NFA to a net liability position of almost US$1 billion. Between 1979 and 1984 both reserve flows and revaluations had a contractionary impact on reserve money developments, while during 1984-88 the two affected base money in opposite directions. Although reserves flowed in and NFA increased by almost US$3 billion on this account between 1984 and 1988, the revaluation of past net foreign liabilities in domestic currency terms more than neutralized the positive impact of the reserve flows on base money. Over the whole 1965-88 period, reserve flows alone accounted for a relatively insignificant part of base money expansion (2 percentage points out of 50) whereas the revaluation effect accounted for -10 percentage points. The counterpart of this latter effect is a +10 percentage point component of the residual item attributable to the accumulated exchange losses as net foreign assets.

The relatively modest amount of reserve inflows until 1988, however, does not justify the conclusion that the external sector and policy toward it (especially exchange rate policy) did not have a significant effect on base money growth. It is necessary also to take account of the effects of changes in the exchange rate on base money itself, since base money in Yugoslavia includes not only a dinar component (H) consisting of currency in circulation and bank reserves (plus small amounts of other dinar liabilities) but also foreign currency liabilities of the NBY to resident commercial banks (FCLB):

$$(3) \quad BM = H + E.FCLB$$

where E is the exchange rate. The foreign currency component (E.FCLB) accounted for more than 80 percent of reserve money at end-1989.

The origin of the foreign currency component of base money in the NBY's balance sheet was the system, in force from 1978 to October 15, 1988, under which the NBY underwrote the exchange losses on the principal of foreign currency deposits redeposited by commercial banks with the NBY. 1/ Dinars, equivalent to the foreign currency redeposited at the prevailing exchange rate, were extended as NBY credit to the

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1/ Foreign currency deposits were first introduced in Yugoslavia in 1963 to attract emigrants' savings and residents' transfers from abroad into the domestic banking system and ease the availability of foreign exchange.

banks to augment liquidity in the domestic market. 1/ The credit was cheap to give the banks an incentive to mobilize such deposits. 2/ To avoid making losses whenever the dinar was devalued, the NBY should have charged an interest rate on such credits to banks which exceeded the rate paid by the NBY to the banks on their foreign currency deposits by the rate of currency depreciation. The failure to achieve ex-post uncovered interest rate parity and the pursuit of international competitiveness through devaluations led to increases in dinar value of the foreign currency component of base money without any corresponding offset through increased interest receipts on the dinar credit counterparts of such liabilities. On the asset side, i.e., right-hand side of equation (2), the increase was reflected in the "residual" or "other items net" as in Table 1 and contributed to the mounting losses and negative net-worth of the NBY. Some offset to the losses was provided by the system of reserve requirements which also offered interest rates that were severely negative in real terms, but the offset was only partial.

It could, of course, have been possible to avoid this situation with counterveiling measures while continuing with the policy whereby the NBY underwrote the exchange losses of redeposited foreign currency deposits. One way would have been to have raised interest rates on dinar credits to the banks as mentioned above. Another could have been to have made a regular transfer to the NBY from the public sector budgets. Either would have avoided the impact on base money growth of the policies toward foreign currency deposits and the exchange rate, though the former would have reduced the encouragement that banks gave to foreign currency deposits.

But in the absence of these alternatives, the NBY was left with a situation in which exchange rate depreciation had a feedback effect on

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1/ Instead of offering the redeposit facility along with dinar credit, the NBY could have made an outright purchase of the foreign currency from the banks. In this case, however, in so far as the exchange risk associated with foreign currency deposits would have rested with the commercial banks, the banks would have had an incentive to increase the dinar lending rates appropriately and thereby restrain monetary expansion.

2/ The NBY credits were called "interest free credit" since in the period until April 1, 1985, no interest was paid by commercial banks on their dinar liabilities. As a reciprocal arrangement, the NBY also did not pay any interest on foreign currency deposits. Although banks and the NBY started paying interest on their corresponding liabilities from April 1, 1985 and August 1, 1986, respectively, interest rate parity was never maintained in the ex-post sense.

the available liquidity in the economy, which in turn accommodated inflation. 1/ In addition, the currency depreciation played its more familiar role of adding to import price rises.

3. Public sector deficit and seignorage

Traditionally the existence of a public sector deficit has been a necessary condition for inflation in most models of price behavior. 2/ 3/ On a first reading, Yugoslavia provides a rare example where inflation was not associated with any sizeable public sector deficit, monetized or otherwise. This subsection shows that the deterioration of the NBY's net-worth discussed above can be viewed as a deficit of the consolidated public sector. Thus, it provides an explanation consistent with the fiscal view of inflation. This

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1/ It is well-known that in the long run the authorities can set either the nominal exchange rate or the money supply independently but not both. Furthermore, as shown by Adams and Gros (1986), the pursuit of a target real exchange rate by devaluation in line with inflation, leads to unstable prices at worst, and in the long run lack of monetary control over the inflationary process at best. In an economy integrated with world financial markets the long-run result extends to the short run through capital flows in the balance of payments. In such an economy, any tightening of domestic credit only leads to an acceleration of such flows. External monetary flows through the balance of payments cannot be offset in the long run on a sustained basis by compensating variations in net domestic credit. Given the restrictions on external capital transaction in Yugoslavia, however, it appears that there was considerable scope for pursuing an independent anti-inflationary monetary policy in the short run simultaneously with a real exchange rate rule. In this paper it is argued that the existence of foreign currency deposits and NBY's policies towards these deposits circumscribed the scope for pursuing such an independent monetary policy.

2/ According to Fischer and Easterly (1990): "Milton Friedman's famous statement that inflation is always and everywhere a monetary phenomenon is correct. However, governments do not print money at a rapid rate out of a clear blue sky. They generally print money to cover their deficit. Rapid money growth is conceivable without an underlying fiscal imbalance, but it is unlikely. Thus, rapid inflation is almost always a fiscal phenomenon."

3/ In these models, see e.g. Sargent and Wallace (1973), financing of the deficit by seignorage, i.e., printing money, leads to inflation, which in turn generates an inflation tax on the public's holding of base money at a rate equal to the rate of inflation. In the absence of foreign inflows or direct credit to the private sector by the central bank, seignorage equals monetized public sector deficit. With public sector deficit constant in real terms, the economy converges to the steady state with inflation tax equal to seignorage to leave the real stock of base money unchanged.

subsection also shows in some detail why the NBY's net-worth deteriorated while it continued to capture real resources through seignorage.

The public sector in Yugoslavia traditionally matched current expenditures by current revenues. Consequently, the contribution of the public sector deficit to money growth has been rather small. 1/ The NBY has had direct dealings with only the federal government and not with other segments of the public sector, and except for 1972, 1975, and 1987, NBY credit to the federal government accounted for only a marginal part of the growth in base money. As we have seen from Table 1, on average, net credit to the government accounted for only 5 percentage points of the 50 percent nominal growth in base money per year between 1965 and 1988. The contribution of net credit to the government to base money growth remained marginal throughout the 1980s when inflation accelerated. Table 1, however, neglects the distinction between "dinar" and "foreign currency" components of base money, i.e., H and E.FCLB, and is not appropriate for isolating the importance of government finance in money printing in Yugoslavia during the reference period. Furthermore, Table 1 takes too narrow a view of the impact of the finances of the government--in the widest sense--on base money growth.

$\left(\frac{\Delta H_t}{P_t}\right)$ We begin with a decomposition of the counterparts of seignorage in the NBY's balance sheet:

$$(4) \qquad \frac{\Delta H_t}{P_t} = \frac{\Delta NCPB}{P_t} + \frac{\Delta NCG_t}{P_t} + \frac{\Delta NFA_t}{P_t} - \frac{\Delta OI_t}{P_t} - \frac{\Delta(E.FCLB)_t}{P_t},$$

To keep track of the evolution of real dinar base money $\left(\Delta\left(\frac{H}{P}\right)_t\right)$ as a result of the interaction between seignorage $\left(\frac{\Delta H_t}{P_t}\right)$ and inflation tax $\left(\frac{\Delta P_t}{P_t}\left(\frac{H}{P}\right)_{t-1}\right)$ we also note the familiar expression:

$$(5) \qquad \Delta\left(\frac{H}{P}\right)_t = \frac{\Delta H_t}{P_t} - \frac{\Delta P_t}{P_t}\left(\frac{H}{P}\right)_{t-1}$$

For the years 1979-88, each of the components involved in (4) and (5) have been calculated on a monthly basis and the yearly totals as percentages of gross material product (GMP) are presented in Table 2.

From Table 2 we find that during 1979-88 on average the NBY captured resources through seignorage at the rate of 2.8 percent of GMP per year. These resources were made available to the private sector and

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1/ The Yugoslav public sector consists of two types of communities: the socio-political communities at the federal, republican, provincial, municipal, and communal levels catering to traditional governmental duties and the self-managing communities of interest looking after the areas of health care, education, child care, pensions, etc.

Table 2. Yugoslavia: Seignorage and its Uses 1/

(As percent of gross material product)

	Seignorage	Credit to private sector and banks	Net credit to government	Change in net foreign assets	Change in other items net	Change in foreign currency component of base money (real)	Inflation tax	Change in real dinar base money
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1979	1.1	4.6	0.9	-3.0	-1.7	3.1	2.8	-1.7
1980	1.5	4.0	-0.0	-2.9	-5.1	4.7	3.6	-2.1
1981	2.3	5.2	-0.1	-1.0	-1.8	3.7	2.8	-0.6
1982	2.5	4.8	0.1	-3.5	-5.7	4.7	2.6	-0.1
1983	1.1	4.3	-0.0	-7.5	-14.5	10.2	3.9	-2.8
1984	3.3	4.6	-0.0	-5.6	-11.3	6.9	3.0	0.3
1985	3.1	3.5	-0.1	-4.2	-10.9	7.0	3.6	-0.5
1986	3.5	4.0	-0.1	-1.3	-10.3	9.4	3.7	-0.3
1987	4.4	4.1	1.8	-5.7	-21.6	17.4	5.6	-1.2
1988	5.1	4.3	-0.4	-2.2	-27.9	24.5	5.9	-0.8
Average:								
1979-88	2.8	4.4	0.2	-3.7	-11.1	9.2	3.8	-1.0

1/ The following identities hold: (1) = (2) + (3) + (4) - (5) - (6)
(8) = (1) - (7)

banks in the form of loans at the annual rate of 4.4 percent of GMP and loans to the government absorbed only a marginal 0.2 percent of GMP. Net foreign assets, other items net and foreign currency components of base money changed at the rates of -3.7, -11.1 and 9.2 percent of GMP per year, respectively. Dinar base money in real terms decreased at the rate of 1 percent of GMP per year while inflation tax accrued to the NBY at 3.8 percent of GMP per year.

There are two important questions that arise from the above analysis. First, with a limited need for financing the government, why did the NBY resort to high seignorage? Second, with inflation tax accruing to the NBY at the rate of 3.8 percent of GMP per year and the conventional public sector in balance, why were the profits of the NBY not greater than they were after taking account of the exchange losses on foreign currency deposits?

The answers to both the questions lie in the credit activities of the NBY. The expansion of credit to the private sector and banks is to be understood in the context of an institutional set-up where the NBY was committed to support socially owned enterprises in general and to pursue an activist policy with the aim of preventing systemic disruptions induced by liquidity problems. 1/ NBY credit to the private sector and banks more or less kept pace with inflation through the period. The credit was subsidized and the subsidy increased with inflation because the nominal interest rate was not adjusted fully when inflation rose. 2/ Given this interest rate policy, the interest earned on these credits was insufficient to compensate for the erosion of their real value. The NBY's income from domestic lending was well below what it could have been with a proper interest rate policy. 3/ To put the

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1/ For Israel during the 1970s, similar evidence has been found by Litvin, Meridor and Spivak (1988).

2/ During the hyperinflation in the early 1920s in Austria, Hungary and Germany the central banks in these countries made loans and discounts to private agents at very low nominal interest rates. These loans amounted virtually to government transfer payments to the recipients of the loans, see Sargent (1982).

3/ Also note that credit repayments depend on the subsidy element of loans and, as the subsidy element increases, larger monetary injections are necessary to keep the flow of new credit unchanged.

point in terms of the inflation tax, the full revenue from this source was not obtained by the NBY because it was partly offset by an inflation subsidy on the NBY assets. 1/

The apparent puzzle of the absence of any significant public sector deficit during the course of Yugoslav inflation is therefore resolved when the accumulating losses and deteriorating net worth of the NBY is taken into account. As explained in this and the previous subsection, these losses occurred because of the valuation effects on foreign currency deposits and subsidization of credits to banks and the private sector. Although most inflationary episodes have traditionally been associated with substantial deficits in the public sector, the association in Yugoslavia was instead with the quasi-fiscal operations carried out by the Central Bank. The expansion of base money could have been avoided if revenues had been transferred from the budgets to meet the policy commitment. By their very nature, the quasi-fiscal operations are not always transparent and are difficult to gauge, but a significant characteristic of such operations is their departure from sound banking principles. 2/ The significant departures made by the NBY from appropriate interest rate policy, both with regard to foreign currency redeposit scheme and subsidized credits, argue in favor of

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1/ The conventional measure of inflation tax, as reported in Table 2, has obvious limitations in the Yugoslav context. The conventional measure is appropriate only when there is no inflation induced change in the real rate of interest that apply on the central bank's assets and liabilities apart from base money. Given the NBY's interest rate policy and hence the large reduction brought about by inflation in the real rate of interest that it earned on credits to banks and the private sector, it was only an increase in real fiscal tax revenue that could have kept the consolidated public sector revenue constant in real terms with accelerating inflation. In that sense, in the Phelpsian differential taxation approach, it could be argued that what the NBY got from explosive prices was not an inflation tax but instead it paid an inflation subsidy. In a more general context of transmission mechanism for monetary policy in developing countries, Montiel (1991) discusses such a subsidy as a financial repression subsidy measured with reference to the difference between the rates of interest in official and curb markets.

2/ Indeed the Central Bank, in its pursuit of appropriate monetary objectives, can depart from sound banking principles temporarily and at times suffer the consequence of having its balance in deficit. Such departures on a consistent and long-run basis, however, compromise the monetary policy objectives.

regarding the losses of the NBY as part of the consolidated public sector deficit. 1/ Such a view leads to the resolution of the missing public sector deficit puzzle. 2/

4. Appropriate definition of base money

As we have seen, base money in Yugoslavia is defined to include foreign currency liabilities of the NBY to resident commercial banks (E.FCLB) which was the fastest growing component of base money between 1978 and 1989. Is it appropriate to include this component in the definition of base money?

The concept of base money is primarily designed to explain the money stock from the supply side. Thus, the appropriate definition of base money depends on the choice of the monetary aggregate. Over a variety of countries the choice of monetary aggregate, which has received much support, is the one with the most stable and predictable velocity-behavior. Over the years in Yugoslavia foreign currency deposits became very close substitutes for dinar liquidity. 3/ 4/ Prospects of devaluations induced economic agents to hold a growing proportion of their liquid resources in foreign currency deposits. Furthermore, as can be verified from chart 1c, fears and apprehensions about impending policy action at times led to large shifts between the foreign currency and dinar components of liquidity holdings. Admittedly, the appropriate choice of the monetary aggregate is an empirical matter. As shown in the following sections on demand for money, the fast spread of currency substitution led to difficulties in

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1/ Before launching the stabilization program in December, 1989, the federal government of Yugoslavia took over the accumulated valuation losses of the NBY as its own public debt. See Mates (1990) for a discussion of the parafiscal operations of the NBY.

2/ Apart from introducing greater transparency, this approach also clarifies the policy choices involved in reducing subsidies and identifying alternative fiscal sources of financing the subsidies. Whether such a consolidation would have led to a change in policies is difficult to speculate in the absence of a comprehensive analysis of the constraints facing the policy maker.

3/ No data exist on foreign notes and coins held by the public in Yugoslavia during the reference period. Such "money under mattresses" is not captured in the measure of foreign currency denominated liquid claims used in this paper.

4/ Dinars and foreign currency assets may be complements as well, for instance, as a result of cash-in-advance constraint in a set up with illegal goods markets where both currencies are used in transactions. In Yugoslavia, however, the substitution property appears to have dominated over that of complementarity.

defining the demand for dinar liquidity independently of the demand for foreign currency denominated liquid claims in Yugoslavia. 1/ While the velocity of all monetary aggregates increased in Yugoslavia in response to accelerating inflation (Charts 1d and 1e), the faster increase in the velocity of aggregates excluding foreign currency deposits leads to serious doubts about the usefulness of the dinar money stock as an intermediate target of monetary policy. The difference in the seasonal unit root properties of monetary aggregates excluding foreign currency deposits and those of macroeconomic variables, such as price and wage, confirms the limitations of defining the money stock without foreign currency deposits. The most appropriate definition of the money stock in Yugoslavia is therefore M_2 including foreign currency deposits and this money stock is satisfactorily explained from the supply side only when E.FCLB is included in the definition of base money. 2/

When the exchange rate was not directly determined by the NBY, the NBY had immediate leverage only over the dinar component (H) of base money consisting of currency in circulation and bank reserves, and its operational policy had to be formulated in terms of dinar base money. Theoretically, given an inflation objective, it should have been possible to set the level of dinar base money on the basis of projections of the demand for total (dinar and foreign currency) liquidity and the expected path of the exchange rate and its impact on currency substitution. Projecting the demand for dinar liquidity in the face of a flight from dinars induced by volatile inflationary expectations and the relative superiority of foreign currency deposits, and the continuous increase in the dinar value of foreign currency deposits through devaluations, turned out to be fairly hazardous. The pursuit of a projected level of base money through periodic variations in the dinar component of base money taking into account the developments in the foreign currency component would have been a safer operational strategy for monetary policy.

III. Money Demand: Some Preliminaries

Apart from the consideration of its fundamental role in the formulation and implementation of monetary policy, demand for money in Yugoslavia merits particular attention because of its suspected volatile behavior and sharp increases in velocity induced by inflationary expectations in a high inflation environment. Inflation being a dynamic

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1/ It may be argued that Yugoslav inflation is in terms of dinars and hence the focus of attention should be dinar money. Such reasoning is not correct when close substitutes exist for dinar liquidity. Existence of such substitutes can lead to a highly unstable relationship between dinar liquidity and inflation.

2/ Note that E.FCLB is different from other components of base money in so far as the former cannot be used to support a multiple expansion of credit and deposits, i.e., the multiplier is one. With growing importance of foreign currency deposits in M_2, the money multiplier defined as M_2/BM does display a tendency of converging to one during the sample period.

manifestation of persistent over-supply of money relative to demand, after analyzing money supply in the previous section we turn now to demand for money in Yugoslavia.

In previous studies for Yugoslavia, quarterly and annual data have been utilized by Tyson (1979) and Payne (1990) to estimate demand for money by enterprises and the economy as a whole, respectively. 1/ Mihaljek (1989) analyzed demand for money by households in Yugoslavia during 1963-1988 using a cash-in-advance optimizing framework and annual and monthly data. Bole and Gaspari (1990) used monthly data to estimate demand for money by households and business firms for the periods June 1986-December 1987 and January 1988-June 1989. In this paper, we use monthly data for June 1970 to November 1989, a period of little over twenty years including the hyperinflationary episode, to estimate aggregate demand for money in Yugoslavia, perhaps for the first time. The use of the long data series reflects the view that Yugoslav inflation was a continuous process with an initial slow build-up in the 1970s, picking up momentum through the 1980s and bursting out in galloping price rise in the last few months of 1989. Instead of assuming that the demand function for money changed at the beginning of the high inflation episode, the data is used to test the hypothesis that the onset of inflation was characterized by a structural break in the behavior of demand for money.

A priori, one may hypothesize that the demand for money in Yugoslavia may depend on retail prices (P), the relative rates of return on alternative assets and a scale variable measuring income or transactions. Apart from the variable P, we include the deposit rate of interest (R) as obvious arguments in a demand for money function. 2/ The existence of foreign exchange deposits and the possibility of a large degree of currency substitution in Yugoslavia with a nominally depreciating currency during the sample period suggests the inclusion of the exchange rate (X, in terms of dinar per U.S. dollar) as a relevant

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1/ Tyson's (1979) period of observation was 1961.IV-1971.IV, while Payne's (1990) was 1952-85. Although the studies did not include the period when inflation accerelated the most, both the authors estimated a significant negative impact of inflation on money demand.

2/ Because nominal interest rates were controlled and relatively stable during the sample period, the variable R is not a good indicator of the relative tightness of the money market and this led Tyson (1979) to use the rate of growth of base money as a proxy for the rate of return variable in the demand for money by enterprises. However, given that R is not the best but the only choice for return on interest earning money substitutes in Yugoslavia and it is desirable not to introduce money supply as an explanatory variable in money demand, we retain R as an explanatory variable in our analysis.

rate of return variable in the demand for money function. 1/ Tyson (1979) and Bole and Gaspari (1990), while analyzing demand for money by enterprises, used enterprise transactions or sales as the scale variable. On the other hand, the scale variable chosen by Bole and Gaspari (1990) for explaining demand for money by households was pre-tax income including wages, transfers, subsidies, and pensions. Because the focus of this paper is on aggregate demand for money, both the nominal monthly wage rate (W) and industrial production (Y) have been included as scale variables in the analysis. 2/ In light of the evidence in Bole and Gaspari (1990) of households' higher propensity to demand money relative to enterprises, inclusion of W simultaneously with Y is expected to capture any change in demand brought about by a wage-induced change in the distribution of income between labor and enterprises.

Four alternative definitions have been considered for the money stock: narrow (M_1), broad with (M_2) and without ($M_2(-V)$) the valuation effect and broad dinar money (D). While the importance of considering both M_1 and M_2 is evident, $M_2(-V)$ and D were considered because of the crucial role they played in the formulation of monetary targeting in Yugoslavia. The stock of foreign currency deposit or at least the past stock of it was considered a store of value which was immutable in the short-run. Accordingly, monetary targeting was often formulated in terms of $M_2(-V)$ or D, which is M_2 adjusted partially or fully for foreign currency deposits. 3/

1/ Bole and Gaspari (1990) used a synthetic single measure of opportunity cost of holding money constructed from the rates of inflation and currency depreciation. From their two equation structural model of money demand, which has a reduced form non-linear in parameters, they estimated the structural parameter of "coefficient of dollarization" measuring the relative importance of currency substitution. No attempt is made in this paper to retrieve the "coefficient of dollarization."

2/ Barring some season fluctuations, employment grew almost at a constant rate during the sample period and variations in the growth of the wage rate was the main source of variations in total wage income. Because of lack of availability of data, transfers, subsidies and pensions could not be taken into account in our analysis.

3/ While data on all other variables are available on a monthly basis starting from June 1970, information on foreign currency deposits (F) was available only from January 1980. We have defined

(i) $D_t = M_{2t} - X_t F_t$

and

(ii) $M_2(-V)_t = D_t + X_{\text{January, 1980}} F_t$

and analyzed their behavior only for the period January 1980-November 1989.

For the purposes of our analysis the real rate of interest on deposits was derived as follows: first, the nominal rate (R), which is reported in an annualized form, was utilized to derive the corresponding monthly rate; second, this monthly rate was adjusted for contemporaneous inflation. Thus, we defined r* as

$$(6) \quad r^* = \text{Ln}\left[\left(1 + \frac{R}{100}\right)^{1/12} - 1\right\} \times 100\right] - \Delta p.$$

The two defining characteristics of the variables for Yugoslavia for the period under observation are their pronounced seasonal patterns and dominant trends. To alleviate the problem of trend, all variables have been transformed into logarithmic form and lower case letters have been used to indicate logarithms of corresponding upper case variables.

A purely deterministic trend or seasonality does not complicate the problems of statistical inference as much as unit roots in the time series behavior of variables. 1/ The problems of statistical inference in the presence of unit roots has led to the growing literature on cointegration, see, e.g., Granger (1986), Hendry (1986) and Engle and Granger (1987). More recently, Hylleberg, Engle, Granger, and Yoo (1990) (HEGY henceforth), Beaulieu and Miron (1990), and Lee (1990) have investigated the problems associated with seasonal unit roots. One of the important implications of the recent literature on seasonal cointegration is that if two series do not have unit roots at corresponding frequencies, the two series cannot be "fully" cointegrated, ruling out the possibility of a long-run relationship between the two in the sense of finding a linear combination of them which is stationary.

1/ Consider, for example, monthly variables

(i) $\quad Z_t = \beta Z_{t-1} + \varepsilon_t$

and

(ii) $\quad Z'_t = -\beta' Z'_{t-2} + \varepsilon'_t$

For $\beta = \beta' = 1$, Z_t has a unit root corresponding to a peak at frequency zero in the spectrum while Z'_t has unit roots at frequencies $\pm\pi/2$. Notice that we can rewrite (i) and (ii) as

(iii) $\quad Z_t = \sum_{j=0}^{\infty} \beta^j \varepsilon_{t-j}$

and

(iv) $\quad Z'_t = \sum_{j=0}^{\infty} (-\beta')^j \varepsilon_{t-2j}$.

It is obvious that for $\text{mod}(\beta)$, $\text{mod}(\beta') < 1$ the effect of a random shock (ε) on the variables will get diluted with the progress of time. In the case of unit roots ($\beta = \beta' = 1$), however, the two series will have long memories and shocks will last forever. In particular, for Z'_t a random shock may in fact change the seasonal patterns permanently.

Hence, in the first subsection we investigate the existence of seasonal unit roots in the variables. We examine the series for multiplicity of unit roots or order of integration in the second subsection. 1/

1. Testing for seasonal unit roots

Following HEGY (1990), for monthly data a general class of linear time series models which exhibit potentially complex forms of seasonality can be written as:

$$(7) \quad \phi(B)\omega_t = \mu_0 + \mu_1 S_{1t} + \mu_2 S_{2t} + \ldots + \mu_{11} S_{11t} + \nu t + \varepsilon_t$$

where S_{jt}'s are monthly dummy variables, t is trend, $\phi(B)$ is a polynomial in the backward shift operator B with the property $B^j\omega_t = \omega_{t-j}$, and ε is a white noise process. If θ is a root of the characteristic polynomial $\phi(\cdot)$, the frequency associated with it is the value of α in $e^{\alpha i}$, the polar representation of θ. For monthly data, a root is seasonal if $\alpha = \frac{2\pi j}{12}$, j=1,2, ...,11. Furthermore, as shown by Beaulieu and Miron (1990), for such data the seasonal unit roots are:

$$(8) \quad -1;\ \pm i;\ -\tfrac{1}{2}(1\pm\sqrt{3}i);\ \tfrac{1}{2}(1\pm\sqrt{3}i);\ -\tfrac{1}{2}(\sqrt{3}\pm i);\ \tfrac{1}{2}(\sqrt{3}\pm i)$$

1/ To see the relationship between unit roots and order of integration note that for $\beta = 1$, $Z_t = \sum_{j=0}^{\infty} \varepsilon_{t-j}$, i.e., Z_t in (i) of the preceeding footnote is the integration of all past shocks. Now consider

$$(i) \qquad Z''_t = 2Z''_{t-1} - Z''_{t-2} + \varepsilon_t$$

which can be rewritten as

$$(ii) \qquad (1-B)^2 Z_t'' = \varepsilon_t$$

or

$$(iii) \qquad Z_t = \sum_{k=0}^{\infty}\sum_{j=0}^{\infty} \varepsilon_{t-j-k}$$

with B as the backward shift operator. Clearly Z''_t, which has two unit roots at frequency zero, is I(2) or integrated of order two--in other words, the past shocks have to be cumulated twice to obtain the variable. Since the strength of memory of a variable and the persistence of past shocks depend on the order of integratedness, the order has obvious implications for cointegration or existence of a long-run relationship.

with these roots corresponding to 6, 3, 9, 8, 4, 2, 10, 7, 5, 1 and 11 cycles per year, respectively. If ω_t process has a unit root at a particular seasonal frequency, then it is said to be integrated at the same frequency.

HEGY(1990) developed procedures for testing whether a process is integrated at only some, not necessarily all, of the seasonal frequencies. The details of the methodology and the finite sample critical values of the associated test statistics provided by HEGY, however, were restricted to the case of quarterly data. Beaulieu and Miron (1990) present the corresponding results for the case of monthly data. A brief summary of Beaulieu and Miron (1990) test procedure as followed in this paper is presented in Appendix A. The evidence on all variables except m_1, $m_2(-v)$ and d strongly reject the hypothesis of a unit root at any seasonal frequency other than 0. 1/ 2/

Narrowly defined money (m_1), valuation adjusted money ($m_2(-v)$) and dinar money (d) displayed some fairly complicated pattern of stochastic seasonality. Apart from at frequency 0, we fail to reject the existence of unit roots at frequencies $\pi/2$ and $2\pi/3$ which correspond to 3 and 9, and 8 and 4 cycles per year, for m_1. Similarly, there is evidence that $m_2(-v)$ and d have unit roots at frequencies 0 and $5\pi/6$. The existence of unit roots at frequencies other than 0 in m_1, m_2 $(-v)$ and d rules out the possibility of full cointegration between any of these three variables, on the one hand, and p, w, x, r* and y, on the other, and has two interesting interpretations. First, foreign currency deposits, over the years, became a dominant component of liquid assets in Yugoslavia and perhaps exclusion of its total impact in any form from the monetary aggregate leads to an artificial concept which does not correlate in the long run with variables such as price, wage and income. 3/ Second, m_1, $m_2(-v)$ and d have close relationships with dinar base money. In Yugoslavia monetary policy has often been carried out on the basis of expanding dinar base money, through NBY credit to agriculture, exporters and banks, on a simple rule such as so many

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1/ Note that the result that all these variables have unit roots only at frequency zero rules out the transformation

$$\Delta^{12} z_t = (1-B^{12}) z_t = z_t - z_{t-12}$$

to carry out the analysis. Such a transformation, which roughly corresponds to the rate of growth over the last 12 months, is valid only when z has unit roots at all seasonal frequencies.

2/ Existence of a unit root at zero frequency is perhaps a common feature of many economic variables and was found to be true for prices, nominal and real interest rates, and nominal and real wages in the U.S. by Beaulieu and Miron (1990).

3/ The problem may be somewhat akin to trying to relate demand for only golden apples to income and price when red apples are very close substitutes to golden apples.

percent over some past period. Pursuit of such a rule tends to perpetuate the effect of a random shock on dinar base money, and hence on m_1, $m_2(-v)$ and d, and changes their seasonal patterns forever.

With the finding that m_2, p, w, x, r* and y do not have unit roots at different seasonal frequencies, a necessary condition for the existence of full cointegration or an equilibrium relationship among the variables is satisfied. In the next subsection, we test for the order of integration of the variables, i.e., for the multiplicity of unit roots at frequency zero, in order to find the degree of differencing required to reduce each variable to stationarity.

2. Testing for order of integration

For any variable z, to test for the order of integration, we carry out the augmented Dickey-Fuller (ADF) tests. Appendix B contains the test procedure followed and the detailed findings.

The order of integration was tested for m_2, p, w, x and y as well as real balance (m_2-p), real wage (w-p), real exchange rate (x-p) and the (expost) real rate of interest per month on deposits (r*).

As shown in Appendix B, the variables fall into two separate groups: (i) m_2, p, w and x are I(2), and (ii) y, m_2-p, w-p, x-p, and r* are I(1) variables. The highly integrated nature of the variables should not appear surprising in view of the policies pursued in Yugoslavia. A simple three equation model of the money market can be utilized to give a stylized representation to the structure of the variables. 1/ Consider

$$(9)\quad \left(\frac{M^d}{PY}\right)_t = \exp\left[a_o - a_1\left\{\frac{P_{t+1} - P_t}{P_t}\right\}\right] \qquad \text{money demand}$$

$$(10)\quad M^s_t = M_{t-1}\left[1 + b\left\{\frac{P_t - P_{t-1}}{P_{t-1}}\right\}\right] \qquad \text{money supply rule}$$

$$(11)\quad M^d_t = M^s_t = M_t \qquad \text{equilibrium}$$

as a three equation system incorporating the dependence of money demand on expected inflation and money supply on past inflation. 2/ Taking logarithms and approximating log (1+z) by z, we obtain from (7)-(9)

1/ I am indebted to Daniel Hardy for drawing my attention to this simple illustration.

2/ The model of demand for money used in the next section is much more general than that used in this illustration. In the error correction model presented in the next section, expected inflation is implicitly assumed to be dependent on past developments in inflation, money supply and other relevant variables.

$$(12)\quad m_t = p_t + y_t + a_o - a_1(p_{t+1} - p_t)$$

and

$$(13)\quad m_t - m_{t-1} = b(p_t - p_{t-1})$$

which can be solved to yield

$$(14)\quad a_1\Delta^2 p_{t+1} = (1-b)\Delta p_t + \Delta y_t$$

Furthermore, if we assume that y_t is I(1), that is

$$(15)\quad \Delta y_t = \mu_t$$

where μ_t is a white noise process, and monetary policy is sufficiently responsive to inflation with b=1, we get

$$(16)\quad \Delta^2 p_{t+1} = \frac{1}{a_1}\mu_t$$

which implies a price path integrated of order 2. It is easy to verify that m is also I(2). The high response of money supply to inflation, i.e. a value of b close to unity, is the primary reason for the high order of integration of the variables.

IV. Demand for Money in the Long and the Short Run

We estimate the demand for money in Yugoslavia in two stages: first, we test for cointegration and search for a long-run relationship among the variables m_2, p, w, x, r^* and y, and then in the second stage we try to estimate a dynamic equation to explain the short-run behavior of demand for money. 1/ The questions of stability of the estimated relationship and dynamic multipliers associated with inflation, real wage, real exchange and real interest rates are taken up at the end of the section.

1. Testing for cointegration

Cointegration of variables with different orders of integration has to be tested in multiple stages. 2/ First, variables with the highest speed have to be tested for their cointegration property through an examination of the residual (u) from the cointegrating relationship. If the residual u is integrated of a lower order than the variables themselves then the variables at the first step can be considered to be

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1/ Despite the pronounced seasonality in the series, no deseasonalizing filters were applied to the data before estimating the demand functions lest important information hidden in the seasonal patterns be lost.

2/ See Yoo (1987), Chapter II for a discussion of the topic which is called multi-cointegration.

cointegrated. In the second stage, u has to be tested for cointegration with the variables of the next lower order of integration and so on until the lowest order is reached.

Accordingly, since m_2, p, w, and x are I(2) variables with the highest speed among all, a static regression was run with m_2 as the left hand side variable. ADF-test on the residual of this regression and the critical values for such tests provided by Engle and Yoo (1987) suggested the strong likelihood of the residual being I(1) rather than I(2).

Given that Δp,y and r* are I(1), at the second stage we investigated whether the residual from the first step was cointegrated with these three variables. 1/ A regression was run with the residual of the first stage on the left hand side and Δp, y and r* on the right. Values of ADF-test statistics for the residual of the second stage again suggested the likelihood of it being I(0) rather than I(1).

Once having proved the cointegrating properties of m_2, p, w, x, Δp, y and r* sequentially as above, we estimated a static regression of m_2 on all the other variables simultaneously to obtain:

(17) $$m_2 = 1.098 + 1.033p + 0.130w - 0.172x - 0.744\Delta p + 0.711y - 0.140r^* + \hat{u}$$

Sample: 70.6 - 89.11

$R^2 = 0.99$, CRDW = 0.49
No. of observations x sum of squared first 16 autocorrelations = 673.6

The ADF test statistic for testing unit roots in the residual $\tilde{u}$ indicated the existence of no such roots. Note that the coefficients of p, w and x add up to 0.992 which conforms to the earlier finding that m_2,w and x are individually cointegrated with p with conintegrating vector (1,-1) and suggest the estimation of

(18) $$(m_2-p) = 1.083 + 0.139(w-p) - 0.161(x-p) - 0.800\Delta p + 0.706y - 0.151r^* + \hat{u}'$$

Sample: 70.6 - 89.11

$R^2 = 0.81$ CRDW = 0.49
No. of observations x sum of squared first 16 autocorrelations = 672.7

The cointegration technique was first developed to operationalize the concept of long run equilibrium, and so equation (18) may be thought

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1/ Note that p being I(2), Δp is I(1).

of as a description of such a relationship resulting from the interaction between money demand and supply. However, the accordance of the estimated parameters with priors on money demand elasticities and the history of large discretionary changes in monetary policy implicit in Table 1 lead to the interpretation of (18) as a money demand equation. The estimated relationship involves only I(1) variables and has interesting properties. First, it is homogeneous of degree zero in levels of nominal variables. Second, an increase in the real wage increases the demand for real balances for reasons already discussed above, while an increase in the real exchange rate (a real devaluation) decreases it. It appears that the decrease in the demand for real dinar balances exceeds the increase in the demand for foreign currency deposits following a real devaluation, and results in a net decrease in the demand for real balances. Third, the semi-elasticity of demand for real balance with respect to inflation is -0.8. 1/ It is important to note that a mechanical inversion of this semi-elasticity to derive the inflation-tax maximizing rate of inflation is inappropriate, because much of M_2 consisted of foreign currency deposits which, with the pursuit of the real exchange rate rule, were virtually indexed to inflation and yielded no inflation tax. Inflation is well known for increasing the velocity of money and accommodating itself in part. In Yugoslavia, according to (18), almost 4/5 of the inflation was accommodated by the resulting increase in velocity of money. Fourth, the elasticity of real balance with respect to index of industrial production is 0.7. This estimate of 0.7, as a proxy for income-elasticity of demand for real balances, indicates that liquidity was not a luxury good in Yugoslavia with its history of high and volatile inflation. 2/ Fifth, demand for real balances goes down by -0.15 percent for every 1 percent increase in the real rate of interest on deposits. It appears that the decrease in demand for non-interest-bearing component of M_2 exceeds the increase in demand for the interest-bearing component in response to an increase in the real rate of interest and results in a slight decrease in aggregate demand for money.

1/ If the nominal rate of interest remains unchanged in the face of increasing inflation, the semi-elasticity of demand for real balance with respect to inflation is not -0.8 but -0.65 (= -0.8 + 0.151).

2/ GMP is observed to have had an elasticity of 0.73 with respect to the index of industrial production. When this relationship between GMP and the index of industrial production is taken into account, liquid assets appear to have been unit elastic with respect to income.

2. The dynamics

The dynamics of demand for real balances is specified as an error correction model:

$$\Delta (m_2 - p)_t = \alpha_0 + \sum_{i=1}^{2} \alpha_{1i} \Delta (m_2 - p)_{t-i} + \sum_{i=0}^{2} \alpha_{2i} \Delta (w-p)_{t-i} + \sum_{i=0}^{2} \alpha_{3i} \Delta (x-p)_{t-i} + \sum_{i=0}^{2} \alpha_{4i} \Delta r^*_{t-i} + \sum_{i=0}^{2} \alpha_{5i} \Delta y_{t-i} + \sum_{i=0}^{2} \alpha_{6i} \Delta^2 p_{t-i} + \alpha_7 \hat{u}'_{t-1}, \quad (19)$$

where $\hat{u}'$ is the residual from equation (18). Note that all the variables in the equation are I(0). We conducted a simplification search and in the process could not reject the hypotheses: (i) $\alpha_{12} = 0$ (ii) $\alpha_{32} = 0$, (iii) $\alpha_{40} = 0$, (iv) $\alpha_{42} = 0$ (v) $\alpha_{20} = \alpha_{21} = \alpha_{22} = \alpha_2$, (vi) $\alpha_{52} = 0$, (vii) $\alpha_{62} = 0$, and (viii) $\alpha_{51} = 0$ by standard F-tests. 1/ The estimated equation is given by

$$\begin{aligned} \Delta(m_2-p)_t = {} & \underset{(1.78)}{0.002} + \underset{(2.31)}{0.129}\, \Delta (m_2 - p)_{t-1} + \underset{(5.75)}{0.130}\, \Delta_3 (w-p)_t \\ & + \underset{(8.06)}{0.234}\, \Delta (x-p)_t + \underset{(2.35)}{0.075}\, \Delta (x-p)_{t-1} \\ & - \underset{(-1.72)}{0.020}\, \Delta r^*_{t-1} + \underset{(2.63)}{0.039}\, \Delta y_t - \underset{(-12.83)}{0.668}\, \Delta^2 p_t \\ & - \underset{(-4.91)}{0.0266}\, \Delta^2 p_{t-1} - \underset{(-2.19)}{0.029}\, \hat{u}_{t-1} \end{aligned} \quad (20)$$

Sample: 70.9 - 89.11

$R^2 = 0.65$, DW = 1.89

No. of observations x sum of squared first four autocorrelations = 4.7

where $\Delta^2 p_t = \Delta p_t - \Delta p_{t-1}$ is the acceleration in the rate of inflation over the last two months and $\Delta_3 (w-p)_t = (w-p)_t - (w-p)_{t-3}$ is the rate of growth of real wage during the last quarter. Equation (20) is interpreted as the short-run demand for real balances. Note that a significant feed-back mechanism is captured by the coefficient of $\hat{u}'_{t-1}$: the rate of growth of real balances is sensitive to the departure of real balances from their equilibrium value in the preceding month and real balances change over time to adjust to their equilibrium long run value.

1/ The tests were conducted sequentially. We have not investigated the implication of the sequential procedure.

Evidently, by explaining 65 percent of the variation in the acceleration of the rate of growth of real balances, equation (20) does a satisfactory job of modelling the short-run demand for real balances. The complicated dynamics reflect perhaps the inherent nature of the problem of modelling dynamic behavior in a situation of highly volatile inflation and discrete policy shifts.

3. Stability

Typically, for analyzing the behavior of demand for money during high inflation, a demand function is estimated only for the period of high inflation as in the study by Bole and Gaspari (1990). This approach is equivalent to assuming a structural change in the behavior of demand for money at the onset of high inflation. The estimated money demand function reported in this paper maintains the assumption that there was no structural break in liquidity preference in Yugoslavia in the period (June 1970-November 1989) of over twenty years during which inflation accelerated form 1-3 per month to over 50 percent per month. The validity of this assumption was examined by tests of stability.

The residual from a cointegrating relationship is required to be of a lower order of integration than that of the variables involved in the relationship. Any instability in the relationship characterized by systemic departures of the coefficient of one or more variables in a sub-sample results in a contribution to the residual of a term with the same order of integration as the variables themselves. Thus, there cannot be cointegration if there is a structural break in the relationship. The acceptance of the cointegration property of equation (18) is equivalent to the acceptance of stability in the long run behavior of demand for real balances. Hence, we concentrated on testing the stability properties of the short run demand for real balances, i.e., equation (20), through recursive regressions.

Starting with an initial set of regression estimates based on data for September, 1970 to February 1973, subsequent observations for the period March 1973 to November 1989 were added one at a time to obtain the recursive error terms and point estimates of the parameters. Chart 2 depicts the sequence of estimated standard errors of the equation and one-step ahead forecast errors. In the absence of any structural break, the forecast errors should be close to zero and 95 percent of such errors should lie within the band delineated by two estimated standard errors. As can be seen from Chart 2, the confidence band is penetrated only 15 times in 201 months and 92.5 percent of the recursive residuals lie within the confidence band. There is no indication of any major instability problem in the behavior of demand

for real M_2 balances in Yugoslavia, especially when the history of incessant price "freezes and defreezes" is taken into account. 1/ 2/

4. Dynamic multipliers

Chart 3 portrays the dynamic multipliers associated with inflation, real wage, real exchange and real interest rates. As can be verified from the diagram, convergence to the final multiplier is neither monotonic nor fast. For example, in response to a permanent increase in the inflation rate of 1 percent, real balances decline by more than 1 percent in the first three months and then slowly increase over time to settle down in the long run at a level 0.8 percent lower than that prevailing before the inflationary shock. The nature of the dynamic response of real balances to exogeneous shocks underscores Friedman's warning about "the long and variable lags" associated with monetary adjustment and the need for caution in interpreting the short-run response of real balances.

V. Some Policy Implications and Conclusions

We have shown that the asset-liability structure of the NBY, together with the policy stance on exchange and interest rates, led with inflation to large concomittant increases in base money, specifically since 1980. We have also shown that real money balances were

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1/ See Mencinger (1987) for a chronological overview of interventions in price formation in Yugoslavia during 1971-86. Extensive price liberalization was undertaken in multiple stages in the period after May 1988. It is reasonable to assume that interventions in price formation did not alter the long term trend in inflation but imparted a stop-go pattern to inflation. The resulting volatility of the inflation rate would be reflected in oscillations in real money balances, particularly when price controls and decontrols were unanticipated, and due allowance should be made for this factor in analyzing the stability of demand for real balances.

2/ It is important to note that the test is biased toward accepting the null hypothesis in models with lagged endogenous variables. Furthermore, although there is no evidence to suggest that the sample should be broken up into two or more subsamples to accommodate the possibility of discrete structural breaks at specific points of time, the stability properties of the model are not fully satisfactory. For example, the recursive point estimates of the coefficients do not tend to converge to their final values in a fast manner and there are indications of increased instability after 1984. The stability properties of the demand for money function in Yugoslavia merit careful scrutiny especially in view of the changes in economic system introduced from time to time. According to Ben-ner and Neuberger (1990), Yugoslavia has had six economic systems in the post-war period with at least three different systems prevailing during our sample period.

CHART 2

YUGOSLAVIA

STABILITY OF MONEY DEMAND

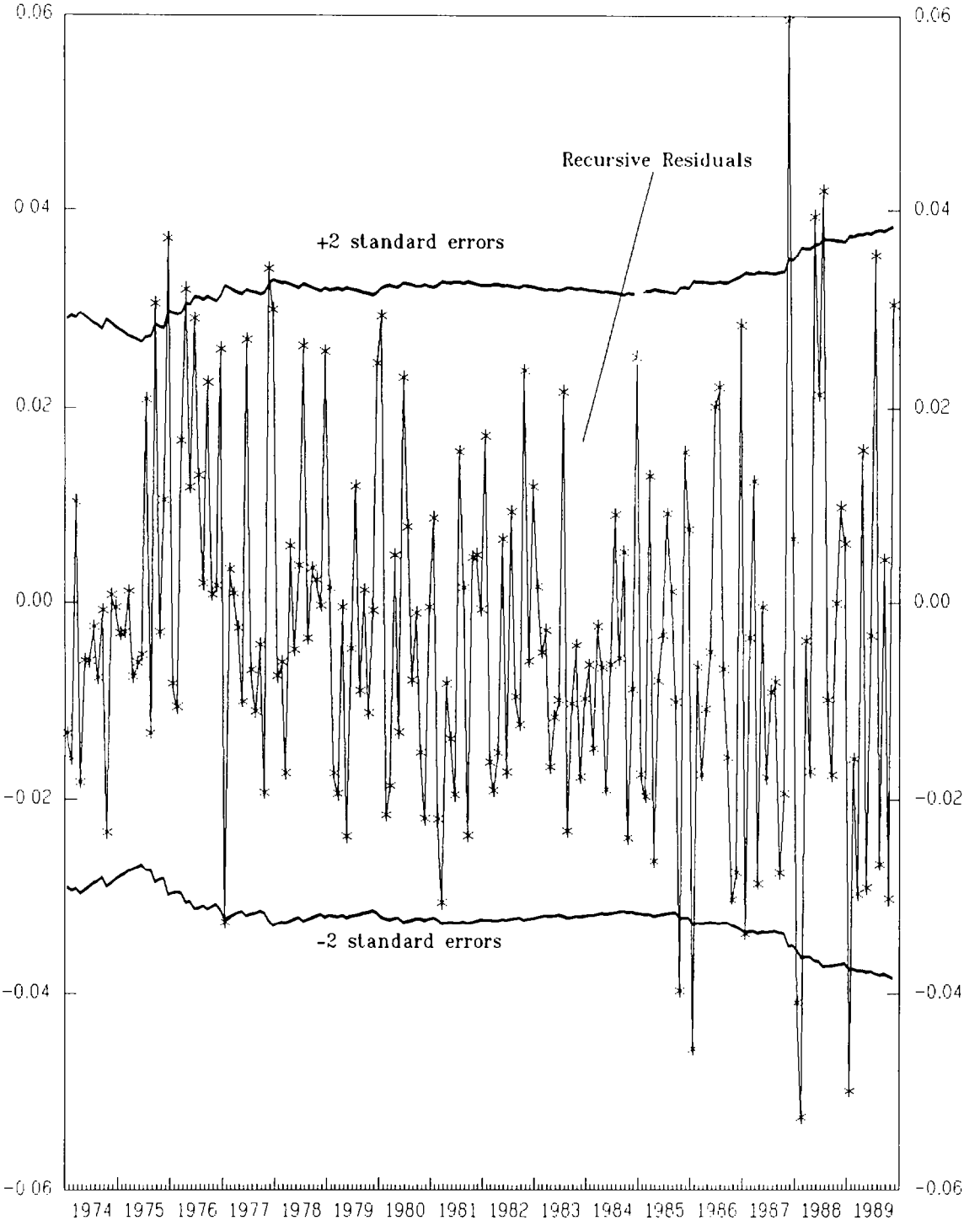
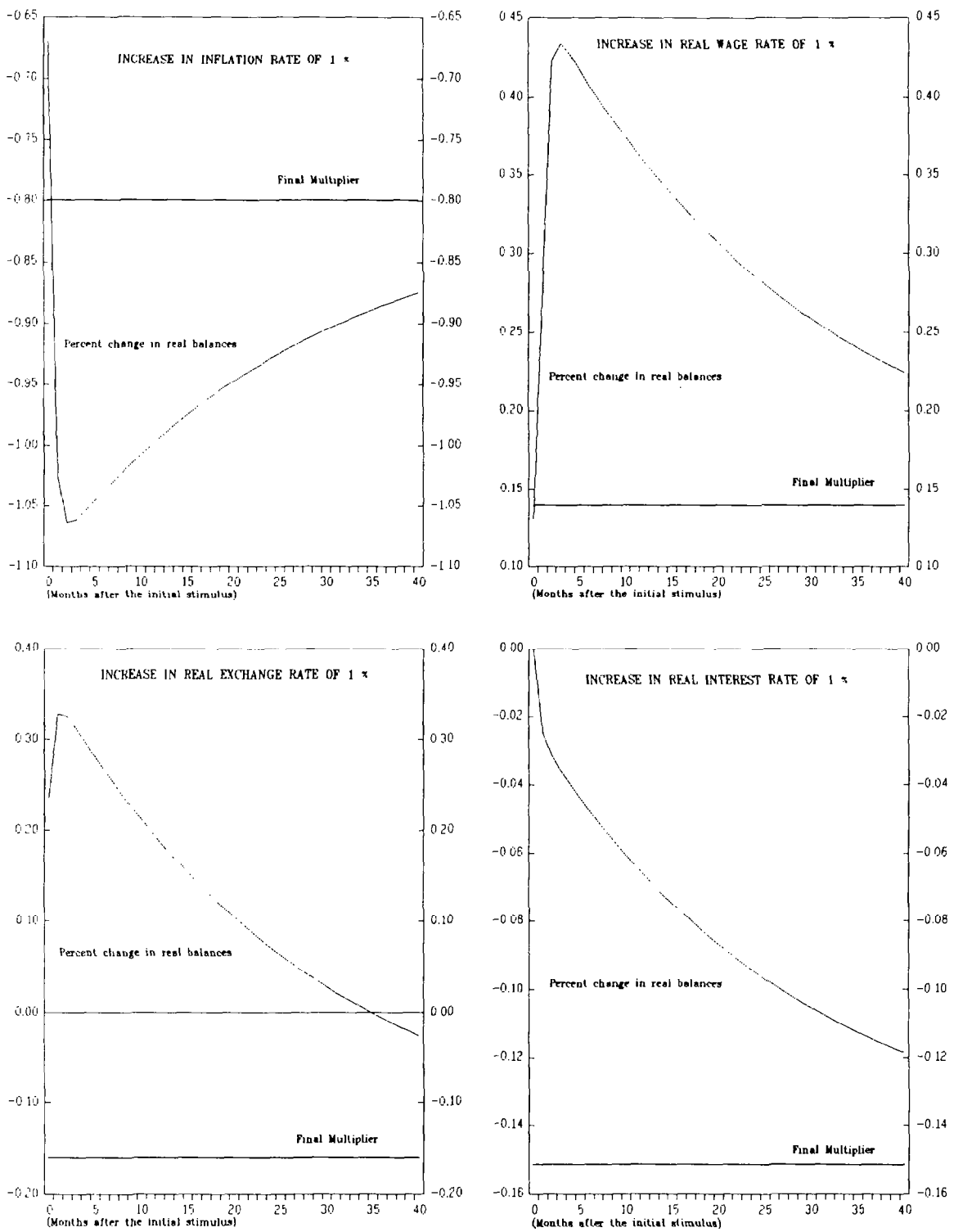


CHART 3

YUGOSLAVIA

DYNAMIC RESPONSE OF REAL BALANCES



cointegrated with the relevant economic variables, despite their highly explosive and seasonal nature, and in long-run equilibrium relationship as economic theory would suggest.

Over the long haul money growth is a necessary condition for sustained inflation and inflation itself sometimes leads to increases in the velocity of money and money supply. In Yugoslavia, inflation led to considerable increases in the velocity of money and such increases accommodated 80 percent of the inflation. The NBY's commitment to support economic activity through prevention of systemic disruptions caused by liquidity problems, the existence of foreign currency deposits and successive devaluations, in the absence of supporting policies, led to a significant feedback from inflation to money supply. The simultaneous increases in the velocity of money and money supply induced by inflation led to the perpetuation and acceleration of inflation in Yugoslavia.

We have shown that money supply accommodated inflation through an effort by the NBY to maintain credit growth in line with inflation. Furthermore, the interest rate policy of the NBY both with regard to selective credit and foreign currency redeposit scheme was inappropriate and led to losses and a deteriorating net worth of the NBY. These losses were exacerbated by the NBY's underwriting of exchange losses on commercial banks' foreign currency redeposits in the face of repeated devaluations during the 1980s. It has been argued that such losses were part of the consolidated public sector deficit on an accrued basis and this mounting deficit led to excessive money growth.

In its formulation of monetary policy the NBY took the view that such losses, being "accrued" and not "realized", were not relevant. The obvious political advantage of such a view was that it left more room for domestic credit and discretionary monetary expansion. With hindsight, however, it appears that the NBY overestimated the lags with which "accrued" losses exert pressure on monetization.

Foreign currency deposits over the years became the dominant component of liquid assets in Yugoslavia. Monetary targeting in Yugoslavia was variously formulated in terms of narrow money (M_1), broad money without valuation effect ($M_2(-V)$) or dinar money (D). These aggregates either partially or fully excluded the dinar value of foreign currency deposits. On a priori grounds it is difficult to argue for or against the inclusion of a particular variable in the monetary target. It appears, however, that over the years foreign currency deposits became an integral part of the liquidity stock in Yugoslavia and were extremely close substitutes for dinar money. The prospect of devaluation induced economic agents to hold increasing proportions of their liquidity in foreign currency deposits while devaluation per se directly increased the dinar equivalent of foreign currency deposits. The increased money supply measured in dinars, together with diminished demand for dinars, sustained the Yugoslav inflationary process. The seasonal unit root properties of M_1, $M_2(-V)$ and D which are found to have been out of line with other variables in the economy such as wages, prices, and exchange rate, confirms the inappropriateness of formulating

monetary targets ignoring foreign currency deposits. Does all this imply that the introduction of foreign currency deposits in Yugoslavia was a mistaken idea to begin with? It is fair to say that in the absence of other policy corrections and structural reform Yugoslavia would have been in difficulty, with or without foreign currency deposits. Without them capital flight would have been higher and savings lower; with them, inflation had a direct and robust feedback effect on the available liquidity in the economy. 1/

Broad money (M_2) was found to be co-integrated with prices, wages, exchange rate, inflation, index of industrial production, and the real rate of interest, permitting the estimation of a long-run relationship for the demand for real balances with standard properties. The short-run dynamics, however, proved to be predictable but complicated. The convergence of real balances to equilibrium in response to a shock in exogenous variables is far from rapid or monotonic. Thus, the temptations of fine tuning should be resisted and the best policy for Yugoslavia appears to be the pursuit of a steady and tenacious monetary policy without any effort to accommodate or neutralize short-run fluctuations. This will require interest rates closely in line with those prevailing in international markets and an exchange rate policy which avoids a continuously rising dinar value of foreign currency deposits. Needless to say, the feasibility of pursuing such a robust policy opens up the "whys" of monetary policy and points to the necessity of addressing structural issues. A comprehensive explanation of Yugoslav inflation has to go beyond just delineating how a steady supply of liquidity sustained the inflationary process. It has to answer why inflation started in the first place and "why" monetary policy accommodated inflation and address the fundamental structural forces driving the process.

1/ See Beckerman (1987) for similar policy conclusions in the Peruvian context.

Appendix A

Testing for Seasonal Unit Roots in Monthly Data

For monthly data, the Beaulieu and Miron (1990) test procedure consists of estimating

$$(A1) \quad z_{13t} = \sum_{k=1}^{12} \pi_k z_{k,t-1} + m_0 t + \sum_{k=1}^{12} m_k S_{kt} + \sum_{k=1}^{q} \beta_k z_{13t-k} + \varepsilon_t$$

where t is trend, S_k's are seasonal dummies and 1/

(A2)

$$z_{1t} = \sum_{j=1}^{12} \cos(0jx) B^{j-1} w_t, \quad z_{5t} = \sum_{j=1}^{12} \cos\left(\frac{2j\pi}{3}\right) B^{j-1} w_t, \quad z_{9t} = \sum_{j=1}^{12} \cos\left(\frac{5j\pi}{6}\right) B^{j-1} w_t,$$

$$z_{2t} = \sum_{j=1}^{12} \cos(j\pi) B^{j-1} w_t, \quad z_{6t} = \sum_{j=1}^{12} \sin\left(\frac{2j\pi}{3}\right) B^{j-1} w_t, \quad z_{10t} = \sum_{j=1}^{12} \sin\left(\frac{5j\pi}{6}\right) B^{j-1} w_t,$$

$$z_{3t} = \sum_{j=1}^{12} \cos\left(\frac{j\pi}{2}\right) B^{j-1} w_t, \quad z_{7t} = \sum_{j=1}^{12} \cos\left(\frac{j\pi}{3}\right) B^{j-1} w_t, \quad z_{11t} = \sum_{j=1}^{12} \cos\left(\frac{j\pi}{6}\right) B^{j-1} w_t,$$

$$z_{4t} = -\sum_{j=1}^{12} \sin\left(\frac{j\pi}{2}\right) B^{j-1} w_t, \quad z_{8t} = -\sum_{j=1}^{12} \sin\left(\frac{j\pi}{3}\right) B^{j-1} w_t, \quad z_{12t} = -\sum_{j=1}^{12} \sin\left(\frac{j\pi}{6}\right) B^{j-1} w_t,$$

$$z_{13t} = (1-B^{12}) w_t$$

"For frequencies 0 and π, one simply examines the relevant t-statistics. For the other roots, one tests $\pi_k=0$, where k is even, with a two-sided test. If one fails to reject, then one tests $\pi_{k-1}=0$. Another strategy is to test $\pi_{k-1} = \pi_k = 0$ by calculating an F-statistic." 2/ The relevant critical values are contained in Beaulieu and Miron (1990).In this paper, the order of lag for the dependent variable has been chosen to minimize the Schwartz information criterion (SC). The relevant estimates along with t-values and F-statistics for m_2, $m_2(-v)$, d, p, w, x, r* and y are reported in Table A.

The evidence on all variables except m_1, $m_2(-v)$ and d strongly reject the hypothesis of a unit root at any seasonal frequency other than 0. However for m_1, apart from at frequency 0, we fail to reject

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1/ This representation of z_t's, for j=1, 2, ..., 12 contained in Beaulieu and Miron (1990) explicitly demonstrate how these transformations are related to particular seasonal frequencies.

2/ Beaulieu and Miron (1990) p.5.

the existence of unit roots at frequencies $\pi/2$ and $2\pi/3$, which correspond to 3 and 9, and 8 and 4 cycles per year. Similarly, there is evidence that $m_2(-v)$ and d have unit roots at frequencies 0 and $5\pi/6$. 1/

1/ Note that the hypothesis of d and $m_2(-v)$ having a unit root at frequency $5\pi/6$, which corresponds to 7 and 5 cycles per year, can be rejected only by the sequential t-test at 10 percent level of significance. However, since the F-statistics are better behaved than the sequential t-tests, the balance of evidence is in favor of not rejecting the hypothesis.

Table A. Money Demand in Yugoslavia: Testing for Seasonal Unit Roots
With Constant, Trend, and Seasonal Dummies 1/

	m_1	d	$m_2(-v)$	m_2	p	w	x	r^*	y
	Narrow M July 1971 -Nov. 1989	Diwr M Jan. 1981 -Nov. 1989	Val. Adj. M Jan. 1981 -Nov. 1989	Broad M June 1971 -Nov. 1989	CPI July 1971 -Nov. 1989	Wage July 1971 -Nov. 1989	Exch. Rate June 1971 -Nov. 1989	Interest June 1971 -Nov. 1989	IIP June 1971 -Nov. 1989
					(Value of t-statistics) 2/				
z1	3.57063 ****	1.67918 ****	1.70935 ****	2.24975 ****	3.99585 ***	2.48466 ****	1.77997 ****	0.02080 ****	1.25356 ****
z2	-4.30965	-3.24895 *	-3.28610 *	-4.93474	-3.30700 ****	-3.35905 *	-4.85693 ****	-8.33601 ***	-4.24782 ****
z3	-2.91524	-2.95158 ****	-2.99437 ***	-3.30695 ****	-5.30748	-2.95913 **	-4.13093 ****	-3.74805	-6.63951
z4	-0.58696	-2.52200	-2.40199	-3.15194 **	-0.88172	-2.14707 *	-3.03195 ***	-0.06191 ****	-0.64382 ****
z5	-1.39721	-2.40244 **	-2.34237 ***	-3.69682 **	-2.67525 ****	-3.69729 ****	-3.37279 ***	-4.95809	-3.86684 **
z6	1.40031 **	2.12219	2.18674	2.02077	2.94698	-3.26367	2.49559 *	-0.80914	-1.94936 ****
z7	-3.29250 ****	-2.31634 ****	-2.35321 ****	1.75000 ****	-1.92338 ***	-1.23245 *	-3.01671 ****	-2.04068 ****	-6.31295 ****
z8	-3.55698 ****	-3.80259 *	-3.79132 *	-4.93019 ****	-4.16667	-5.30035 ****	-6.03724 ****	-3.08254 ****	-0.90055 ****
z9	-4.84239 ***	-2.95344	-2.91093	-7.44658	-2.51023 ****	-4.30417	-7.48937	-7.19663 *	-5.80559
z10	2.26286 *	-0.58617 **	-0.50709	1.20730	3.63927	0.93104	0.37770	-1.59249	0.26438 **
z11	-3.63683 ****	1.55080 ****	1.48912 ****	1.16764 ****	-0.65022 ****	-1.19320 ****	1.56462 ****	2.78695 ****	3.43710 ****
z12	-4.72432	-4.05505	-4.25622	-5.21060	-4.52937	-4.64939	-5.42228	-2.90547	-3.02238
					(F-values for testing joint significance) 2/				
z3 and z4	4.372	8.307 **** *	8.07900 **** *	11.121 **** ****	14.407 **** ****	6.698 **** ****	14.197 **** ****	7.189 *** ****	22.343 **** ****
z5 and z6	1.982 ****	5.166 ****	5.30000 ****	9.262 ****	8.257 ****	11.754 ****	8.902 ****	12.739 ***	9.687 ****
z7 and z8	11.868 ****	10.766	11.312	14.156 ****	10.168 ****	13.745 ****	25.219 ****	7.032 ****	20.745 ****
z9 and z10	14.696 ****	4.549 ****	4.372 ****	29.749 ****	11.039 ****	9.488 ****	28.147 ****	26.598 ****	16.894 ****
z11 and z12	19.245	9.092	10.070	14.362	10.464	11.758	16.136	8.387	10.954

1/ Sample periods vary for m1, m2, p, w, x, r,* and y depending on whether the value of "q" in (A1) maximizing SC in 0 or 1.
2/ * indicates significance at 10 percent, ** at 5 percent, *** at 2.5 percent, and **** at 1 percent level of significance.

Appendix B

Testing for Order of Integration

For any variable z, to test for the order of integration, we carry out the augmented Dickey-Fuller (ADF) tests whereby we define

$$(B1) \quad \Delta^{j} z_t = \Delta^{j-1}(z_t - z_{t-1}) \qquad j=1,2, \ldots.$$

and set up the following regressions

$$(B2) \quad \Delta^{j} z_t = \beta \Delta^{j-1} z_{t-1} + \sum_{k=1}^{q} \alpha_k \Delta^{j} z_{t-k} + \theta t + \phi + \varepsilon_t .$$

For testing the hypothesis that z_t has 'j' unit roots at frequency 0, i.e. z_t is I(j), against the alternative hypothesis that z_t is I(j-1), we test for $H_0: \beta=0$ against $H_1: \beta<0$. For each variable the test was carried out for j=1,2, and 3 under three alternative specifications: (i) $\theta = \phi = 0$, (ii) $\theta = 0$, ϕ unrestricted, (iii) both θ and ϕ unrestricted.

The tests can be carried out by estimating equation (B2) and comparing t-values of β with critical values provided by Fuller (1976). 1/ The relevant t-statistics are reported in Table B. 2/

The variables fall into two separate categories: (i) m_2, p, w and x are I(2), 3/ and (ii) y, m_2-p, w-p, x-p and r* are I(1) variables.

1/ See Fuller (1976), p. 373. In general, the value of q was chosen to minimize the Schwartz-information criterion (SC) over the range of q = 0, 1, 2, ..., 19. In the case of testing the hypothesis that m_2, p, w and x are I(3) against the alternative of I(2), a monotonic positive relationship was observed between larger values of q, and the likelihod of not rejecting the null hypothesis. Furthermore, although the global minima of SC were attained for q = 12 or 13 in case of m_2, p and w, the SC tended to have local minima at a much lower value of q<4. For these cases, the values of q chosen correspond to these local minima. The detailed results are available on request from the author.

2/ The t-statistics are reported only until the hypothesis H_0: z~ I(j) is not rejected.

3/ We do not consider the significance of β for m_2, p and w under H_0:I(1) when $\theta = \phi = 0$ to be sufficient grounds for assuming these variables to be I(0). The appropriateness of assuming $\theta = \phi = 0$ increases with higher values of j in I(j).

Table 8. Money Demand in Yugoslavia: Testing for Order of Integration
Augmented Dickey-Fuller Test Statistics 1/ 2/

	m2 Broad M	p CPI	w wage	x Exchange rate	y IIP	m2-p Real m2	w-p Real w	x-p Real x	* r Real r
		H_0:I(1)							
							**	*	
Unrestricted	0.430	-0.192	0.624	10.129	-0.806	0.392	-2.199	-1.906	0.192
					*				
θ=0	-2.275	-2.415	-1.539	6.224	-2.744	-0.558	-2.203	-2.279	2.410
	****	****	****						
θ=ϕ=0	-6.465	-3.379	-4.116	-2.104	2.275	-0.632	-1.069	-1.986	2.776
		H_0:I(2)							
					****	****	****	****	****
Unrestricted	8.508	4.705	2.578	0.386	-4.342	-3.956	-2.949	-15.914	-17.457
					***		****	****	****
θ=0	8.693	4.322	7.214	1.759	-3.412	-2.409	-3.011	-15.839	-16.974
								****	****
θ=ϕ=0	3.022	3.308	6.155	2.312	2.3454	2.436	-3.028	-15.737	-16.466
		H_0:I(3)							
	****	****	****	****					
Unrestricted	-10.039	-15.715	-14.869	-10.953					
	****	****	****	****					
θ=0	-15.351	-15.364	-14.322	-10.690					
	****	****	****	****					
θ=ϕ=0	-15.247	-15.241	-14.122	-10.558					

1/ * indicates significance at 10 percent, ** at 5 percent, *** at 2.5 percent, and **** at 1 percent level of significance.

2/ For all the variables the sample period utilized for testing the hypothesis end in November, 1989. For testing the hypothesis of I(1), the sample begins in September, 1971, except for (i) m_2, m_2-p and (ii) r* for which it starts from (i) February, 1972 and (ii) October, 1971, respectively. One observation at the beginning of the sample is lost when moving from the test of hypothesis Z~ I(j) to Z~ I(j+1).

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